Felidæ, &c. The anterior tooth, associated with carnassial teeth and the small tubercular tooth, was compressed and sharp-pointed. The low condyle forming part of the angle of the jaw, was such as occurs in *Thylacinus*, not as in *Cheiromys*.

Dr. DUNCAN remarked that it is by no means necessary that all Carnivorous Mammals should be formed upon the same type, and that he did not see why there should not be a carnivorous form of the Kangaroo type.

The CHAIRMAN said that the settlement of these questions must now be postponed until we obtain further materials. He mentioned the discovery by Dr. Krefft, in the interior of Australia, of a species of fish resembling *Lepidosiren*, and possessing singular affinities to some of the Devonian fishes.

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2. *On* FOSSIL REMAINS *of* MAMMALS *found in* CHINA.

By PROFESSOR OWEN, F.R.S., F.G.S.

[PLATES XXVII.–XXIX.]

SINCE making known in 1858 the fact of a fossil tooth of an elephantine species having been obtained at Shanghai, China*, I have omitted no opportunity of acquiring further evidences of the extinct mammals of that part of the Asiatic continent; and I am now enabled to communicate characters of remains of several other mammalian genera, through the kindness of Robert Swinhoe, Esq., late H.M. Consul in the Island of Formosa, and to whom zoology is indebted for several interesting discoveries.

Before proceeding to the description of Mr. Swinhoe's specimens, I may premise a more complete description than has appeared of the first-mentioned fossil, of which outlines of the grinding-surface and inner and outer side views are appended, of the natural size (Pl. XXVII. figs. 1, 2, 3).

STEGODON SINENSIS, OW.

The tooth in question is the second upper molar (*d* 3 of the type series) from the right side. Its crown, in a length of three inches, is divided into five transverse ridges, the proportions of which, as to height and basal breadth, with the ridged and wrinkled character of the enamel, suffice for its reference to a species of the group of Proboscidians discovered by Crawfurd in the Irrawadi Tertiaries of Ava, and described by Clift in the second volume of the second series of the Transactions of the Geological Society (p. 369, pls. 36–39, 1828). And here I beg leave to express my sense of the wise appreciation of the needs of the palæontologist by the Council of the Society in publishing figures of the type molars of those "Transitional Mastodons"† of the natural size.

In the present tooth the first or foremost ridge (Pl. XXVII. figs. 1

* By Mr. Lockhart, 'Report of the British Association for the year 1858,' "President's Address," p. lxxxvi.

† Odontography, p. 224, Section 228.

& 2, 1) is defined by a cleft on the outer side of the tooth, but not on the inner side, fig. 3; here the abraded surfaces of ridges 1 and 2 are blended by wear into a common hollow field of smooth dentine (fig. 1, *a*). There is a slight constriction near the part where the worn surface of the first ridge blends with that of the second; and this constriction, which may be detected in the succeeding ridges, I take to be a trace of that stronger one which more completely divides the transverse coronal ridge in the molars of better Mastodons into an inner and an outer part. A well marked tubercle (figs. 1 and 2, *f*) projects at the outer side of the base of the first ridge, 1, near the interspace between that and the second ridge. The second field of abrasion (ib. ib. 2) although it broadens inwards to the common hollow, shows, before losing its individuality, a similar indication of constriction, or reciprocal inbending of the enamel boundary. The same indication, though feeble, is obvious in the succeeding ridges (3, 4, 5, *a*), which, by the unequal working of the lower grinder, show a broader field of dentine as they pass inward. The third and fourth ridges, which are entire, show their slightly undulated course from the outer to the inner side, which is lower and more worn. The ridge at first inclines a little backward, then, at the indication of constriction, bends forward, and finally resumes the transverse course to the inner, lower and more worn side of the tooth.

Now this character is not shown in the *Mastodon elephantoides*, Clift, of which the antepenultimate upper molar (*m* 1) is figured, of the natural size, in plate 39. fig. 6, *loc. cit.*,—nor in the homologous tooth of the same species, also from Ava, figured (one-third natural size) as of *Elephas Cliftii*, in the 'Fauna Antiqua Sivalensis' of Falconer and Cautley, pl. 30. fig. 2.

From the general conformity of character of the transverse ridges in the last three molars (*m* 1, *m* 2, *m* 3) of this species, it is unlikely that so marked a difference of course and configuration of the ridges should exist in the second grinder, answering to *d* 3, of the same species.

Nevertheless in the number of ridges in a given tract of the grinding-surface, in their height and breadth of base, and in the absence of intervening cement, the conformity of the Chinese molar with the grinders of the *Mastodon elephantoides* is close. The enamel also shows the same vertical linear impressions and ridges, by which we may reckon that the summit (say, of the fourth ridge in the tooth here described), if it were unworn, might be cleft into from thirteen to fifteen small mamillæ.

This structure is well shown in the full-sized figure of the upper molar (*m* 1) of *Mastodon elephantoides*, Clift (in plate 39. fig. 6, Trans. Geol. Soc. vol. ii. second series).

In a tooth of an allied species from the Siwalik tertiaries, homologous with the specimen under description, figured in the 'Fauna Antiqua Sivalensis,' pl. 29. figs. 3, 3 *a*, as of *Elephas bombifrons*, but subsequently referred by Falconer to his *Elephas (Stegodon) insignis**,

* Palæontological Memoirs, vol. i. p. 459, in description of plate 29.

one may make out in the reduced figure (half natural size) the presence, but not the number, of marginal mamillæ on the fourth or penultimate ridge. But whilst this figure illustrates the degree of correspondence, it serves at the same time to show the specific degree of difference between the second upper milk-molar of *Mastodon* (*Stegodon*) *sinensis* and *Mastodon elephantoides*, Clt., or *Stegodon insignis*, Fr.

The original of Falconer's figure being in the British Museum, yields the following admeasurements, giving the difference in size and proportions between:—

	Steg. sinensis.		*Steg. insignis.*	
	in.	lines.	in.	lines.
Length of crown	2	10	2	6
Greatest breadth of crown	2	0	2	1½

In *Stegodon sinensis* the deciduous tooth is longer (antero-posteriorly) in proportion to its breadth. The tubercle at the outer interspace between the first and second ridges is larger and situated more immediately upon the interspace, closing it externally. The transverse divisions increase in breadth from the first to the fourth, the last being narrower, though not to the same degree as in *Steg. insignis*; neither do the ridges increase so regularly to the fourth in the Ava and Siwalik species as in *Steg. sinensis*. The ridges in *Steg. insignis* are loftier as well as narrower than in *Steg. sinensis*; the sculpturing is somewhat coarser; the fourth unworn ridge shows about twelve mamillæ. The fangs or roots of the tooth are not defined in the Siwalik tooth. In the Chinese one the fore part of the crown, divided externally into the two anterior ridges (Pl. I. fig. 2, 1 & 2), is supported by one fang deeply grooved on the side turned toward the second: this root is much larger, and supports all the remainder of the tooth; its base being entire, we are able to infer that only the hind part of the last coronal ridge (5) has been broken away, and that there could not be any added talon at that end of the tooth. The anterior vertical surface of the crown (ib. fig. A) shows a smooth concavity with the enamel worn through to the dentine by the pressure against the antecedent molar (*d* 2). The thick layer of cement which coats the dentine of the base of the tooth and its two divisions is well preserved, which leads me to doubt whether it could at any time have existed in the coronal clefts of the teeth of the present species.

The molars of *Elephas (Stegodon) insignis*, Fr., chiefly differ from those of *E. (St.) Cliftii*, Fr., in the much greater mass of laminate cement that fills up the valleys*. As this difference is to be added to those above described, it further opposes the reference of the Chinese proboscidian tooth to the *St. insignis*.

Of the *Elephas (Stegodon) Cliftii*, Fr., no tooth has yet been acquired homologous with the Chinese specimen. From the general analogy of retention of pattern of grinding-surface, notwithstanding the increase of size and number of coronal ridges as the molars recede in position, we may certainly infer, from there being no mark

* Falconer, 'Palæontological Memoirs,' 8vo, vol. ii. p. 85.

of a longitudinal line bisecting the tooth into an outer and an inner division*, and from the ridges "being a little convex in front and concave behind, determining a similar form to the valley between them"†, that the milk-tooth with sinuously disposed ridges and valleys cannot belong to that species.

I note, however, in the upper molars of the *Elephas* (*Stegodon*) *bombifrons*, Fr., a tendency to sinuosity in the transverse course of the ridges, and an indication of a median constriction in some of them, which comes nearer to the character of the Chinese tooth. Unfortunately the homologue of that tooth has not been obtained of the *E. bombifrons*. It is very significant of the tact of discerning differential characters so happily possessed by our late distinguished fellow labourer, that in the figures (5 and 6) which he has given of two fragments of large upper molars with the above characters somewhat more marked, in plate 29 *A* of the 'Fauna Antiqua Sivalensis,' illustrative of his *Elephas bombifrons*, he should have appended to his ascription of those fragments to that species a note of interrogation, and should have added in the posthumous account given in the 'Palæontological Memoirs' the following expression of mature and probably final opinion:—"Doubtful what figures 5 and 6 are" (vol. i. p. 460).

Now, after a close comparison of my Chinese deciduous molar with every specimen in the British Museum likely to elucidate its specific character (and most have been beautifully figured, though, unfortunately, with much reduction of size, in the master-work above quoted, 'Fauna Antiqua Sivalensis'), and with specimens and figures of specimens in other collections, there is none more likely to belong to the same species of *Elephas* or *Mastodon* or *Stegodon* than the fragment of upper molar from the Siwalik tertiaries, of the specific nature of which Falconer was doubtful. I conclude, therefore, that the best service to science will be to record the characters, with figures of the natural size, of the second upper grinder, *d* 3, right side, of the proboscidian from Shanghai, as of a *Stegodon sinensis*, to which, with probability, though not with certainty, the fragments of the large *Stegodon*, of a species to Falconer unknown, from the Siwalik tertiaries may also belong.

Howsoever this may prove, it is acceptable to find the results of comparisons converging and concurring in approximating the Chinese Proboscidian most nearly to those extinct forms which have laid their bones and teeth in localities geographically nearest to the grave of the *Stegodon sinensis*.

I have not deemed it expedient to slice a unique tooth for microscopical scrutiny; but there is no more appearance of cement in the coronal interspaces of the present Chinese fossil molar than in those of the more Mastodontal forms of Proboscidia. This, however, would not exclude the *Mastodon sinensis* from the section of Pro-

* Falconer, 'Palæontological Memoirs,' vol. i. p. 113.

† Ibid. p. 114. Both these characters are well shown in the upper (first true) molar of Clift's *Mastodon elephantoides* = *Stegodon Cliftii*, Fr., *loc. cit.* pl. 39. fig. 6.

boscidia indicated in my 'Odontography' as "transitional forms"*, since defined by Falconer under the generic name *Stegodon*†, of which he gives as one character, "the enamel is very thick, and the coronal interspaces, in most species, are filled up with an enormous quantity of cement"‡—an admission of exception which significantly points to the difficulty of defining or circumscribing the generic groups in the grand gradational series of modifications of the Proboscidian order, for the knowledge of which science is mainly indebted to Kaup, Clift, and Falconer.

STEGODON ORIENTALIS, OW.

The molar of *Stegodon sinensis*, above described, alleged to be "from marly beds in the vicinity of Shanghai," showed by its colour and mineralized condition that it had been derived from some such, probably tertiary, deposit.

The portions of proboscidian molars which I have next to notice are in a less altered condition. The dentine retains its original white colour, and has only lost its soluble constituent, which causes it to adhere, like chalk, to the tongue; the enamel also has its recent pearly tint; a thick mass of cement appears to have been retained in the intervals of the coronal ridges.

One of these ridges, with the contiguous halves of two others, form a molar two inches nine lines in breadth (Pl. XXVIII. figs. 1 & 2); a portion of a posterior ridge with a low basal heel, from the same, or the same-sized tooth, and the last two ridges, with a terminal half ridge or talon, of a milk-molar, one inch and a half in breadth (ib. figs. 3 & 4), represent the present species.

These fragments form part of the series of teeth obtained by Mr. Swinhoe, and said to be "from a cave, near the city of Chung-king-foo, in the province of Sze-chuen." The condition of the fragments agrees with the statement, viz. that they were from a cavern.

In the largest fragment a longitudinal extent of grinding-surface of two inches includes the summits of three ridges. The basal breadth of the ridge (ib. fig. 2) *b b* is one inch; its height (unworn) is one inch four lines, measured along the sloping side. One slope, I think the anterior, is rather more inclined than the other. The ridge (ib. fig. 1) *a a* runs straight, or nearly so, across the tooth; the entire ridge is cleft at the summit into about a dozen mamillæ by as many vertical grooves; the dentine rises into the base of each mamilla. The enamel (*e*) averages two lines in thickness.

From the above-defined characters it is plain that we have here, also, parts of a "transitional Mastodon," in other words, a species of *Stegodon*, Fr. In the straight, or nearly straight, direction of the coronal ridges, and the absence of any trace of mid cleft, these molar fragments more resemble the teeth of *Stegodon Cliftii*, *St. insignis*, and *St. ganesa* of Falconer than does the *St. sinensis*; and

* 'Odontography,' *Proboscidia*, Section 228.

† "*Elephas* we divide into three sectional groups, viz. *Stegodon*, being the species which Owen calls *Transitional Mastodons*, the *M. elephantoides* of Clift, and of which there are three, and perhaps four, Indian fossil species."—*Palæontol. Memoirs*, vol. i. p. 20.

‡ Palæontological Memoirs, vol. ii. p. 9.

in the apparent quantity of coronal cement (ib. fig. 2 *c*) as well as in the evidence of a hinder talon (ib. fig. 3 *t*), they are more like *St. insignis* than *St. Cliftii*. Yet the two hinder ridges, with the terminal talon of the tooth (ib. figs. 3 & 4), which, in breadth, corresponds with the second upper deciduous molar of *St. insignis* and *St. sinensis*, clearly differ from both. The last two ridges run straighter across, are of the same extent, and are divided by more numerous vertical grooves into smaller and correspondingly numerous apical mamillæ. The second of these ridges is cleft in the middle.

From the alleged conditions of discovery, and the little-altered condition of the above-described portions of proboscidian molars, one would be led to deem them to be of as comparatively recent geological age as our ordinary British Cave-fossils. The section, however, of Proboscidia to which they indubitably belong has not hitherto been known to be represented by fossils of later age than of an upper miocene or older pliocene period.

I believe the ground to be good for indicating this second kind of Chinese proboscidian as *Stegodon orientalis*, Ow.

Hyæna sinensis, Ow.

The genus *Hyæna*, Storr, Cuv., is represented, in the present collection, by an upper premolar, *p* 3 (Pl. XXVIII. figs. 5 & 6), a lower premolar, *p* 3 (ib. fig. 7), and by a lower canine.

The upper premolar is from the right side of the jaw: it exceeds in antero-posterior diameter that tooth in *Hyæna crocuta*, is still larger than that of *Hyæna brunnea**, and is nearly double the size of that in the existing Asiatic species, *Hyæna striata* seu *vulgaris*. The main cone is relatively lower than that in *H. crocuta*; its outer vertical contour is more convex; and this comparison I have been careful to make with a specimen of the recent Cape species having *p* 3 worn in precisely the same degree as the Chinese tooth, viz. with the apex of the cone just abraded sufficiently to expose a speck of dentine. The hinder basal talon (fig. 5, *t*) is larger in *Hyæna sinensis*; and a tubercular production abuts upon the hind ridge of the main cone as in *Hyæna striata*. The antero-internal tubercle (fig. 6, *a*) is relatively less than in *Hyæna striata*: the ridge rising from it toward the tip of the main cone is as prominent as in *Hyæna crocuta*. As in that species, there is no trace of cingulum along the outer side of the base of the crown, which is so well marked in *Hyæna striata*. In the main, the generic character of this massive bone-cracker is closely held by the Chinese cave-tooth.

The third upper premolar of *Hyæna spelæa*, like the rest of the dentition, closely accords with that in *Hyæna crocuta*; consequently the distinctions above noted equally hold in differentiating the Chinese *p* 3 from that of the Hyæna from our own caverns.

I come next to the comparison with the fossil remains of *Hyæna* from the Siwalik tertiaries, *Hyæna sivalensis* of Baker and Durand†. The third upper premolar is smaller in the Siwalik Hyæna than in

* *Hyæna fusca*, Bl., Ostéographie (*Hyæna*), pl. iii.

† Journal of the Asiatic Society, October 1835, vol. iv. p. 569. See also Falconer, 'Palæontological Memoirs,' i. p. 548.

Hyæna crocuta, and consequently still smaller than in *Hyæna sinensis*. The difference of size, however, between *H. sivalensis* and *H. crocuta* is much less than that between *H. crocuta* and *H. striata*; consequently the Siwalik Hyæna was larger than that now existing in Hindostan, although less than that which once roamed in China. In the shape of the chief cone, however, of *p* 3, upper jaw, *H. sivalensis* more resembles *H. sinensis* than it does either of the above-named existing species of *Hyæna*. I refer to the character of greater vertical convexity of the outer side of the crown of the chief cone. In the posterior talon and the antinternal ridge of enamel of *p* 3, *H. sivalensis* more closely conforms with the *H. crocuta* than does *H. sinensis*, and departs from the *H. striata* in a minor development of both posterior and anterior basal tubercles. The external basal cingulum is also wanting in *H. sivalensis* as in *H. sinensis*. The degree in which the Chinese *Hyæna* surpassed in size that from the Red Crag of Suffolk will be appreciated by comparing fig. 5, Pl. XXVIII., with fig. 6 in pl. viii. of Ray Lankester's able memoir on *Hyæna antiqua*, in the 'Annals and Magazine of Natural History,' third series, vol. xiii.

Differences of like kind and value are shown by the second lower premolar (*p* 3 of the type series) of *Hyæna sinensis*, as compared with *H. crocuta*, *H. striata*, and *H. sivalensis*. The crown is broader both antero-posteriorly and transversely, but is lower vertically, than in *H. crocuta*; it is consequently a stronger cone: its qualities for cracking and crushing bone are intensified. The ridge continued upward from the anterior basal talon is stronger than in *H. crocuta*; it is more completely an upward production of the talon itself; and this is less defined as an anterior tubercle than in *H. striata*. The superior size of *H. sinensis* to *H. sivalensis* is more marked in the comparison of the lower premolar than in that of the upper one. Besides the superiority of size, the inner side of the chief cone is more convex vertically and transversely, more bulging, in the Chinese than in the Siwalik Hyæna; it more resembles, in this particular, the much smaller tooth of *Hyæna striata*.

The two fangs in both upper and lower premolars are deeply grooved along the surfaces turned towards each other; the hinder fang is entire in the specimen of the upper premolar from the cave near Chung-king-foo.

The canine has lost the apical half of its crown, but closely accords in form and in its transversely lineate back ridge with that of *Hyæna crocuta*; in size it conforms with the premolars above described.

	Upper *p* 3.			Lower *p* 3.		
	Hyæna sinensis.	*H. crocuta.*	*H. sivalensis.*	*H. sinensis.*	*H. crocuta.*	*H. sivalensis.*
	lines.	lines.	lines.	lines.	lines.	lines.
Antero-posterior diameter	12	11	10½	11½	10	9½
Vertical diameter	10	12	9	11	12	9½

On the foregoing grounds it may be inferred that the *Hyæna* which has left its remains in the Chinese cave was fully as powerful an animal as the *Hyæna spelæa* of Europe. It was of a distinct species, and, like the feebler one from the Red Crag, manifested, by the development of the tubercle from the hind part of the basal ridge of the third upper premolar, a tendency to a combination of the dental characters on which mainly modern taxonomists have rested in the generic distinction of the two best-marked forms of existing Hyæna (*Crocotta maculata*, Kaup, and *Hyæna striata*). Ray Lankester has well remarked on this instance of "divergence of types as we ascend the geological ladder," which his *H. antiqua* afforded. The only question is, whether *H. sinensis* may not have climbed to as high a rung, before it finally fell, as did the *H. spelæa*. The specimens above described have undergone less change from their recent state than have many of the teeth of *H. spelæa* from British caves.

The fossil specimens representing the *Hyæna sivalensis*, B. and D., and F. and C., are in the museum of the Asiatic Society of Bengal, in that of Dr. Jameson at Suharunpoor, and in the British Museum. Of the teeth of the lower jaw the notice is restricted to the fact of their "being larger than in the existing *Hyæna*"*; but whether the Indian or the S. African species, is not stated. From the above admeasurements, however, it is obvious that the existing species of India was meant, viz. the *Hyæna vulgaris* seu *striata*.

Rhinoceros sinensis, Ow.

The genus *Rhinoceros* is represented by portions of four upper molars, and of as many lower molars, in two of which the crown is nearly entire.

The most perfect of the upper molars is the last of the left side, *m* 3 (Pl. XXIX. figs. 1 & 2) including the elongated lobes *c*, *d*, continued inward from the outer tract of dentine (here broken away), together with the dividing valley, *e*. The fore and rear sides of the tooth converge outwardly, and the hinder lobe has no indent or valley penetrating it from that side; both which characters determine the place of the tooth in question. The postinternal lobe or ridge (*d*) sends a short broad simple promontory †, *p*, into the valley *e*. There is no tubercle or ridge at the entry to that valley, which runs sinuously outward and forward of nearly uniform depth to the end. The fore part of the cingulum (*r*) descends from the origin of the ant-internal lobe (*c*) to the inner side of its base, where it subsides; the hind part of the cingulum is represented by a short thick lobular ridge (r^1) at the inner and back part of the postinternal lobe, *d*. The enamel, two millimetres in thickness at the fore part of the grinding-surface, thins off to less than half a millimetre over the promontory and end of the valley. In size the molar, as far as it is preserved, agrees with the corresponding tooth in *Rhinoceros sumatranus*; the fore-and-aft diameter of its inner side is one inch nine lines.

* Falconer, 'Palæontological Memoirs,' vol. i. p. 343.
† Hist. of Brit. Foss. Mamm. p. 374.

The second specimen consists of a smaller proportion of the inner part of a penultimate or antepenultimate molar, with evidence of the notch or valley penetrating from the hinder side of the crown. The promontory, running from the postinternal lobe into the valley entering from the inner side of the crown, resembles in simplicity of form that of the preceding tooth. The ridge at the back part of the base of the postinternal lobe is likewise very thick. A small mammilloid process projects near the entry to the valley *e*. The bases of the two inner fangs are preserved.

A first molar (*m* 1), abraded to the base of the crown, agrees in size and in so much of character as is preserved with the foregoing specimens; it exemplifies that of the valley *e*, inasmuch as, although the terminal bed is brought to the level of the grinding-surface, it is not insulated. The outer side of the tooth is broken away.

The outer enamel-wall (Pl. XXIX. fig. 3), with a small portion of adherent dentine, of a fourth upper molar, not forming part of any of the other three teeth, shows a strong vertical columnar bulge (*a*) terminating at the apex of the antexternal lobe, as in *Rhinoceros sumatranus*; but it also has a second, well defined, but less prominent, vertical ridge (*b*) rising to the apex of the postexternal lobe, the two ridges dividing the outer surface of the crown into three facets. In *Rhinoceros sumatranus* this character distinguishes the premolars from the true molars; but the second or hinder ridge of the outer enamel-wall is less defined in that species; and in the present tooth the middle facet is not uniformly concave from before backward, but undulates, through the projection, near the hinder boundary ridge, of a lower longitudinal rising of enamel. The apices of the two outer lobes (*a*, *b*) are more prominent than in *Rhinoceros sumatranus*; and the angular contour of that border of the tooth makes a closer resemblance than in Rhinoceroses generally to the outline of the same part in *Palæotherium*.

The fossil upper molars of the species of *Rhinoceros* from Ava, figured by Clift*, are much worn; but, as in the Chinese molar in the same condition, the closed and somewhat deeper end of the valley (*e*) is not insulated, as it is in all the Siwalik kinds at the same stage of attrition. The Avan teeth, however, indicate a larger animal than the Chinese species, and are more satisfactorily differentiated by the absence of the second longitudinal ridge (Pl. XXIX. fig. 3, *b*) on the outer wall of enamel.

From *Rhinoceros platyrhinus*, Fr.†, the Chinese species differs, both in the contour of the outer wall of the upper molar, and in the simplicity of the promontory. From *Rhinoceros sivalensis*, *Rh. sinensis* differs in the contour of the outer wall, in the thicker or broader promontory, and in the more uniform depth of the valley (*e*), whereby its termination is not insulated as in the specimen figured in pl. 75. fig. 5 of the 'Fauna Antiqua Sivalensis.' The same differences forbid a reference of the Chinese upper molars to *Rhinoceros palæindicus*; and both this and the *Rhinoceros sivalensis* were

* Trans. Geol. Soc. second series, vol. ii. pl. 40. fig. 1.

† Fauna Antiqua Sivalensis, pl. 72. fig. 6.

species of larger size. The Chinese Rhinoceros, in this respect, seems to have agreed with the two-horned kind of Sumatra, but to have had a different pattern of upper molar.

The lower molars from the cave of Chung-king-foo, of which there are parts of four, sufficiently exemplify the generic modification of *Rhinoceros*, but are too few and too much worn and mutilated for worthy evidence of specific distinction. I believe myself justified, from the characters of the upper molars, and the results of the comparisons above detailed, in indicating the Chinese Rhinoceros as *Rh. sinensis*, Ow. The enamel is, in most parts, smooth and not thick; it retains the natural colour; and the dentine, of chalky whiteness, is absorbent from loss of the soluble constituent, and not otherwise altered.

The main characteristics of the upper molars of this extinct species are evenness of depth of the main valley, its encroaching promontory thick and simple, unusually good indications on the outer enamel-wall of the two lobes (*a*, *b*) composing the thick continuous outer tract of dentine which is the characteristic of the present genus of Perissodactyle.

Considering remoteness of position, and the evidence pointing to still greater remoteness in geological time between the present and other known fossil Asiatic Rhinoceroses, I should have been more surprised to find identity of species, than to detect the indications of diversity which have above been noted.

Tapirus sinensis, Ow.

To the genus of Tapir are referable three molars of the upper, and four of the lower jaw. They resemble the other fossils from the Chinese cavern in colour and chemical composition; the dentine and portions of jawbone adherent to the fangs of the teeth are blanched and absorbent from loss of animal matter, but not mineralized.

Of the existing species of *Tapirus* these teeth most resemble those of the Sumatran kind (*T. malayanus*, Raffles, *T. indicus*, Cuv.). In the upper molar series there are modifications of grinding-surface which help to define the position in that series of such detached teeth.

The tooth, Pl. XXVIII. fig. 8, resembles the third or the fourth premolar in the degree of equality of the rear (*b*, *d*) with the front (*a*, *c*) half of the crown, and in the smaller proportion of the antexternal tubercle (*r*) of the cingulum; it more resembles the third premolar in the extension of the cingulum at the rear of the crown (*r*) to the inner end of the base of the postinternal lobe (*d*), such rear portion of the cingulum not being bent up to the apex of that ridge as in the last premolar and in the true molars of *Tapirus indicus*.

Compared with the tooth of the Sumatran species, with which it is homologous, this penultimate premolar of the Chinese Tapir is larger, and has a proportionally greater transverse diameter, or from without inwards; it is still larger than in the European fossil species.

Dimensions of p 3 in	*Tapirus priscus.*		*T. sinensis.*		*T. malayanus.*	
	in.	lines.	in.	lines.	in.	lines.
Greatest transverse diameter	0	$11\frac{1}{2}$	1	3	1	1
Antero-posterior diameter...	0	$10\frac{1}{2}$	1	0	0	11

Among minor differences may be noted a better development in the Chinese tooth of the inner extension of the hind part of the cingulum (r'), and a ridged production of opposite sides of the contiguous bases of the two elongate compressed conical lobes (c, d) at their inner ends, meeting, as it were, to close the inner entry to their dividing valley, e.

Compared with *Tapirus priscus*, from the Eppelsheim miocene, the Chinese tooth is still larger than it is in comparison with the Sumatran species, and its transverse extension of crown is greater; the degree is given in the above admeasurements*. The fangs are broken away from this premolar; and in the hollow of the post-external root were crystals, determined by my friend and colleague, Professor Maskelyne, to be calcite in complete scalenohedra, a form or condition of carbonate of lime commonly met with in limestone caves. This was satisfactory in the degree in which it was confirmatory of the statement that the fossils were from a cave.

The next molar, in the degree of transverse contraction of the hinder half of the crown, answers to the penultimate molar, m 2; it is from the left side; the pulp-cavity, exposed by the breaking away of the fang, is partially filled with a reddish earth.

Dimensions of m 2 in.....	*Tapirus priscus.*		*T. sinensis.*		*T. malayanus.*	
	in.	lines.	in.	lines.	in.	lines.
Transverse diameter	1	0	1	3	1	2
Antero-posterior diameter...	0	10	1	2	1	0

The part of the cingulum continued inward from that which bends up the back part of the rear ridge is better developed in *Tapirus sinensis* than in *Tapirus malayanus*.

The third upper molar (Pl. XXVIII. fig. 9) is the last of the right side, and repeats the differential characters, as to size, of the two preceding molars, as compared with *Tapirus malayanus* and *T. priscus*. The antexternal root is preserved, part of the postexternal one, and the base of the confluent pair supporting the inner side of the crown (c, d); in the cavity of the fang, exposed by fracture, were also crystals of calcite. The divergence of the outer and inner fangs carries the transverse breadth of that part of the tooth much beyond the same diameter of the crown.

In the left lower penultimate premolar, p 3 (Pl. XXIX. fig. 6), besides a difference of size as compared with its homologue in *Tapirus malayanus*, there is a marked superiority of development of the ridge (t), continued from the outer angle of the anterior lobes (a) forward and inward, circumscribing a cavity in front of that lobe,—also in the height of the corresponding ridge from the outer angle of the

* It may also be estimated by comparing fig. 8, Pl. XXVIII. with fig. 9, p. 231, 'Quarterly Journal of the Geological Society,' vol. xii. 1856, "Upper molar of *Tapirus priscus*, from the Crag of Suffolk."

posterior lobe (*b*), which extends forward to abut upon the back part of the anterior lobe. These differences repeat characteristics seen in the anterior lower premolar, *p* 2, of *Tapirus malayanus*; but the transverse development of the anterior lobe in the present specimen shows it to be the succeeding premolar, *p* 3; and there is an abraded spot on the enamel of the fore part of the crown, proving it to have been preceded by another tooth, viz. that which answers to *p* 2 in the type series, but which is the foremost of the lower grinders in all Tapirs.

The first lower molar, *m* 1, right side, of *Tapirus sinensis* (Pl. XXIX. fig. 5) exceeds its homologue in *T. malayanus* by one line in both transverse and fore-and-aft diameters of the crown; the enamel is thicker, but the characters of the accessory ridges are less marked than in *p* 3. If the figure of the Chinese lower molar be compared with that of the lower molar of *Tapirus priscus* from the Red Crag of Sutton (Quarterly Journal of the Geol. Soc. vol. xiii. p. 233, figs. 8 *a*, 8 *b*), the difference of dimensions will be appreciated. The second lower molar, *m* 2, left side, repeats the differential characters of the foregoing as compared with its homologue in *Tapirus malayanus*. The posterior fang of this tooth is preserved to a length of one inch seven lines; its anterior surface shows the deep longitudinal, almost angular, channel which traverses that part, the hind surface of the fang being almost flat. There are fragments of another right lower molar of the same species of *Tapirus*, which, on the grounds above stated, I may be justified in defining as *Tapirus sinensis*. The differences observable in the molars of the American species of Tapir being greater and more numerous than those noticed in the Sumatran species as compared with the Chinese specimens, I have not spent time in their specification.

Remains of *Tapirus* appear not to have been met with in the Indian tertiaries. In Europe they have been found in the miocene of the Bourbonnais, and the pliocene of Auvergne, in the Eppelsheim miocene, and in the Red Crag at Woodbridge and Sutton. The Crag Tapir, like the Crag Hyæna, was much smaller than the Chinese species.

Mr. Swinhoe has been so good as to send me a copy of a figure of a quadruped called the "White-encircled Moh," from the old Chinese dictionary of Urh-ya, which dates from the commencement of the Christian era. This figure combines the head of an elephant, with its large pendent ears and long proboscis, with the trunk of a Tapir, the mane and bushy tail of a horse, and pentadactyle hind feet. It is worthy of a passing notice, however, because the trunk shows the diversity and arrangement of contrasted colours which are peculiar to the Malayan and Sumatran Tapirs. It may also be remarked that the Tapir has a mid tract of erect stiff hairs along the upper surface of the neck, exemplifying a certain correspondence with the one-hoofed perissodactyles, and it has a rudimental proboscis. Opinions, of course, will vary as to the source of the figure of the "white-encircled" proboscidian and maned quadruped in the old Chinese

work, viz. whether from a Tapir which continued to exist in China to within the historic period, or from figures and descriptions, brought home by some Chinese voyager, of the species now existing in the Malaccan promontory and in Sumatra.

Mr. Swinhoe writes to me that the Tapir "has long since ceased to be an animal known to the Chinese, and has given rise to many fables, which are repeated in Chinese dictionaries, and in the great Chinese Herbal, 'Pun-tsao-Kang.'"

It is satisfactory, therefore, to have acquired indisputable evidence that a Tapir, nearly allied to, but larger than the Sumatran kind, has existed in China, and has left its remains in conditions of preservation and entombment corresponding with those of large spelæan mammals, some of which were the latest to die out, and others still exist, in Europe.

It also adds to the illustration afforded by the existing Malaccan Tapirs of the original tract of dry land from which the Malaccan peninsula is nearly, and Sumatra quite insulated.

Chalicotherium sinense, Ow.

The last specimen from Mr. Swinhoe's Chinese spelæan teeth, that will be noticed in the present paper, is an upper molar of the right side, the last of the series, *m* 3 (Pl. XXIX. figs. 7, 8, 9 & 10), with the pattern of grinding-surface of that genus of Anoplotherioid from the Eppelsheim miocene which Kaup distinguished and named *Chalicotherium**.

In the upper true molars of this genus the crown has an outer and an inner division; the outer one presents an anterior (*a*) and a posterior (*b*) lobe, the former the larger; both are hollowed externally (*f*, *f'*), with a thick convex dividing bulge (*n*), the indent (*f*) being bounded by a similar convexity (*o*) anteriorly.

The coronal projection of each lobe is angular (fig. 7, *a b*), and inclines to the apex inwardly, as in *Anoplotherium*, fig. 11. The outer surface of the hind lobe (*f'*) looks obliquely backward and outward, and is turned most backward in the last molar (as in fig. 7), and to a greater degree than in *Anoplotherium*. The inner division of the crown consists of the postinternal lobe (*d*) and the mammilloid cone (*m*)—an antinternal lobe not being marked off, as in *Paloplotherium* and *Anoplotherium* (fig. 11, *c*), by the extension of the fissure (*l*) from the fossa (*h*). The valley *e* (Pl. XXIX. fig. 7) is wide and deep, and is joined at the fossa (*h*) by the valley *k*, which is of similar size; the entry to each valley is partially bounded by a development (*r*, *r*) of the cingulum, or basal ridge. The postinternal lobe (*d*) is marked off, as usual, by an indent or valley from *b*.

The cingulum may be traced from the low ridge along the fore side of the base of *a* to its thicker portion (*r*) at the entry of the valley, *k*, whence it is continued more feebly along the inner side of the base of *m* to join the ridge at the entry of the valley *e*: it thence extends just recognizably along the inner side of *d*, where it subsides.

The cingulum reappears along the rear of the base of the lobe *b*,

* Ossemens fossiles de Darmstadt: obl. fol. 1833.

and less conspicuously along the outside of the base of the lobe *a*. The middle of the outer concavity of this lobe shows a narrow vertical ridge of the enamel, ending a little behind the apex of the lobe.

In the anterior view of the crown (fig. 9) the convexity of the prominence (*o*) in the vertical direction is shown, and the degree of inflection of the outer surface inward to form the apex (*a'*) of the V-shaped summit of the antexternal lobe; the cone (*m*) simulates in this view an antinternal lobe. The absence of this lobe is characteristic of *Chalicotherium*; I do not regard the part of the cingulum (*r*) as its rudiment, because it is present in the premolars as well as in the molars, and it coexists with the true representative of the antinternal lobe (*c*) in both *Paloplotherium* and *Anoplotherium* (fig. 11, *r*).

The posterior view of the crown (Pl. XXIX. fig. 8.), in like manner, gives the vertical curve of the dividing bulge, and shows the proximity to the inner side of the tooth of the apex of the lobe *b*; the second or postinternal lobe forms the cone *d*. The inner side of the tooth (*ib.* fig. 10), formed by the cone *m*, and the postinternal lobe (*d*), with the uniting cingulum (*r*), is much narrower than the outer side; and the inner division shows consequently a confluence of its roots (*t*). This molar was implanted by two thick and strong outer roots, and by one larger inner root, composed, as indicated by the inner and outer longitudinal impressions, of two confluent fangs.

With the aid of the pocket-lens the fine transverse striæ of the enamel appear, and best beyond the cingulum. The radical cement is rough and thick. The dentine is blanched, not petrified, but has lost gelatine, and sticks like chalk to the tongue, as in the other cave-fossils.

The reader comparing fig. 7, Pl. XXIX., with *m* 3, fig. 36, pl. 80, of the 'Fauna Antiqua Sivalensis,' fol., or with figs. 5 and 6, *a*, pl. 7, of Kaup's 'Ossemens Fossiles de Darmstadt,' oblong fol., and with the excellent figure of the upper molar, apparently *m* 3 of *Chalicotherium Goldfussi*, in Bronn's 'Lethæa Geognostica,' atlas, fol. taf. xlvi. fig 2, *a*, may appreciate the grounds for indicating the Chinese Anoplotherioid as *Chalicotherium sinense*.

The last molar of *Chalicotherium sinense* is less than that of *Ch. Goldfussi*, Kp., and two lines larger in all the dimensions given at p. 431, than is that tooth in *Ch. sivalense*, Fr. Compared with this, the outer bulge (*o*) of the antexternal lobe is thicker, more convex vertically, and more produced outwardly. The outer concavity of the postexternal lobe (*f'*), which in *m* 3 becomes almost backward in aspect, is less deep in *Ch. sinense*; it is angularly indented in *Ch. sivalense*. The basal ridge (*r*) between the two inner lobes and that anterior to the base of the mammilloid lobe (*m*), are relatively less developed in *Ch. sinense*. The Anoplotherioid character of this lobe, as a large, rather low cone, is well marked. Its summit and the angular margin of the antexternal lobe are worn to the dentine, the exposed tract in the latter being from one to two lines in breadth. The enamel of the anterior part of the ridge of the postexternal and postinternal lobes is abraded, and the dentine beneath, at the fore part of these lobes, is partially exposed. The anterior part of the

interval between the postexternal (*b*) and the postinternal (*d*) lobes is not closed by a ridge descending from the summit of the post-external lobe as in *Chalicotherium sivalense**: nor does the inner side of the antexternal lobe terminate in so ridge-like a way as in *Ch. sivalense*; it is more rounded. The inner side of the postinternal lobe (*d*) is rounded in *Ch. sinense*, not angular as in *Ch. sivalense*†. The following are admeasurements of the last molar (*m* 3′) of the two species of *Chalicotherium*.

Admeasurements of the last Upper Molar.

	C. sinense.		*C. sivalense.*	
	in.	lines.	in.	lines.
Fore-and-aft diameter of outer side	1	7½	1	4
,, ,, inner side	1	2½	1	0½
Transverse diameter of fore side	1	8	1	6
,, ,, near side	1	6½	1	3½

Falconer observes of the molars of *Chalicotherum sivalense*, "their width is greater than their length" (*tom. cit.* p. 192); but the direction of these dimensions is not defined. In *Chalicotherium sinense*, as in *Ch. sivalense*, the diameter from without inwards equals that from before backwards. In speaking of the length of a tooth, one ordinarily means the extent to which the crown projects from the socket; and this is commonly the "vertical diameter" of the crown. In this sense the length of the molars of *Chalicotherium* is much less than their breadth, whether transverse or antero-posterior. But, then, this inferiority of length does not differentiate the molars of *Chalicotherium* from those of *Anoplotherium*. The length of the entire tooth in both genera, which includes the implanted part, is greater than any other diameter or dimension. The difference in the mineral condition of this Chinese cave-tooth and the fossil teeth of the same genus from the upper Miocene of France, Germany, and India is very striking and suggestive.

The older Chalicotherian molars, recognized by Kaup and Lartet, are truly petrified fossils. Those also from the Siwalik sands are in this state; but Falconer remarks that, when clay is the matrix, the bones, and, we may presume, the dentine of the teeth, remain white, and, except in being deprived more or less completely of their animal matter, they have undergone little alteration (*tom. cit.*

* This structure is noticed by the careful and minute observer Falconer, as follows:—"The apex of the posterior reentering angle gives off a like transverse ridge, which sweeps round into the posterior side." (Palæontological Memoirs, 8vo, vol. i. p. 192).

† The differential structure in *Chalicotherium sivalense* is noticed as follows, in the same useful and instructive summary of his scientific thoughts and works:—"This is the 'transverse ridge,' which is much inclined downwards and joins on with the isolated conical cusp (*a*, *a′*, *a″*) in the anterior and inner corner of the tooth, a cusp characteristic of *Anoplotherium*." (Falconer, Palæontological Memoirs, vol. i. p. 192.) I may, however, remark that the conical cusp is equally characteristic of *Paloplotherium*, and, though of smaller size, of *Hipparion*.

p. 190). The Chalicotherian fossils are said to be in this latter state; but both bone and dentine of the original specimens in the British Museum are more mineralized and discoloured by the matrix than is the tooth from China here described.

The correspondence, in colour, chemical condition, matrix, and cavernous locality, of the tooth of *Chalicotherium sinense* with those of Bovine and other Ruminants, of Hyæna, Rhinoceros, and Tapir, which are alleged, and with every appearance of truth, to be from the same cave, supports the inference of a correspondence of geological age in regard to the introduction therein of the individuals of those genera and families which have yielded the remains now described. If the Anoplotherioid molar had not been in the series, such series would have been referred, without hesitation, to a geological period not older than Upper Pliocene, and with a possibility of Postpliocene age.

I accept the evidence of the majority of the fossils, with the older alternative, and conclude that this particular anoplotherioid Artiodactyle which has departed from the generalized character of the type-genus by the suppression of a premolar on each side of both jaws, and the commencement of a diastema or break in the dental series, continued to exist in China until the pliocene division of tertiary time, perhaps to a late period of that division.

I may remark that the Chalicotherian modification has not hitherto been found in older tertiary deposits than miocene. It indicates the course or characters of derivative change in the Artiodactyle series, in a manner interestingly analogous to that shown by *Anchitherium* and *Acerotherium* in the Perissodactyle series.

In both great primary groups of hoofed Mammals this change is manifested, in the dental system, by arrest of development at the fore part of the series, especially in the upper jaw. When no teeth there arrive at full growth, the offensive and defensive weapons called horns usually make their appearance; median and odd in the Perissodactyle Rhinoceros, in a pair or pairs in the Artiodactyle ruminants, with well-known exceptions, not, however, affecting a statement of general tendency. *Chalicotherium*, in the diminished size of the premolars, in the transverse disposition of the incisive alveoli of the mandible (traces of which are visible in the original of the figure 1, pl. 80, of the 'Fauna Antiqua Sivalensis'*), and in the contiguous small canines, makes a close step to the Ruminant dentition, as it does also in the molar formula, $p\,\frac{3-3}{3-3}$, $m\,\frac{3-3}{3-3}$, and in the diastema between these and the fore teeth. Upper canines as well as incisors failed, as in most Ruminants, to attain development. This view of Chalicotherian modifications in the Artiodactyle series may not meet with general acceptance; but I think it is preferable to the notion of *Chalicotherium* having been a kind of cross between *Anoplotherium* and *Rhinoceros*.†

* Originally in the Dadoopoor Collection of Messrs. Baker and Durand, and now in the Museum of the Marischal College, Aberdeen.

† Falconer characterizes the *Chalicotherium sivalense* as "one of the most

The extent of the range of the species of *Chalicotherium* over the great division of dry land to which that form seems to have been restricted, was considerable, viz. from France to China. In tracing it in this direction, the species appear to have lived on nearer to the present period as they were located eastward.

At Sansan, as at Eppelsheim, the remains of *Chalicotherium* have become petrified in beds of miocene age, now covered by later tertiaries. In the caverns of Greece (Pikermi &c.) they are associated with Upper Miocene and Old Pliocene forms. In the teeth from the Siwalik deposits, although the Chalicotherian dentine, in some degree, and as contrasted with that of the sandstone fossils of the same locality, may come into the category of the "soft fossils," yet they are far from presenting the appearance and evidence of comparatively recent unchangedness which characterizes the dentine of the teeth from the Sy-chuen cave.

Land at the eastern limits of the great Europæo-Asiatic tract, and now forming China, may have been exempt, or much longer exempt (since it became fit to be trod by tapirs and anoplotherioids) from those alternate elevations and depressions which have destroyed, have modified, or have covered with deposits of Pliocene and Post-pliocene age the western Miocene land *.

DESCRIPTION OF THE PLATES.

PLATE XXVII.

Stegodon sinensis.

Fig. 1. Second upper molar, *d* 3, grinding-surface,
2. „ „ outer side view.
3. „ „ inner side view.

PLATE XXVIII.

Stegodon orientalis.

Fig. 1. Portion of true molar, grinding-surface.
2. „ „ side view.
3. Hind end of milk-molar, *d* 3, grinding-surface.
4. „ „ side view.

Hyæna sinensis.

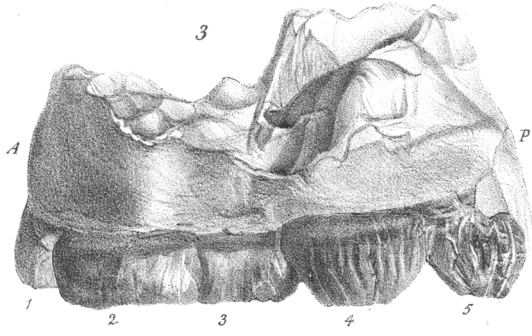
Fig. 5. Third upper premolar, right, *p* 3, front view.
6. „ „ „ outer side view.
7. Second lower premolar, *p* 3, outer side view.

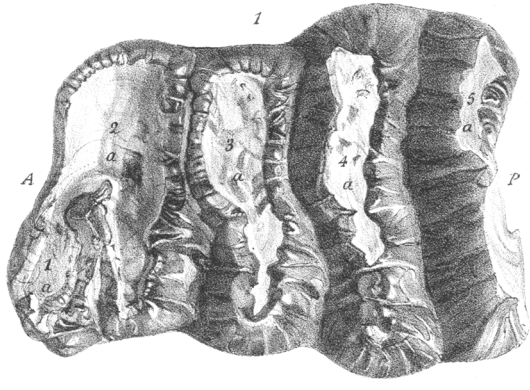
Tapirus sinensis.

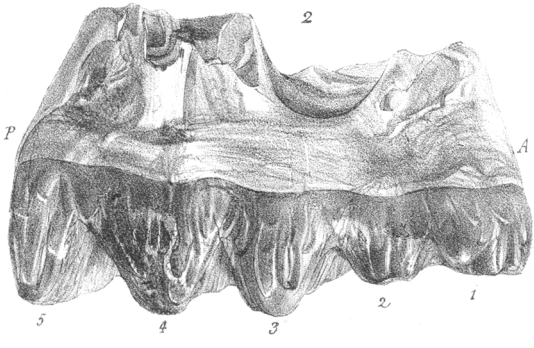
Fig. 8. Third upper premolar, *p* 3, grinding-surface.
9. Last upper molar, *m* 3, „ „

remarkable aberrant Pachyderms that have yet been met with, closely allied to *Anoplotherium*, but showing a return from the ruminant tendencies of the Cuvierian species back to a more pachydermatous type, and a closer affinity with Rhinoceros, between which and *A. commune* it may ultimately prove to be an intermediate form."—*Palæontological Memoirs*, vol. i. p. 22, and p. 195.

* Other fossils were obtained by Mr. Swinhoe from a vendor of drugs at Shanghai, such fossils being collected and sold as articles of the Chinese Materia Medica. An esteemed medical friend has referred me to an old work showing that fossils were collected in Europe for the same purpose in the middle ages.







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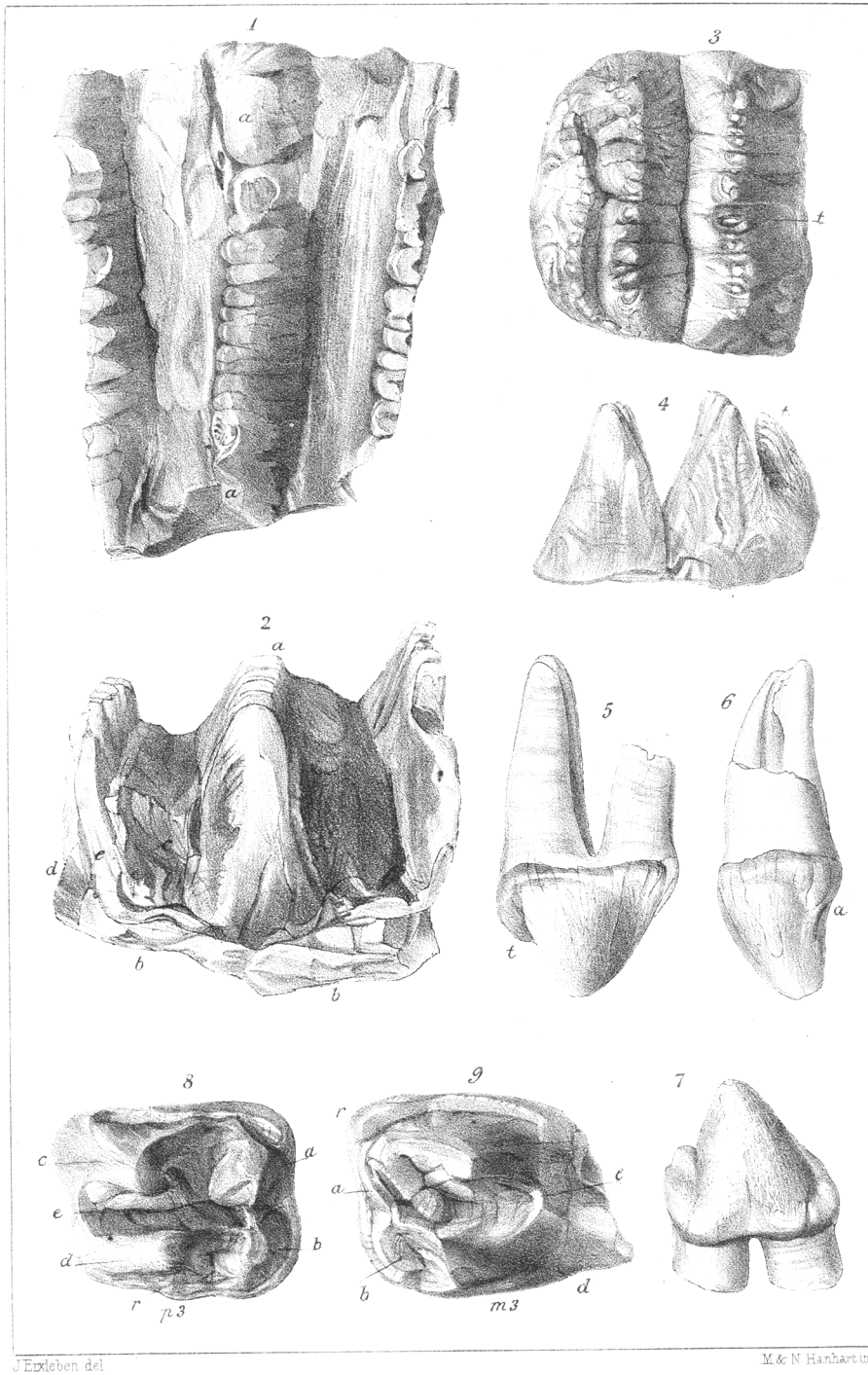
CHINESE FOSSIL MAMMALS



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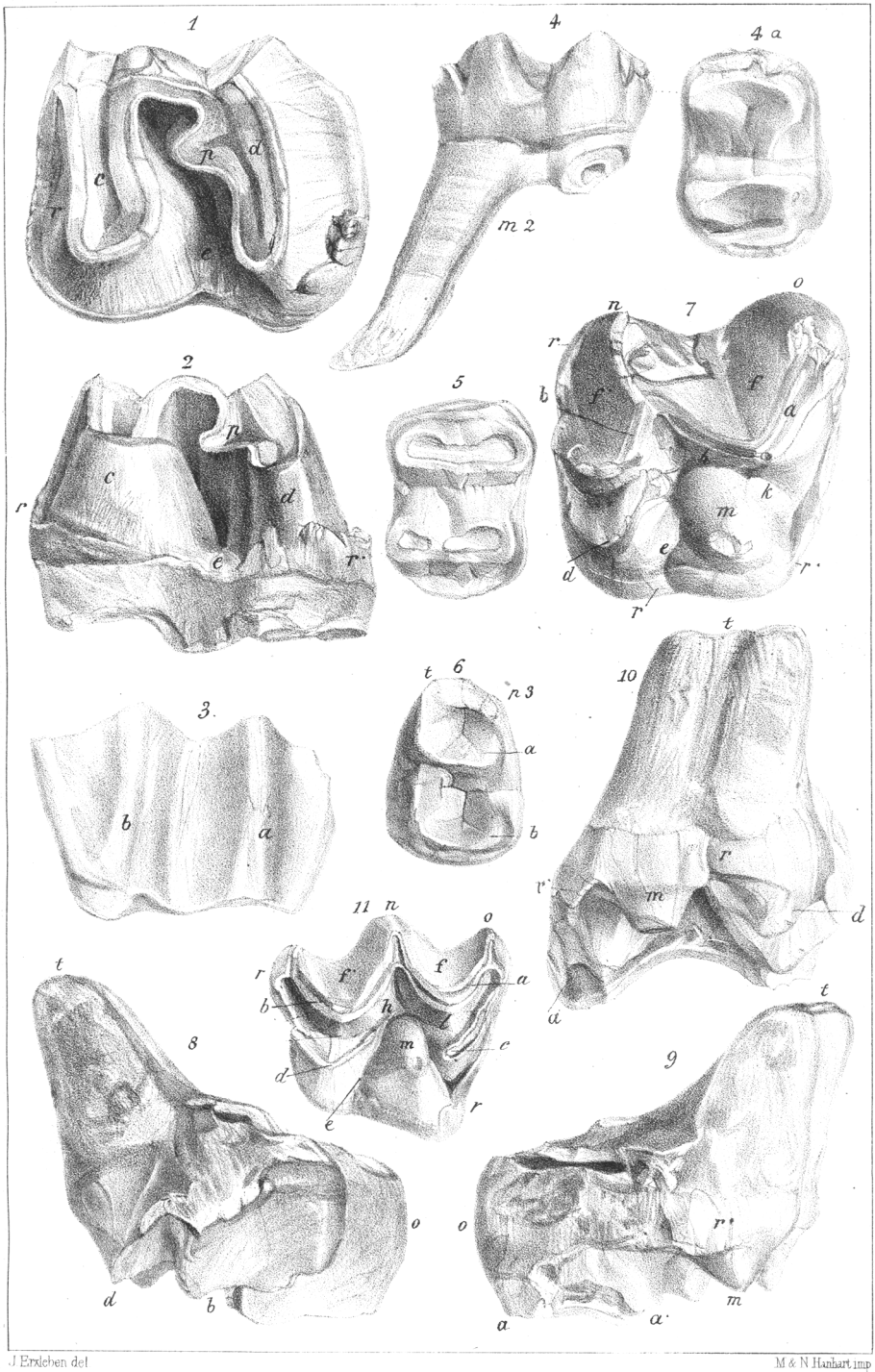
CHINESE FOSSIL MAMMALS.



CHINESE FOSSIL MAMMALS.

PLATE XXIX.

Rhinoceros sinensis.

1. Last upper molar, *m* 3, grinding-surface.
2. " " inner side view.
3. Upper molar, outer enamel-wall.

Tapirus sinensis.

4. Second lower molar, *m* 2, outer side view.
4*a*. " " grinding-surface.
5. First lower molar, *m* 1, grinding-surface.
6. Second lower premolar, *p* 3, grinding-surface.

Chalicotherium sinense.

7. Last upper molar, *m* 3, grinding-surface.
8. " " rear view.
9. " " front view.
10. " " inner side view.

Anoplotherium commune, Cuv.

11. Upper true molar, from a Montmartre specimen in the British Museum.

DISCUSSION.

The CHAIRMAN called attention to the remarkable association of forms among the fossils described by Prof. Owen.

Prof. BUSK remarked that the materials at command seemed to him insufficient for the establishment of new species. He observed that the distinctive characters of *Stegodon sinensis* appeared to be very slight, and that the *Hyæna* might just as probably be *H. spelæa*. The tooth of *Rhinoceros* might be a milk-molar of *R. sumatranus* or *R. sondaicus*.

Mr. BOYD DAWKINS suggested that, as the specimens were obtained from apothecaries, there was no evidence of the contemporaneity of the fossils.

Mr. H. WOODWARD stated that Mr. Swinhoe had himself obtained a series of these fossils from a cave many miles inland—he believed, on the course of the Yang-tse-kiang. Mr. Woodward also called attention to Mr. Hanbury's paper on Chinese Materia Medica, in which many fossil teeth of mammalia are noticed.

Prof. OWEN, in reply, stated that great quantities of the fossils had passed through his hands, and that he had selected for description those which, from their minute agreement in chemical and other characters, might justly be inferred to be of the same age, and to be derived from the cave mentioned by Mr. Swinhoe.

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3. *Further discovery of the* FOSSIL ELEPHANTS *of* MALTA.

By Dr. A. A. CARUANA.

[Communicated by Dr. A. Leith Adams, F.G.S.]

(Abstract.)

THE author described the discovery of some fossil bones in a fissure at Is-Shantiin, at the entrance of the quarry of Micabibba, on the 24th of January of the present year.

The fissure in which the bones were found was an expansion of a

narrow vertical rent, varying in width from 3 to 5 inches, and filled, as usual, with red earth and fragments of stone, which may be traced from the surface of the rock, traverses the sandstone quarry for a distance of 60 feet, and runs on, constantly increasing in depth, towards the south-south-west, in the direction of the Gandia fissure, with which it probably unites at a distance of less than a quarter of a mile. The expanded portion of the fissure in which the bones were found was in the shape of half a barrel cut through the flat ends; and it measured from 2 to 3 feet in width, 10 feet in length, and a little more than 6 feet in depth. It was covered by a large block of sandstone. The sides of the fissure were, as usual, perfectly smooth. It had no stalagmitic floor.

The fissure was filled with a compact deposit of red earth, with fragments of limestone, containing throughout teeth and fragments of bones of fossil elephants, associated with bones of large birds, as in the Gandia fissure; but no shells were observed. A tooth, which the author supposed to be that of a *Hippopotamus*, was also obtained*. The author also met with three small fish-teeth.

The remains of Elephants obtained from this fissure consist chiefly of fragments of the long bones. Several of the Elephants' teeth were entire, and they were generally rather better preserved than those discovered in the Gandia fissure. A fragment of a tusk, 21 inches in length, was obtained; the greatest circumference of this was 17 inches, or 2 inches more than the specimen found by Dr. A. Leith Adams at Tal-Maghlak.

This fissure at Is-Shantiin is said by the author to raise the number of localities in Malta in which Elephant-remains have been found in abundance to five, namely:—the cave at Casal Zebbug, discovered in 1859 by Capt. Spratt; two caves at Tal-Maghlak, in Casal Krendi, discovered by Dr. A. Leith Adams in 1861; the Gandia fissure, within the limits of Casal Micabibba and Casal Siggeni, excavated in 1865 by Dr. Adams and the author; and the Is-Shantiin fissure at the entrance to Casal Micabibba. These localities are all in the denuded district of the eastern half of the island; and in this direction there is abundant evidence of the existence of many similar ossiferous fissures. From the mode of occurrence of these bones the author infers that, at the time of their deposition where we now find them, that part of the island was exposed to the impetuous wash of continuous and rapid currents of fresh water. The remains already found indicate the existence of three species of Elephants, two or more species of *Hippopotamus*, one species of gigantic Dormouse and other large extinct animals, which must have wandered over the island in large numbers, probably associated with Carnivora, of which, however, no remains have been discovered in Malta, although the author has found a portion of the lower jaw of *Hyæna* in the island of Gozo. He considered that the area of the island was wholly inadequate for the shelter and support of so many large mammals, and, considering their affinity to African species, and certain hydrographical conditions noticed by Capt. Spratt, he inferred that, at the

* See Dr. Adams's note at the end of this paper.

period when these mammals were living, Malta must have been united to the African continent.

Note by Dr. A. Leith Adams, F.G.S.

I have received from Dr. Caruana the tooth he supposes may belong to an Hippopotamus, and find it is a fragment of a germ true molar of one or other of the pigmy Elephants. The fish-teeth are also in my possession, and referable to Sharks of the genus *Lamna* or *Oxyrhina*, and are very probably Miocene, and derived from the rocks in which the Shantiin fissure exists, having been washed into it along with the soil and other organic remains. Similar teeth were found in Zebbug Cave by Captain Spratt, F.G.S.; and I discovered allied Sharks' teeth in another ossiferous cavern in the island.

Discussion.

Prof. Busk remarked that there was no doubt that three species of elephants had lived and bred in Malta.

Capt. Spratt said that, it appeared to him, the chief interest of the communication lay in the greater comparative abundance of the larger species of elephant in the new locality.