THE

QUARTERLY JOURNAL

OF THE

GEOLOGICAL SOCIETY OF LONDON.

EDITED BY

THE ASSISTANT-SECRETARY OF THE GEOLOGICAL SOCIETY.

VOLUME THE TWELFTH.

1856.

PART THE FIRST.
PROCEEDINGS OF THE GEOLOGICAL SOCIETY.

LONDON:

LONGMAN, BROWN, GREEN, LONGMANS, AND ROBERTS.

PARIS:—FRIED. KLINCKSIECK, 11 RUE DE LILLE; BAUDRY, 9 RUE DU COQ, PRES LE LOUVRE; LEIPZIG, T. O. WEIGEL.

SOLD ALSO AT THE APARTMENTS OF THE SOCIETY.

MDCCCLVI.

DESCRIPTION OF PLATE III.

a. The fossil tibia of the *Gastornis parisiensis*, nat. size.
b. The lower articular surface of the same bone.
2*a*. The lower end of the tibia of the *Dinornis casuarinus*, nat. size.
2*b*. The lower articular surface of the same bone.
3. The lower end of the tibia of the Vulture (*Sarcoramphus papa*).
4. *Ib.* *ib.* *ib.* Raven (*Corvus corax*).
5. *Ib.* *ib.* *ib.* Crown Pigeon (*Lophyrus corona'us*).
6. *Ib.* *ib.* *ib.* Turkey (*Meleagris gallopavo*).
7. *Ib.* *ib.* *ib.* Bustard (*Otis tarda*).
8*a*. *Ib.* *ib.* *ib.* Seres Crane (*Grus Antigone*).
8. The lower articular surface of the same bone.
9. The lower end of the tibia of the Gallinule (*Gallinula chloropus*).
10*a*. *Ib.* *ib.* *ib.* *Notornis Mantelli*.
10*b*. The lower articular surface of the same bone.
11*a*. The lower end of the tibia of the *Aptornis otidiformis*.
11*b*. The lower articular surface of the same bone.
12. The lower end of the tibia of the *Apteryx australis*.
13*a*. *Ib.* *ib.* *ib.* of a Swan (*Cygnus ferus?*): fossil, from a pleistocene formation.
13*b*. The lower articular surface of the same bone.
14. The lower end of the tibia of the Albatros (*Diomedea exulans*).
15. The lower end of the tibia of the Curlew (*Numenius arcuata*).

Description of some MAMMALIAN FOSSILS *from the* RED CRAG *of* SUFFOLK. By Prof. OWEN, F.R.S., F.G.S.

INCE my description of the mammalian fossils of the Red Crag, llected by Sir Charles Lyell at Newbourn, Suffolk, in 1840*, and ıe publication of the 'History of British Fossil Mammalia,' in which ıese and subsequently discovered Cetacean Crag fossils were figured, have visited several localities where the Red Crag is worked for hosphatic nodules, in Suffolk, and have myself collected, and have eceived from other collectors, numerous specimens of mammalian emains, from the Red Crag, of which I have selected the following s most worthy of being described.

Genus *Rhinoceros*.

There is some difficulty in determining the species of Rhinoceros by detached fossil molar teeth—the only recognizable parts of the genus that I have yet obtained from the Red Crag of Suffolk.

Most of the detached molars of *Rhinoceros* from this formation appear by their size, want of roots, and indications of absorbent action at the base of the crown, to have belonged to the deciduous series of teeth, and to have been shed by young individuals; and the milk-teeth are less characteristic even than the permanent ones, as indeed most structures of the immature period of life partake more of the general and less of a special character than those of the adult. There are, however, specimens of the permanent teeth sufficiently cha-

* Annals and Magazine of Natural History, vol. iv. 1840, p. 186.

racteristic and well-preserved to determine their relations to the like evidences of extinct Rhinoceroses previously discovered in England. The most characteristic examples of these teeth from the Red Crag are figured for the present communication*, and, having previously studied and endeavoured to demonstrate the differences between the upper molars of the *Rhinoceros tichorhinus* and those of the *Rhinoceros leptorhinus* in my 'British Fossil Mammalia,' figs. 122, 125, and 126 (*Rh. tichorhinus*), fig. 141 (*Rh. leptorhinus*), I have been, in some degree, prepared to deduce satisfactory evidence of the nature of the molars of the Rhinoceros from the Red Crag.

Baron Cuvier†, Prof. Kaup‡, Dr. Buckland, and Prof. Jaeger§ have given the laudable example of figuring such fossil teeth of the natural size: all who are reduced, as in the present case, to mere teeth for the determination of species must regret that the authors of the excellent 'Zoologie et Paléontologie Françaises‖,' and of the 'Nouvelles Études sur les Rhinoceros Fossiles¶,' should not have followed that example: for, reduced figures of objects rarely exceeding two or three inches in natural size cannot afford satisfactory means of comparison, and the loss to science is greater than such saving of expense or space can compensate for.

In the upper molar (fig. 1, probably the third of the right side) from a 'Red Crag' or 'Coprolite' pit, at Wolverston, Suffolk, the contour of the outer side of the tooth, *d*, *d'*, *d''*, more resembles that of the older pliocene and miocene Rhinoceroses (*Rh. megarhinus*, Christol, *Rh. Schleiermacheri*, Kaup), than that of the pleistocene *Rh. tichorhinus* or *Rh. leptorhinus*; the vertical ridge *d'* is relatively more produced and is nearer the antero-external angle of the crown, *d*, than in the *Rh. tichorhinus*, in which the outer border of the crown is more undulated. From the ridge *d'*, the outer border of the crag-tooth has extended to the hinder angle of the tooth, *d''*, in a nearly straight line; a part of the enamel near that angle has been, unluckily, broken away, but the body of dentine seems there to be entire, whence one may refer the resemblance of the contour of that border to that of the fourth and fifth upper molars of the *Rhinoceros megarhinus*, figured (half nat. size) by M. Christol, in the 'Annales des Sciences Naturelles,' tom. iv. 2nd sér. pl. 2. figs. 3^e, 4^e, 5^e.

In that species of *Rhinoceros* the second, third, and fourth molars (premolars) are distinguished from the three following molars (true molars) by a basal ridge extending along the inner side of the tooth, and continued along a part of both the anterior and posterior sides of the tooth. The present crag-fossil shows the same basal ridge, *f*, *f*, commencing at the inner half of the anterior side of the crown, sweeping across the whole inner side, and gradually ascending to

* The woodcuts illustrative of the Teeth, Bones, and Antlers described in this communication will be found at pages 231–236.

† Ossemens Fossiles, tom. ii. pls. 6, 13, 1822.

‡ Ossemens Fossiles de Darmstadt, 4to et fol. 1833.

§ Fossilen Säugethiere Wurtembergs, fol. 1839.

‖ Gervais, 4to, 1852–54.

¶ Duvernoy, in the 'Archives du Muséum d'Histoire Nat.,' tom. vii.

terminate near the entry of the posterior valley *a*, where, however, it has been worn away by pressure against the adjoining tooth. There is no evidence of such a ridge in any of the upper molars of the *Rhinoceros tichorhinus*. In the excellent figures of the upper molars of the *Rhinoceros Schleiermacheri*, of the natural size, given by Prof. Kaup*, the third and fourth molars exhibit a similar basal ridge to that in the *Rhinoceros megarhinus*, and in the crag-tooth, fig. 1.

In the greater depth and width of the entry to the internal (*b*) and posterior (*a*) valleys, the crag-tooth resembles the pliocene and miocene Rhinoceroses above-cited, and differs from the pleistocene *Rhinoceros tichorhinus*; in which, owing to the entry of the corresponding valleys being relatively shallower, and those valleys deepening more as they penetrate the crown, they are sooner converted into pits circumscribed by islands of enamel, as shown in the teeth, figs. 1, 2, & 4, pl. 6, and in figs. 1 & 6, pl. 13, of the 'Ossemens Fossiles' of Cuvier, in the paper by Dr. Buckland in the 'Philosophical Transactions' for 1822, pl. 21. fig. 3, and in my 'British Fossil Mammalia,' figs. 122 & 126.

The internal valley, *b*, is bilobed in the *Rhinoceros tichorhinus*, or bends back so abruptly at its termination, that that termination becomes insulated by attrition from the rest of the valley, as in some of the figures above-cited; such a change does not take place in the *Rhinoceros megarhinus* and *Rh. Schleiermacheri*; in the latter the end of the valley *b* slightly expands, and sometimes it is festooned by small processes of enamel and dentine re-entering it, as is shown in the crag-tooth, fig. 1, *b*, and in the penultimate upper molar of the *Rhinoceros Schleiermacheri*, figured in tab. 9. fig. 5, of Prof. Kaup's excellent work above quoted.

Prof. Christol does not represent this structure in any of the molars of his *Rhinoceros megarhinus*; but in the sixth (penultimate or second true) molar, attributed by M. Gervais to the same species, and figured, of half the natural size, in the 'Paléontologie Française,' pl. 2. fig. 5, the same modification of the end of the valley, *b*, reappears, as is shown in the corresponding tooth of the *Rhinoceros Schleiermacheri*. From these differences I conclude that the fossil tooth from the Red Crag of Wolverston does not belong to the species of *Rhinoceros* (*Rh. tichorhinus*) which is associated in our pleistocene gravels, drifts, and bone-caves with the *Elephas primigenius*, but that it belongs to a species much more nearly allied to, if not identical with, either the *Rhinoceros megarhinus* of the older pliocene formations, near Montpellier, or the *Rhinoceros Schleiermacheri* of the miocene formations near Darmstadt.

The second example of the upper molar of a Rhinoceros, from the Red Crag of Suffolk, fig. 2, is also from the right side; but the outer third of the crown is broken away together with the base of the tooth. It is worn down more deeply than the preceding molar, the valley *b* being insulated, and the valley *a* connected by an isthmus of little more than a line in breadth with the outer wall of

* *Op. cit.* tab. 11. fig. 5.

enamel. The amount of attrition to which this tooth has been subject is about the same as that of the teeth of the *Rhinoceros tichorhinus* figured by Cuvier in the 'Ossemens Fossiles,' tom. ii. pl. 6. figs. 1 & 2. But, whereas it is the shorter posterior valley which is still uninsulated in the crag-tooth (fig. 2), the long internal valley is the one which retains the narrow continuity of enamel in the molar teeth figured by Cuvier; moreover, these teeth show the third island due to the separation of the hinder divison of the expanding and bifurcating valley *b*, in the *Rhinoceros tichorhinus*, whilst no trace of the third enamel-island exists in the crag-molar in question. This molar, moreover, shows a well-developed internal basal ridge, *f*, commencing, as in the foregoing crag-tooth, fig. 1, near the middle of the anterior surface, and rising as it extends along to the inner surface to terminate at the postero-internal angle of the crown.

From the above characters it may be concluded that the portion of the upper molar, fig. 2, from the crag-pit near Felixstow, Suffolk, does not belong to the *Rhinoceros tichorhinus*, but to a species more nearly allied to, if not identical with, either the *Rhinoceros megarhinus* or the *Rhinoceros Schleiermacheri*.

The third example of the upper molar of *Rhinoceros*, from the Suffolk Red Crag, fig. 3, is from the left side, and had been but little used in mastication,—not more, for example, than the tooth of the *Rhinoceros leptorhinus*, from the Clacton pleistocene, fig. 141, p. 373, of my 'History of British Fossil Mammals,' and to about the same extent as the premolar teeth of the *Rhinoceros Schleiermacheri*, figured by Prof. Kaup in tab. 11. fig. 7, of his most useful Illustrations of the Fossils of Darmstadt. In the disposition of the enamel-folds, the present crag-tooth so closely accords with the upper molars of the miocene *Rhinoceros* (*Rh. Schleiermacheri*), that I am strongly inclined to regard it as belonging to that species; I have not, however, had the opportunity of comparing it with an upper molar of the *Rhinoceros megarhinus* in the same stage of attrition.

The valley, *b*, as in the *Rhinoceros Schleiermacheri*, after penetrating along a line parallel with the anterior border, two-thirds across the crown, suddenly bends backwards at a right angle; the commencement of the valley is very wide and deep. The posterior valley *a* is triangular, and in form and place closely resembles that in the *Rhinoceros Schleiermacheri*. The position of the longitudinal ridge *d'* accords with that in the crag-tooth, fig. 1, and with that in the upper molars of both *Rhinoceros Schleiermacheri* and *Rh. megarhinus*. The basal ridge *f* extends as far along the fore part of the crown as in the *Rh. Schleiermacheri*, and it is continued, as in some premolars of that species, around the inner side of the lobe *c*. The basal ridge is confined to the fore part of the crown in the *Rhinoceros leptorhinus*.

In all the characters in which the present crag-molar resembles those of the *Rhinoceros Schleiermacheri* it differs from those of the *Rh. tichorhinus*.

The lower molar teeth of *Rhinoceros* from the Suffolk Crag are more numerous than the upper ones. Unfortunately they are less

characteristic of species. I have figured three of the best-marked specimens.

If the teeth in the lower jaw of the *Rhinoceros Schleiermacheri* figured by Kaup in tab. 11. fig. 8, *op. cit.*, be compared with the figures of the lower molar teeth of the *Rhinoceros tichorhinus* given by Cuvier in pl. 6. fig. 7 and pl. 13. fig. 3, *op. cit.*, and by Buckland in pl. 21. fig. 5, *op. cit.*, it will be seen that the tract of dentine exposed by moderate abrasion in the hinder lobe of the tooth is more angular in the miocene *Rhinoceros*, and more gradually bent in the pleistocene one.

If the figure of the lower molar of the *Rhinoceros* from the Red Crag at Sutton, fig. 4, be compared with that of a probably answerable molar, only a little more worn, of the *Rhinoceros tichorhinus* in the 'History of British Fossil Mammals,' fig. 127, p. 337, the same difference will be recognized, together with the difference in the thickness of the enamel, the greater thickness of which characterizes all the teeth of the *Rhinoceros tichorhinus* as contrasted with those of the *Rhinoceros megarhinus* and *Rhinoceros Schleiermacheri**. I have no hesitation, therefore, in affirming that the crag-tooth, fig. 4, does not belong to the *Rhinoceros tichorhinus*; although, in the absence of means of comparing it with the lower molars of the pliocene and miocene Rhinoceroses hitherto defined, I cannot positively refer it to any of those species. There is a short oblique, basal ridge at the outer and anterior angle of the tooth, and a short rudimentary one at the back part of the crown.

Fig. 5 is a lower molar from the left side of the lower jaw of a *Rhinoceros*, from the Red Crag at Felixstow; it is more worn than the preceding, but repeats all its characters of resemblance to the lower molars of the *Rh. Schleiermacheri*, and of difference from those of the *Rh. tichorhinus*.

The crown of a right lower molar of a *Rhinoceros*, from the Red Crag at Sutton, fig. 6 *a*, *b*, *c*, of which the summit of the anterior lobe had only just begun to be abraded, shows the anterior oblique basal ridge continued, of less thickness, along the fore part of the anterior lobe, where it describes a curve convex upwards, fig. 6 *b*; there is a shorter and thicker curved basal ridge, behind, fig. 6 *c*.

The small lower molar from the right side of the jaw of a Rhinoceros, fig. 7, found in a crag-pit at Sutton, corresponds in size and general form with the second molar of the *Rhinoceros Schleiermacheri* figured in tab. 12. fig. 11, of Prof. Kaup's work above cited.

The above-described specimens of fossil teeth of *Rhinoceros*, from the crag-pits of Suffolk, afford satisfactory evidence of the remains of a species distinct from the common Tichorhine *Rhinoceros* and from the Leptorhine *Rhinoceros* of the pleistocene era, and more nearly allied to, if not identical with, either a species of *Rhinoceros*,

* The figure of the lower molars of the *Rhinoceros megarhinus*, given by Christol in the Annales des Sciences Nat. vol. iv. 2nd ser. pl. 2. fig. 1, and by Gervais, in pl. 30. fig. 1. of the Paléontologie Française, as well as that of the *Rhinoceros pleuroceros*, in pl. 8 of the Archives du Muséum, tom. vii., are too much reduced to be of use in this comparison.

viz. *Rh. megarhinus*, from the older pliocene, or with one, viz. *Rh. Schleiermacheri*, from the miocene tertiary formations.

Genus *Tapirus*.

At the period of the publication of my 'History of British Fossil Mammals,' 1845, no remains referable to the genus *Tapirus* had come under my notice from any British locality; the Tapiroid family was represented only by species of *Coryphodon* and *Lophiodon*.

The existence of a true Tapir in tertiary strata was first made known by Prof. Kaup, in the miocene deposits at Eppelsheim; an almost entire under jaw and part of an upper jaw, with the characteristic teeth of both, are described and figured, tab. 6. *op. cit.*, under the name of *Tapirus priscus*. Remains of a Tapir have also been discovered in both miocene and old pliocene strata in Auvergne and other parts of France: these fossils M. de Blainville thought not to be specifically distinct from the *Tapirus priscus* of Kaup. They are assigned, in Gervais' 'Paléontologie Française,' to a species named *Tapirus arvernensis* (from the Puy-de-Dome), to a *Tapirus minor* (from the pliocene sands of Montpellier), and to a *Tapirus Poirieri* (from the miocene deposits of the Bourbonnais).

It may seem hazardous to affirm the existence of a British fossil Tapir from a single tooth, and that a lower one; but the molar tooth figured, fig. 8, from the crag-pit of Sutton, from which the upper molars of the *Rhinoceros* so near to, if not identical with, the *Rhinoceros Schleiermacheri* were obtained, bears a closer resemblance to a newly risen and unworn molar of the lower jaw of the *Tapirus priscus*, Kaup, than to any other recent or fossil tooth with which I have been able to compare it. There are the same two principal transverse ridges, the same low basal ridge at the fore and back parts of the crown, the same slight concavity of that side of the principal ridge which is directed upwards;—the closest agreement, in fact, both as to form and size, prevails. I am, therefore, led to expect that the former existence of a British Tapir, probably not distinguishable from the *Tapirus priscus*, Kaup, will be confirmed by subsequent discoveries of the more characteristic upper teeth, in the Suffolk crag-pits.

[Since the above paragraph was in type, I have had the desired opportunity of comparing an upper molar tooth (fig. 9) from the Red Crag of Suffolk, now in the British Museum, with those of the *Tapirus priscus*, Kaup, and the comparison has afforded the anticipated confirmation.—R. O., July 1856.]

Genus *Sus*.

Since my first determination of a fossil of the genus *Sus* in the Red Crag of Suffolk*, viz. the external incisor of the lower jaw (p. 428, fig. 173, Brit. Foss. Mamm.), several molar teeth of the Hog genus have been obtained from that formation, and some of them in the

* Annals of Natural History, vol. iv. 1840, p. 185.

usual mineralized state of its characteristic fossils. Of these I have figured the last upper molar tooth of the left side, fig. 10, from the Red Crag at Sutton. It differs from the corresponding tooth in the *Sus scrofa* by the shorter antero-posterior diameter as compared with the transverse diameter of the crown, the latter dimension at the fore part of the tooth being the same as in the corresponding tooth of an ordinary wild boar; but the crown of the fossil tooth wants one-fifth of the length of the grinding surface in the corresponding tooth of the recent species (*Sus scrofa*). Prof. Kaup has described (p. 11) and figured (tab. 9. fig. 3, *op. cit.*) an almost precisely corresponding tooth to that represented in fig. 9; and, for the species of Hog represented by portions of jaws with similar teeth he proposes the name of *Sus palæochœrus*; founding the specific difference chiefly on the same differences in the proportions of the molar teeth which are illustrated by the crag-fossil under consideration. To those who will compare the figure of this fossil, fig. 9, with the figure above cited from Kaup's excellent work, there need not be more said in favour of referring the crag-tooth to the same extinct species of Hog (*Sus palæochœrus*) from the miocene formation near Eppelsheim.

Fig. 11 represents a portion of the crown of a molar of apparently a larger species of *Sus*, from the Red Crag at Ramsholt, Suffolk; it probably belongs to the same species as the *Sus antiquus*, Kaup, founded on fossils from the miocene sands at Eppelsheim.

Genus *Equus*.

Molar teeth, from both upper and lower jaws, of a large species of *Equus*, occur in the Red Crag, and in the usual condition of the fossils of that formation. The disposition of the enamel on the grinding surface of one of these molars from the upper jaw, fig. 12, *b*, resembles that of the tooth from the Oreston cavern, referred to the species called *Equus plicidens* in the 'Brit. Foss. Mamm.' p. 393, fig. 153. It is of large size, and presents the heavy, mineralized, deeply stained characters of the true Red-crag fossils.

Similarly fossilized teeth of a smaller species of *Equus*, probably of the subgenus *Hipparion*, have likewise come under my notice from the Red-crag of Suffolk.

Genus *Mastodon*.

The specimens of teeth and portions of teeth of *Mastodon*, from the crag-pits of Suffolk, are not distinguishable specifically from those referred to the *Mastodon angustidens* (*Mastodon longirostris*, Kaup) from the fluvio-marine crag of Norfolk, in my 'History of British Fossil Mammals,' pp. 276–284. In the Ipswich Museum there is a considerable proportion of the crown of a molar corresponding with the fourth of the upper jaw in Kaup's *Mastodon longirostris*; also a well-preserved atlas vertebra of, apparently, the same species of *Mastodon*.

Family *Cervidæ*.

In the miocene strata near Darmstadt the remains of a peculiar form of small Deer, with pedunculated antlers like those of the Muntjac, but with the typical number of molars, 7—7, at least in the upper jaw, have been found, on which remains Prof. Kaup has founded his genus *Dorcatherium*. With this were associated other and somewhat larger species of Deer, represented by more or less mutilated antlers, which Prof. Kaup refers to his species *Cervus dicranocerus* (tab. 24. figs. 3, 3 *e*, *op. cit.*). In this species the beam of the antler rises from one to two inches above the burr without sending off any brow-snag, but at that distance it sends obliquely forward a branch so large, that the beam seems here to bifurcate, the anterior division being, however, rather the smallest and shortest.

I have received the bases of similar antlers, which had been shed, from different Red-crag pits of Suffolk, some corresponding in size with, others larger than, the largest of the specimens figured by Kaup*; none of these specimens, however, have either branch of the beam entire.

Dicranoceros (Subgeneric division of *Cervus*).

The specimen (fig. 14) from a crag-pit near Sutton, Suffolk, is the base of a shed antler of a species of Deer, identical with, or nearly allied to—certainly belonging to the same section in the Deer tribe as—the *Cervus dicranocerus* of Kaup. The absorbed basal surface is slightly convex, subcircular, 1 inch in long diameter; the base of the antler extends from 2 to 3 lines beyond it: in one half of the circumference, the base is continued with a mere convex bend into the ascending beam; in the other half it projects outward, at first slightly, then more prominently, forming a ridge or "burr," which extends 4 lines from the margin of the absorbed surface. The proportion of the absorbed, and formerly adhering, part of the base to the non-adherent part of the base indicates that the antler was supported by a persistent bony process of the frontal, or by a pedicle, as in the *Cervus anocerus*, Kaup (probably identical with the *Dorcatherium*, Kaup), and in the existing Muntjac. The beam is 2 inches in length before it divides; and it is more extensively and deeply excavated on one side (the excavation widening to the division) than on the other. The antler is marked by longitudinal grooves and a few low ridges, but is equally devoid, with the Darmstadt specimens, of any of the tubercles which characterize the antlers of the Roe. The length from the base to the broken end of the main branch is 3 inches 3 lines; the circumference of the beam above the base is 3 inches 5 lines.

From the same Red-crag pit, I have received a left lower true molar, fig. 15, with proportions of the lobes and their crescents more resembling those of *Cervus* than of other genera of *Ruminantia*,—in the greater angular production *e. g.* of the outer crescents, *e*, *e*, and the greater proportion of dentine between the apex of the triangle and

* Kaup, Description d'Ossemens Fossiles de Mammifères de Darmstadt, 4to 1839, tab. 24. figs. 3, 3 *c*.

the base formed by the enamel-islands. There is a low accessory tubercle at the bottom of the cleft between the two outer crescents*.

A second specimen of antler, from a crag-pit near Felixstow, is larger than the foregoing, but offers the same characteristics. The beam is rather shorter in proportion to its girth above the burr; it is 2 inches long and 4 inches in girth; but it shows the same convexity at the side next the burr and the same concavity on the opposite side. It has been a shed antler; the slightly convex, absorbed surface bears the same proportion to the entire base of the antler as in fig. 14; the burr, in like manner, is limited to, or chiefly developed from, one half of the circumference of the base, where it has projected from 3 to 4 lines beyond the line of attachment.

Assuming one and perhaps the chief use of the burr to be to defend the subjacent skin from abrasion, in actions of the antlers when they are strongly rubbed from above downwards against a hard body—and were it not for such projecting ledge, such actions might peel off the skin where it abruptly terminates at the circumference of the basal adhesion of the antler to the skull,—I infer, from the partial development of the burr in the *Dicranoceros* of the Red-crag, that the pedicle supporting the antler was so oblique as to render such defence necessary only on one—probably the anterior and outer—side of the antler.

M. Gervais has figured, pl. 7. fig. 1. *op. cit.*, a shed antler of a Deer having the same short, simply bifurcated form as the *C. dicranocerus* of the Eppelsheim miocene and the Suffolk crag. It is rather more slender in proportion to its length; the burr, according to the figure, shows the same partial development from one-half of the basal circumference. The fossil is from the lower pliocene (marine sands and blue and yellow marls) of Montpellier. The accomplished French naturalist refers this bifurcate antler to the *Cervus australis* of M. de Serres.

Similar bifurcated antlers, probably not materially differing from the foregoing, or from the *Cervus dicranocerus* of Kaup, except in having been found attached to their supporting bony pedicles, form the type of the subgenus "*Dicroceros*" of M. Lartet, and occur in the miocene lacustrine molasse at Sansan, Gers.

The largest portion of antler of the *Cervus dicranocerus* which I have, as yet, received from the Suffolk crag-pits, is 4 inches in length, and the preserved part of the main branch of this antler is continued in a more direct line from the base than is either of the divisions of the best-preserved antler figured by Kaup, tab. 24. fig. 3 *c*, *op. cit.* The example of the *Cervus dicranocerus*, from a crag-pit near Ipswich, Suffolk, fig. 16, sends off the smaller or subsidiary fork a little nearer the base than in the smaller specimens; the base, however, shows well the same characteristic partial development of the burr, *a*, *a*, as in the other fossils. The circumference of the antler, above the burr, is 4 inches 9 lines; the breadth of the burr is from 5 to 6 lines, being proportionally more than its vertical thickness,

* See the figures of the modifications of homologous similar molars in my 'Odontography,' pl. 134. figs. 1–8, fig. 5 being that of the *Cervus megaceros*.

as compared with the burr in the *Cervus elaphus*. The length of the beam to its bifurcation is only 2 inches.

The individual variations in size and proportion which the crag-specimens of fossilized and more or less rolled antlers of the *Cervus dicranocerus* have presented are not greater than those observed in antlers of different individuals and of different ages of the Fallow or Red Deer.

Fig. 17 *a*, *b*, are views of an upper molar, of probably the *Cervus dicranocerus*, from the same crag-pit as the foregoing antler.

Megaceros (Subgenus of *Cervus*).

A very interesting evidence of the Deer-tribe from the Red Crag of Suffolk is the base of the left antler (fig. 18), which had been shed, of a deer as large as the *Megaceros hibernicus* or of the *Strongyloceros spelæus**.

In the relative size and position, immediately above the burr, of the origin of the brow-snag, in the absence of a second snag at the distance above the brow-snag where such second snag arises in the *Strongyloceros spelæus*, in the commencing flatness of one side, and expansion, of the beam at the broken end, eleven inches from the burr, this crag-fossil resembles the corresponding part of the antler of the Great Irish Deer (*Megaceros hibernicus*). The circumference of the burr is 11 inches. In colour and ponderosity this remarkable fossil agrees with the ordinary fossils of the Red Crag.

I have had similar evidence of the *Megaceros* from the pleistocene brick-earth of Essex, but equally agreeing in colour and mineral characters with the fossil bones of the Mammalia usually occurring in that formation.

Order Carnivora.

Of this order I have received clear evidences of the genera *Ursus*, *Felis*, and *Canis* from the Red Crag. Some more or less imperfect and waterworn canine teeth indicate other genera, as *Phoca*, and apparently a species of the family *Viverridæ*, but do not yield safe ground for a decided reference. I therefore limit my present notice to those molar teeth which satisfactorily determine, at least, genera of the *Carnivora*.

Genus *Felis*.

This genus is represented by a lower sectorial or carnassial tooth resembling in size and other characters that of the *Felis pardoides* of the 'Brit. Foss. Mamm.' p. 169, fig. 66. The specimen, from a Red-crag pit, five miles from Newbourn, consists of the crown and base of the fangs, most of which are worn away, of the lower carnassial or sectorial molar, fig. 19. The two compressed triangular, trenchant, and pointed lobes of the crown have the same near equality of size, as in the corresponding fossil from Newbourn†.

* History of Brit. Fossil Mammals, p. 469, figs. 193, 194.

† *Ib.* p. 169, fig. 66.

As the strata of the Red Crag at that village, from which the mammalian fossils originally determined by me* were obtained, were traversed by vertical fissures, Sir Charles Lyell in his description of the formation remarks:—"It might be suggested, that the mammalian relic was possibly derived from the contents of one of the fissures, the filling of which was an event certainly posterior, and perhaps long subsequent, to the era of the deposition of the crag†."

The subsequent discovery of a feline carnassial tooth of the same size, and apparently species, as that of the *Felis pardoides*, adds satisfactorily to the high probability—founded upon the original feline tooth having undergone the same process of trituration and impregnation with colouring matter as the associated bone and teeth of fishes known to be from the regular strata of the Red Crag—that the *Felis pardoides* is a fossil of that period. The *Felis antediluviana* of Kaup, from the miocene sand at Eppelsheim, and the *Felis pardinensis* of Croizet and Jobert, from the miocene strata of Auvergne, correspond in size with the *Felis pardoides* of the Red Crag of Suffolk.

The lower sectorial tooth, fig. 20, deviates from the feline type, and approaches that of the carnassial in the Glutton, Hyæna, and Grison; but with a minor development of the hinder tubercle, and a major development of the outer cingulum. I suspect that we have, in this tooth, an indication of an extinct osculant genus, linking on the true Felines to the Hyæna or Musteline family. It closely resembles one of the teeth of the Miocene Carnivora to which the generic names *Hyænodon* and *Pterodon* have been given.

Genus *Canis*.

Three views (fig. 21) of a left upper carnassial tooth of a species of *Canis*, agreeing in size and shape with that of the Wolf (*Canis Lupus*), give an outside view, *c*; *a*, an inside view; and *b*, a view of the fore part of the tooth, from which the two fangs, outer and inner, of that part ascend. I am unable to detect any character by which I could positively distinguish this tooth from that of the existing Wolf, or of the species found in our bone-caves and pleistocene deposits. The specimen presents the usual characters of the crag-fossils, and was obtained from a crag-pit near Woodbridge. A portion of the lower jaw of a species of *Canis* from the same pit is figured at fig. 22, *a*, *b*.

Genus *Ursus*.

The Ursine genus is represented by an antepenultimate grinder of the right side, upper jaw, of a Bear, somewhat smaller than the corresponding tooth of the *Ursus spelæus*. The fossil in question was obtained by Mr. Colchester from the Red Crag at Newbourn, near Woodbridge, Suffolk. The specimen is now in the collection of the Rev. Edward Moore, of Bealings, near Woodbridge.

* Ann. of Nat. Hist. vol. iv. 1840, p. 185. † *Ib.* p. 186.

Order Cetacea.

By far the greatest proportion of the mammalian fossils from the Red Crag belong to this order. In reference to the largest specimens, I have little to add to the description of the fossils on which were founded the species of *Balæna* (*Balænodon*?) *affinis*, *Bal. definita*, *Bal. gibbosa*, and *Bal. emarginata*, in the 'Hist. of British Fossil Mammals' (pp. 526–542). Mr. James Carter of Cambridge submitted to me, July 1850, two pairs of *Cetotolites* from Sutton, differing from the *Bal. emarginata* in the thicker and squarer form of the greater end of the tympanic bone. The Rev. R. K. Cobbold has showed me a series of silicified fragments of *Balæna gibbosa*, and cetacean ribs, collected from the Red Crag in the parish of Sutton, where it is separated from Felixstow by the River Deben.

The front part of the atlas of a cetaceous animal, which must have been from 30 to 40 feet in length, was obtained by the Rev. Prof. Henslow, in 1855, from the Red Crag at Woodbridge, Suffolk.

Waterworn teeth, corresponding in size and form to the singular teeth from the marine miocene deposits of the "Département de la Drôme," figured by Gervais, in pl. 20 of his 'Paléontologie Française,' under the name of *Hoplocetus crassidens*, have been discovered in the Red Crag of Suffolk, and transmitted for my inspection.

Teeth corresponding in character with those of the Grampus (*Phocæna Orca*) have also reached me from the Red Crag. One specimen, from a crag-pit at Bawdsey, with a less expanded fang than ordinary, is figured at fig. 23.

Petro-tympanic bones of a species of *Delphinidæ*, about the size of the Grampus, and some of a smaller species, have been obtained from the Red Crag.

Portions of a long, slender, gradually attenuated, edentulous, upper jaw have been transmitted to me, by Mr. Edwards of Bunhill Row, from the Red Crag near Woodbridge, Suffolk: the specimen, fig. 24, from the Red-crag at Felixstow, was submitted to me by Mr. G. Ransome. They belong to that family of *Delphinidæ* of which the genus *Ziphius* is the type, and very closely resemble the species from the crag of Antwerp described by Cuvier* under the name of *Ziphius longirostris*, now forming the genus *Dioplodon* of Gervais. The original fossil from Antwerp appears to have been in a similar mineralized condition to those from our own Red Crag. Cuvier describes it as being "petrified and very heavy." MM. Gervais and Van Beneden distinguish the Antwerp Crag fossil in question from the true *Ziphius longirostris*, Cuvier, under the name of *Dioplodon Becanii*. They believe it to have come from a 'molasse' formation†. There is not enough of the upper jaw preserved in the Suffolk Crag fossils to enable me with certainty to pronounce on their specific identity with, but I have no doubt of their belonging to the same genus as, the Antwerp fossil. They are equally edentulous in respect of the upper jaw.

* Ossemens Fossiles, tom. v. (1823), p. 356, pl. 27. figs. 9 and 10.

† "Elle semble provenir d'un terrain de molasse," Pal. Franç. p. 155.

The following extinct species of *Delphinus* are given by M. Gervais in the 'Paléontologie Française' :—

D. pseudodelphis, from the miocene molasse at Vendargues;

D. Dationum, from the miocene formation at Dax; and

D. Renovi, from the miocene molasse of the Département de l'Orne. M. Pictet refers the formation in which were found the fossil *Ziphius longirostris* of Cuvier (*Dioplodon*, Gervais) to the marine molasse of the miocene period.

Conclusion.—From the foregoing details it will be seen that the researches now applied during fifteen years to the mammalian fossils of the Red Crag of Suffolk have led to the very interesting result, that the majority of them are identical, or closely correspond, with miocene forms of Mammalia, and especially with those from the Eppelsheim locality, described by Prof. Kaup. In Suffolk, as in Darmstadt, we find the *Mastodon longirostris*, *Rhinoceros Schleiermacheri*, *Tapirus priscus*, *Sus palæochœrus*, and *Cervus dicranocerus*, associated together, in the same formation; and, with these miocene forms of extinct Mammalia in the Red Crag, we have, likewise, a Cetacean which most closely resembles a miocene species of that order, previously recognized in the crag or molasse of the continent. At the same time there are, as *e. g.* in the *Megaceros*, specimens of newer pliocene or pleistocene forms of Mammalia mingled with the older tertiary species; whilst on the other hand eocene forms of fish, as *e. g. Edaphodon*, with *Myliobatidæ* and eocene Crustacea, have been obtained from the Red-crag pits.

As, however, several of the Mammalia which occur in miocene formations are also found in the older pliocene deposits in parts of France, it would be rash, perhaps, to pronounce positively on the miocene age of any of the above-cited crag-fossils; but it is certain that the majority of those mammalian fossils, and by far the greatest proportion of individual specimens, belong to an older tertiary period than the Mammalia of the newer pliocene drifts, gravels, brick-earths, and bone-caves.

DESCRIPTION OF THE FIGURES.

Fig 1. Grinding surface of right upper molar (probably the third) of the *Rhinoceros Schleiermacheri*? (From a Crag-pit, Wolverton, Suffolk; communicated by W. C. Maclean, Esq., Collector of Customs at Woodbridge.)

Fig. 2. Grinding surface of the inner portion of the crown of a right upper molar of the *Rhinoceros Schleiermacheri*? (From a Crag-pit, Felixstow; communicated by George Ransome, Esq.)

Fig. 3. Grinding surface of a left upper molar of the *Rhinoceros Schleiermacheri*? (From a Crag-pit, Felixstow; communicated by W. C. Maclean, Esq.)
In these upper molars are marked—*a* the hinder valley, *b* the inner or front valley, *c* the inner end of the front lobe, *c'* the inner end of the back lobe, *d* the front angle, *d'* the ridge, *d''* the back angle of the outer surface, *f* the cingulum or basal ridge.

Fig. 4. Grinding surface of a right lower molar of the *Rhinoceros Schleiermacheri*? (From a Crag-pit, Sutton; communicated by W. C. Maclean, Esq.)

Fig. 5. Grinding surface of a left lower molar of the *Rhinoceros Schleiermacheri*? (From a Crag-pit, Felixstow: communicated by G. Ransome, Esq.) In these lower molars are marked—*a* the outer side of the front lobe, *b* the outer side of the back lobe, *c* the front ridge, *d* the mid ridge, *e* the back ridge, of the grinding surface, *f* the front valley, *g* the back valley.

Fig. 6 *a*. Grinding surface of unworn crown of a right lower molar of the *Rhinoceros Schleiermacheri*? (From a Crag-pit, Sutton; communicated by George Ransome, Esq.)

Fig. 6 *b*. Anterior surface of the same.

Fig. 6 *c*. Posterior surface of the same.

Fig. 7. Grinding surface of second lower molar, right side, of the *Rhinoceros Schleiermacheri*? (From a Crag-pit, Sutton; communicated by W. C. Maclean, Esq.)

Fig. 8 *a*. Grinding surface of a lower molar tooth of the *Tapirus priscus*, Kaup. 8 *b*. Side view of the same. (From a Crag-pit, Sutton; communicated by W. C. Maclean, Esq.)

Fig. 9. Upper molar of *Tapirus priscus*. (From a Crag-pit, Suffolk: British Museum.)

Fig. 10. Grinding surface of the last left upper molar of the *Sus palæochærus*. (From a Crag-pit at Sutton; communicated by W. C. Maclean, Esq.)

Fig. 11. Part of a molar tooth of the *Sus antiquus*? (From a Crag-pit at Ramsholt; communicated by W. C. Maclean, Esq.)

Fig. 12 *a*. An upper molar of the *Equus plicidens*? (From a Crag-pit at Bawdsey; communicated by Sir Charles Lyell.)

Fig. 12 *b*. Polished section of the grinding surface of the same tooth.

Fig. 13, *a*, *b*. A much-worn lower molar of a species of *Equus*: *a*, grinding surface; *b*, side view. (From the Fluvio-marine Crag at Norwich; communicated by W. C. Maclean, Esq.)

Fig. 14, *a*, *b*. Portion of a shed antler of the *Cervus dicranocerus*; *b*, base of the same. (From a Crag-pit, Sutton; communicated by George Ransome, Esq.)

Fig. 15. Grinding surface of a lower molar of the *Cervus dicranocerus*? (From a Crag-pit, Sutton; communicated by Ed. Acton, Esq.)

Fig. 16. Oblique basal view of a portion of a shed antler of a larger individual of the *Cervus dicranocerus*. (From a Crag-pit near Ipswich; communicated by George Ransome, Esq.)

Fig. 17 *a*, side view, 17 *b*, grinding surface, of an upper molar of the *Cervus dicranocerus*? (From the same pit; communicated by George Ransome, Esq.)

Fig. 19. The lower carnassial tooth of the *Felis pardoides*. (From a Crag-pit, Newbourn; communicated by W. C. Maclean, Esq.)

Fig. 20. The lower carnassial tooth of a Carnivore, allied to *Hyænodon* and *Pterodon*. (From a Crag-pit, Woodbridge; communicated by Ed. Acton, Esq.)

Fig. 21. The left upper carnassial tooth of a species of *Canis*: *c*, outer side; *a*, inner side; *b*, fore-part. (From a Crag-pit, Woodbridge; communicated by Ed. Acton, Esq.)

Fig. 22, *a*, *b*. Two views of a portion of the lower jaw of a species of *Canis*. (From a Crag-pit, Woodbridge; communicated by Ed. Acton, Esq.)

Fig. 23. The tooth of a Grampus (*Phocæna*, sp. ind.). (From a Crag-pit, Bawdsey; communicated by W. C. Maclean, Esq.)

Fig. 24. Portion of the upper jaw of the *Ziphius* (*Dioplodon*, Gervais). *a*, Section of the smaller end of ditto. (From a Crag-pit, Felixstow; communicated by George Ransome, Esq.)

All the foregoing figures are of the natural size.

Fig. 18. The base of the antler of the *Megaceros hibernicus*, one-third the natural size: *a*, the surface from which the brow-antler had been broken off. (From a Crag-pit at Felixstow; communicated by George Ransome, Esq.)

Fig. 1.

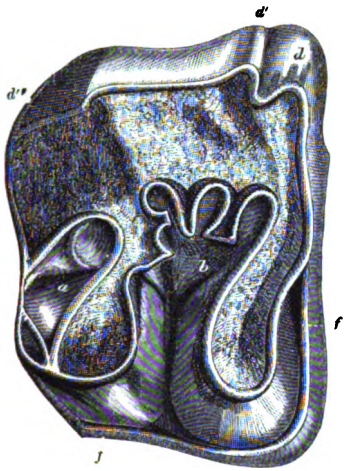


Fig. 2.

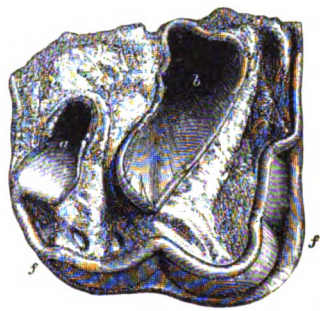
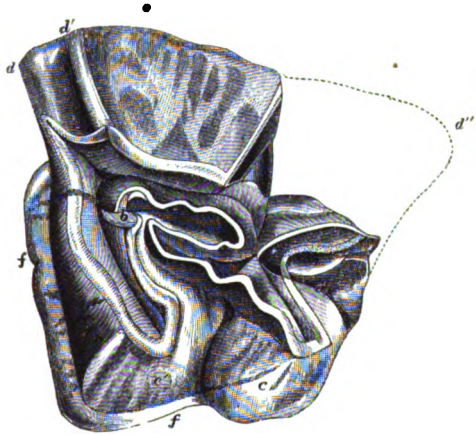


Fig. 3.



Mammalian Remains from the Red Crag.

Fig. 4.

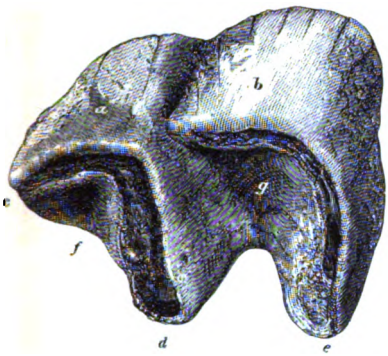


Fig. 5.

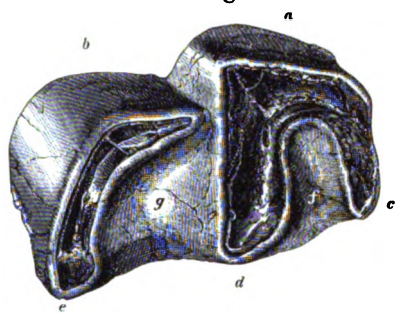


Fig. 6 *a*.

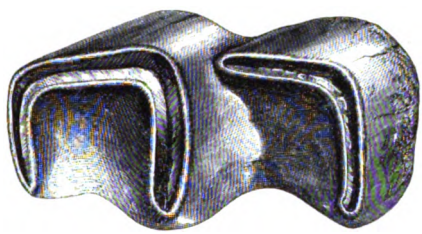


Fig. 6 *c*.

Fig. 6 *b*.

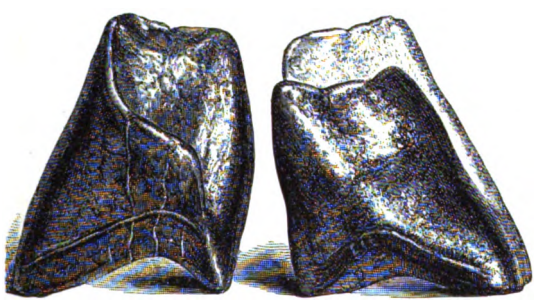


Fig. 7.

Mammalian Remains from the Red Crag.

Fig. 8 *a*.

Fig. 8 *b*.

Fig. 9.

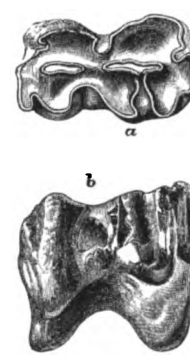
Fig. 10.

Fig. 11.

Fig. 12 *a*.

Fig. 12 *b*.

Fig. 13.



Mammalian Remains from the Red Crag.

Fig. 14 *a*.

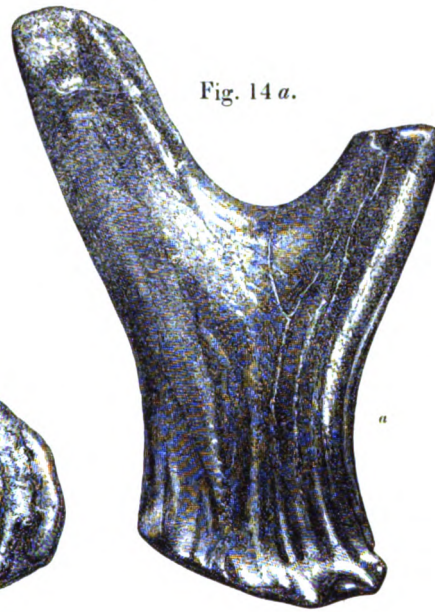


Fig. 14 *b*.

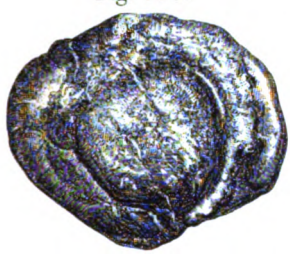
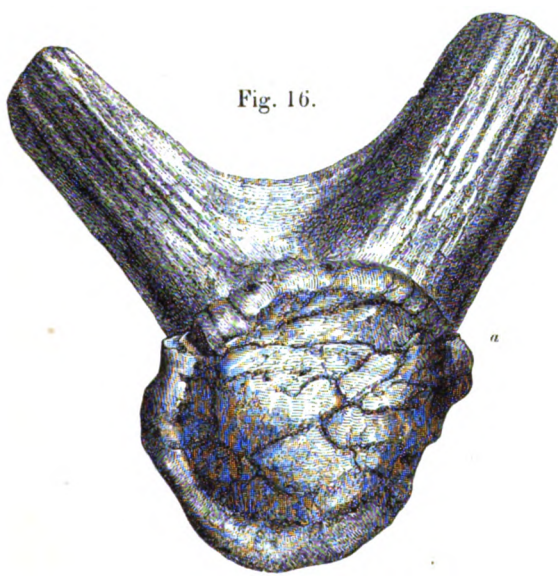


Fig. 16.



Mammalian Remains from the Red Crag.

Fig. 18.

Fig. 15.

Fig. 17 *a*.

Fig. 17 *b*.

Fig. 19.

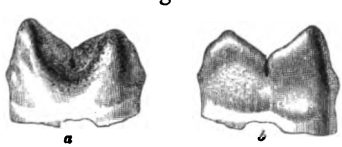
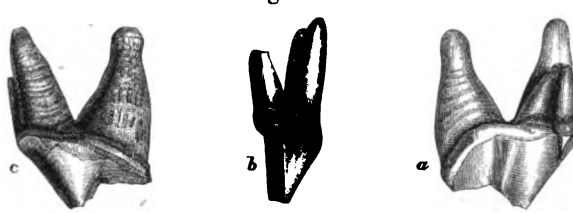


Fig. 20.

Fig. 21.



Mammalian Remains from the Red Crag.

Fig. 22.

Fig. 24.

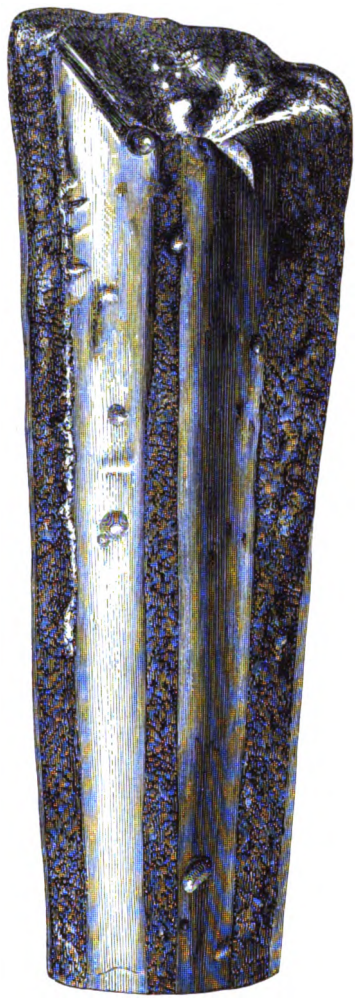
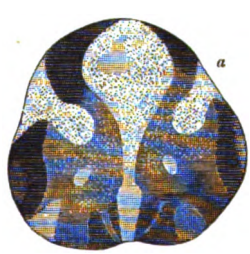


Fig. 23.



Mammalian Remains from the Red Crag.