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ON

THE AFFINITIES

OF

THE STEREOGNATHUS OOLITICUS

(CHARLESWORTH),

A MAMMAL FROM THE OOLITIC SLATE OF STONESFIELD.

BY

PROFESSOR OWEN, F.R.S., F.G.S. &c.

[PLATE I.]

THE Rev. J. P. B. Dennis, F.G.S., lately did me the favour to place in my hands, for examination, the portion of jaw with teeth, imbedded in the oolitic slate of Stonesfield, Oxfordshire, which he had, two years before, submitted to Mr. Charlesworth of York, by whom the fossil was introduced to the notice of the Geological Section of the British Association at the meeting at Liverpool in 1854.

The portion of bone exposed to view is about 9 lines in extent, and is part of a ramus of the lower jaw, containing three molar teeth (Pl. I. figs. 1 & 2).

It is nearly straight; the side exposed is convex vertically, which indicates it to be the outer side; a slight bend downwards, and decrease of vertical diameter, towards the end A, indicate it to be part of a left ramus; the slight inclination of the cusps of the teeth (figs. 1, 3, & 4) towards the end A, might be deemed evidence of its belonging to the right ramus: but neither this degree of inclination, nor the position of the accessory cusp, fig. 3 *a*, are decisive of the way in which the fore end of the fragment points*. Not more of the matrix can be safely meddled with, on the small chance of more evidence to this comparatively unimportant point being had; and I shall, therefore, proceed with the description of the fossil on the assumption that the shallower end, A, is the front end, the deeper one, B, the hind end of the fragment, and that it is part of the left ramus of the mandible.

This ramus is unusually shallow, and broad or thick below, the side passing by a strong convex curve into the lower part; a very narrow longitudinal ridge, continued after its subsidence by a few fine lines, forms a tract which divides the lateral from the under surface: elsewhere the bone is smooth, without conspicuous vascular perforations. The depth or vertical diameter of the ramus is not more than two lines.

This portion of jaw contains three teeth, the middle one of which is the least mutilated; and by carefully removing the matrix which partly covered its crown, I exposed the whole of its singularly modified grinding surface. The first of the three teeth (figs. 1 & 2, *a*) appears to have been smaller than the others, but its crown has been too much broken to show its original characters. The third tooth, *c*, is less mutilated: it is of the same size and had the same structure as the middle one, *b*. Of this, the most perfectly preserved of the three, *b*, careful drawings have been made, magnified about 8 diameters, figs. 3, 4 & 5.

The crown of this tooth is of a quadrate form, 3 millimeters by $3\frac{1}{2}$ millimeters, of very little height, and supports six subequal cusps, in three pairs, each pair being more closely connected in the antero-posterior direction of the tooth than transversely.

The outer side of the crown (fig. 3), supported by a narrow fang which contracts as it sinks into the socket, shows two principal cusps or cones, *o*, *o'*, and a small (anterior) accessory basal cusp, *a*. A small portion of the outer side of the anterior cone, *o*, has been chipped off; that of the second cone, *o'*, shows a well-marked convexity. The hard and shining enamel which covers these parts of the crown contrasts with the lighter cement that coats the root, fig. 3, *r*. The two outer lobes or cones are subcompressed, and placed obliquely on the crown, so that the hinder one, *o'* (fig. 5), is a little overlapped externally by the front one, *o*, the fore part of the base of the hinder one being prolonged inwards on the inner side of the base of the front cone. The two middle cones (fig. 5, *h*, *i*) are subcompressed laterally, with the fore part of their base a little broader than the back part. The two inner cones, *p*, *p'*, have their inner surface (fig. 4) convex, with their summits slightly inclined forwards: a small portion of enamel has been chipped off the hinder lobe, *p'*.

* Compare the tooth, *m* 2, fig. 2 (*Hyopotamus*), Plate VIII., 'Quart. Journ. Geol. Soc.' vol. iv. 1848.

The fore part of the base of the hinder cone (fig. 5, p') is prolonged obliquely towards the centre of the crown, beyond the contiguous end of the base of the front cone, p, so as to cause an arrangement like that of the two outer cones, o, o': the obliquity of the posterior cone of both the outer and the inner pairs, o' and p', being such that they slightly converge as they extend forwards.

In the hindmost tooth, *c*, the two outer cones are broken off, showing that their common base is divided from the two middle cones by a deeper groove than that which separated the two outer cones from each other.

Thus the crown of these molars might be described as supporting three parallel antero-posterior ridges; the outer (fig. 5, o, o') and the inner, p, p', ridges being each divided by an oblique cleft converging forward toward the middle of the tooth; whilst the middle ridge, h, i, is divided by a curved cleft having its concavity turned forward.

The more mutilated state of the front tooth (fig. 2, *a*), of which only the base of the middle ridge of the crown remains, throws no additional light on the modifications of the very remarkable type of the grinding surface of the mandibular molars of the *Stereognathus*.

This type of tooth differs from that of all other known recent or extinct Mammals. The nearest approach to it is made by the true molars of some of the extinct Mammals from the most ancient of the tertiary strata, *e. g.* the *Hyracotherium* and *Hyopotamus*; but, in these genera, only in the molars of the upper jaw.

The two transverse ridges of the molars of the Manatee are each, when first formed, divided into three tubercles; but the clefts are so shallow that they are soon worn down, and a transverse strip of dentine bordered by enamel is exposed. In the *Stereognathus* the longitudinal clefts are deeper than the transverse one, and the result of abrasion would be to produce three antero-posterior strips of dentine, instead of two transverse ones. Nevertheless the temporary sex-cuspid character of the molars of the Manatee is interesting from being coupled with a short or low crown, and with a character of lower jaw, thick and rounded below, like that of the *Stereognathus*; but the ramus is proportionally deeper in the Manatee.

In the last upper molar of the Rat, before it is much worn, there are two transverse rows of three tubercles, but there is also a hinder lobe of two tubercles.

The ante-penultimate and penultimate lower molars of the Hedgehog (*Erinaceus*) show five or six cusps, but they are small, and only two occur on the same transverse line: the same remark applies to the multicuspid molars of the Shrews, the Galeopitheci, and a few other Insectivora.

In the upper true molars of the *Hyracotherium* * we have three pairs of cones, each pair being in the antero-posterior direction of the crown, and there being, consequently, two transverse rows of

* British Fossil Mammals, p. 419, cuts 165, 166; and Geol. Trans. 2 ser. vol. vi. pl. 21. figs. 1, 2.

three cusps, as in the *Stereognathus*; but the middle pair of cusps in the *Hyracotherium* are very small, appearing, in fact, as mere conical tubercular elevations of the middle of the ridge connecting the fore part of the base of the outer and inner principal cones.

In the *Hyopotamus* and *Anthracotherium**, the intermediate cone between the outer and inner principal cones of the anterior half of the molar tooth is developed to equality of size with them, and three cusps or cones are thus seen on the same transverse line of the crown. But there is no trace of the middle cone or tubercle (like that seen in fig. 5, *i*, between the outer, *o*′, and inner, *p*′, hinder cones), answering to the rudimental cusp in *Hyracotherium* and to the cone *i* in *Stereognathus*.

In the little *Microtherium* or *Cainotherium* of the miocene deposits of Germany and France the middle lobe or cone is developed between the pair at the back part of the upper molar, answering to cone *i* in fig. 5; but the cone answering to *h*, fig. 5, is not developed between the front pair of cones. This tendency, however, to lobes, cones, or cusps, in threes, in the older tertiary Mammals, is very significant evidence, as it seems to me, of the affinities of the small oolitic mammal having the above-described regular sex-cuspid molars.

The molars of the lower jaw of the *Hyopotamus* and other Anthracotherioids show no trace of a lobe or cone intermediate between the outer and inner cones of each transverse pair. The structure of the lower molars of the *Hyracotherium* is unknown: it is most probable, however, that the lower molars of the *Chœropotamus* would most resemble those of the Hyracothere; and in the penultimate and last grinders of the *Chœropotamus* a rudimental cusp appears between the outer and inner principal cusps.

The proportional size, and regularity of form, of the cones of the grinding teeth of the *Stereognathus* give a quite different character of the crown from that of the multicuspid molars of the Insectivora, and cause it to resemble more the quadricuspid or pentecuspid molars of the Artiodactyle non-ruminant extinct genera above cited.

I conclude, therefore, that, like the *Dichobunes*, *Xiphodon*, *Microtherium*, *Rhagatherium*, *Hyopotamus*, and *Hyracotherium*, the *Stereognathus ooliticus* was a diminutive form of the great Ungulate order of Mammalia, and that it most probably belonged to the artiodactyle or even-toed division of that order, and to the non-ruminant section of that division, the food of which, if we may judge from the existing hogs and peccaries, was of a mixed nature.

The interest which the above-described fossil from the Stonesfield oolitic slate excites is not exclusively due to its antiquity, its uniqueness, or its peculiarity: much arises out of its relations as a test, in the present state of Palæontology, of the actual value of a single tooth in the determination of the rest of the organization of an animal, or of so much of it as serves for a recognition of the place of the extinct species in the zoological series: the attempt, at least, to analyse the mental processes by which one aims at the restoration of

* Quart. Journ. Geol. Soc. vol. iv. pl. 7. figs. 1, 6, & 9.

an unknown Mammal from a fragment of jaw with a tooth cannot be wholly useless.

That the fragment in question is the jaw of a Mammal is inferred from the implantation of the tooth by two or more roots. Most Mammals are known to have certain teeth so implanted. Such complex mode of implantation in bone has not been observed in any other class of animals. The rule is deduced from the number of observations, positive and negative. Why two or more roots of a tooth should be peculiar to viviparous quadrupeds, giving suck, is not precisely known. That a tooth, whether it be designed for grinding hard or cutting soft substances, should do both the more effectually in the ratio of its firmer and more extended implantation, is intelligible. That a more perfect performance of a preliminary act of digestion should be a necessary correlation, or be in harmony, with a more complete conversion of the food into chyle and blood,—and that such more efficient type of the whole digestive machinery should be correlated, and necessarily so, with the hot blood, quick-beating heart and quick-breathing lungs, with the higher instincts, and more vigorous and varied acts, of a Mammal, as contrasted with a cold-blooded reptile or fish,—is also conceivable. To the extent to which such and the like reasoning may be true, or in the direction of the secret cause of the constant relations of many-rooted teeth discovered by observation,—to that extent will such relations ascend from the empirical to the rational category of laws. So much, briefly, at present, for the grounds of reference of the *Stereognathus* to the Mammalian class.

The broad sex-cuspid crowns of the molar teeth of the *Stereognathus* might crush vegetable matter or insect-cases: a recognition of their adaptability to uses observable in the nearest resembling teeth of existing animals leaves the above wide field of choice, or guess, as to the nature of the food of the oolitic animal. Let us take the latter hypothesis, and endeavour to work out more of the *Stereognathus* on the basis of its multicuspid and assumed insectivorous tooth. Insects fill the air, creep on the ground, burrow in the earth, move on and in the waters. In the living world of animals we have insectivorous molars associated with a frame and limbs modified for flying, running, burrowing, and diving. The principle of the mechanism for crushing insects being the same, it is secondarily modified in each genus of Insectivora; and so modified, though without affecting the crushing power of the tooth, that the odontologist discriminates at a glance the grinders of the Bat, the Hedgehog, the Shrew, or the Mole.

At present we can only refer such secondary modifications, as we do those of the more complex grinding teeth of the Herbivora, to that principle of *variety in non-essentials* which makes the leaf in each kind of tree unlike, and, as it is affirmed, which makes no two leaves, in any single tree, exactly alike.

If the tooth of the *Stereognathus* were like those of any known recent or fossil Insectivore, we should infer that the rest of its organization was like such Insectivore, and so classify it according to the degree of similitude. But as we know of no sufficient ground for the association of any given particular modification of the multicuspid tooth with such aërial, terrestrial, or aquatic modification, as the case might be, of the rest of the frame, our conclusion would be an empirical one ; and, having regard to the narrowness of its support from observation, would not be such as to leave the mind free from a sense of the possibility of its being liable to be proved to be an erroneous conclusion. On the hypothesis of the *Stereognathus* being an Insectivore, there is no known group or form of marsupial or placental Insectivora to which it can be referred.

The course of observation has shown that the teeth of the smaller kinds of hoofed Herbivora, such as the Peccari, the Hyrax, and the Chevrotains, approach in their cuspidate character, in the smaller amount of the cement, and in the simpler disposition of the enamel, to the form and structure of the teeth in the Insectivora. A nearer approach is made by some still smaller species of extinct hoofed quadrupeds, to which reference has been made in the body of this paper. The shape, disposition, and number of the cusps in the molars of the *Stereognathus* have appeared to me to be more like those in *Microtherium*, *Hyracotherium*, &c., than in any known recent or extinct Insectivore. Just in the ratio of this resemblance, therefore, is the inclination to view the *Stereognathus* as a hoofed rather than a clawed Mammal; as having been herbivorous rather than insectivorous, and as having been most probably a mixed feeder.

Physiology, or the known relations of organs to functions, helps me little in this determination: the small degree in which I feel the obligation is limited to the choice of the class: I acknowledge no aid from physiology in any degree of success with which I may have conjectured the nearer affinities of the *Stereognathus*. Can this example, we have then to ask, be justly cited as showing that there is no physiological, comprehensible, or rational law, as a guide in the determination of fossil remains ; but that all such determinations rest upon the application of observed coincidences of structure, for which coincidences no reason can be rendered? I do not believe this to be the case.

I feel in the workings of my own mind what I believe to have operated in other minds, an irresistible tendency to penetrate to the sufficient cause of such coincidences—" to know the law within the law."

In the ratio of the knowledge of the reason of the coincidences of animal structures—in other words, as those coincidences become "correlations" to my conception—is my faith in the soundness of the conclusions deduced from the application of such rational law of correlations; and with the certainty of such application is associated a greater facility of its application. A knowledge of the rational law, or of the physiological conditions governing the relations, of the contents of the cavities of bones to the flight and other modes of locomotion in birds, both enabled me to infer from one fragment of a skeleton that it belonged to a terrestrial bird deprived of the power of flight, and to predict that such a bird, but of less rapid course than the Ostrich, would ultimately be found in New Zealand*. The support

* Transactions of the Zoological Society, vol. iii. p. 32. pl. 3.

of this conclusion being the higher law of the correlation of animal forms, as defined by Cuvier, gave me the requisite confidence in its accuracy.

Comparative Anatomy, as it was advanced by Cuvier, demonstrated to him this fruitful principle of the correlation of animal forms and structures. It was no *à priori* assumption : the founder of Palæontology expressly states—" l'anatomie comparée possédait un principe —celui de la corrélation des formes dans les êtres organisés, au moyen duquel chaque sorte d'être pourrait, à la rigueur, être reconnue par chaque fragment de chacune de ses parties *."

If the principle be true, then in proportion as the correlations are known will be the success and extent of its application. That there is such a principle of correlation the most assiduous and successful cultivators of Comparative Anatomy since Cuvier defined it have admitted. His successor in the chair of Comparative Anatomy at the Garden of Plants thus paraphrases his predecessor's definition : " Doubtless there reigns throughout all the solid pieces that enter into the composition of the skeleton of a vertebrate animal, but especially of a mammalian one, an appreciable harmony of number, form, position, proportions,—in a word, a combination which must have as its result such or such a kind or peculiarity of locomotion : so that one can pretty well prejudge or foresee, at least within certain bounds, by a physiological knowledge, certain osteographical peculiarities and *vice versâ* †." The consequence of the premises is here somewhat lamely expressed, but the admission of the physiological principle of correlation of forms is unambiguous. Something more than "certaines particularités ostéographiques" have been and will be foreseen through the above-defined law.

In certain instances of constant coincidences of structure, as demonstrated by Comparative Anatomy, the sufficient, *i. e.* recognizable, intelligible, or physiological, cause of them is not yet known. But, as Cuvier in reference to such instances truly remarks, " Since these relations are constant, there certainly must be a sufficient cause for them ‡."

In certain other cases Cuvier believed that he could assign that 'sufficient cause,' and he selects as such the correlated structures in a feline Carnivore, and in a hoofed Herbivore. The physiological knowledge displayed by him in his explanation of the condition of those correlations I receive as true. Its application in the restoration of the *Anoplotherium* and *Palæotherium* is exemplary.

* Discours sur les Révolutions de la Surface du Globe, 4to, 1826, p. 47.

† " Sans doute qu'entre toutes les pièces solides qui entrent dans la composition du squelette d'un animal vertébré en général, mais surtout de celui d'un Mammifère, il règne une harmonie appréciable de nombre, de forme, de position, de proportions, en un mot une combinaison qui doit avoir pour résultat tel ou tel genre de translation, telle ou telle particularité de locomotion ; en sorte que l'on peut assez bien préjuger ou prévoir, dans certains limites du moins, par une connaissance physiologique, certains particularités ostéographiques, et *vice versâ*."—*De Blainville*, *Ostéographie*, fasc. 1. p. 33.

‡ " Puisque ces rapports sont constants, il faut bien qu'ils aient une cause suffisante."—*Op. cit.* p. 50.

This principle, however,—those modes of thought—which Cuvier affirmed to have guided him in his interpretation of fossil remains, and which he believed to be a true clew in such researches, were repudiated or contested by two of his contemporaries.

Geoffroy St. Hilaire denied the existence of a design in the construction of any part of an organized body: he protested against the deduction of a purpose from the contemplation of such structures as the valves of the veins or the converging lens of the eye.

Beyond the coexistence of such a form of flood-gate with such a course of the fluid, or of such a course of light with such a converging medium, Geoffroy affirmed that thought, at least his mode of thinking, could not sanely, or ought not, to go. Now this objection has, at least, the merit of being intelligible: we know on what ground the adversary stands and what he would be at.

From this frank assertion of the tenets of the Democritic and Lucretian schools, those concerned in the right conception and successful modes of studying organized structures by the Young have little to fear. But the insinuation and masked advocacy of the doctrine subversive of a recognition of the Higher Mind,—the oft-recurring side-blows at Teleology,—call for constant watchfulness and prompt exposure.

It is not, however, my business here to go over the arguments which have been adduced by teleologists and anti-teleologists from Democritus and Plato down to Cabanis and Whewell.

In the degree in which the reasoning faculty is developed on this planet and is exercised by our species, it appears to be a more healthy and normal condition of such faculty,—certainly one which has been productive of most accession to truths, as exemplified in the mental workings of an Aristotle, a Galen, a Harvey, and a Cuvier,—to admit the instinctive, irresistible impression of a design or purpose in such structures as the valves of the vascular system and the dioptric mechanism of the eye.

In regard to the few intellects,—they have ever been a small and unfruitful minority,—who do not receive that impression and will not admit the validity or existence of final causes in physiology,—I am disposed to consider such intellects, not as the higher and more normal examples, but rather as manifesting some, perhaps congenital, defect of mind, allied or analogous to 'colour-blindness' through defect of the optic nerve, or the inaudibleness of notes above a certain pitch through defect of the acoustic nerve.

M. De Blainville chiefly based his opposition to the Cuvierian principle of correlated structures as applied to Palæontology upon the mistakes which Cuvier had made in their application, and on the limits within which he had been bounded when successfully applying them. For, admitting that the carnivority of an extinct animal could be deduced from an ungual phalanx, he asks, "What bone of the hand would assure you that the humerus of such carnivora was perforated, or otherwise, above the inner condyle? What bone of the fore-limb would tell you whether there was a clavicle or not, or an os penis*?"

* De Blainville, *op. cit.* p. 36.

I do not cite the other objections adduced in the Introductory Chapter of De Blainville's "Ostéographie;" because the author is compelled to take away the force of most of them by excepting the very bone on which the Palæontologist would found, correlatively, his conclusions as to the subordinate structure in question; as, for example, the os sacrum with reference to the determination whether the fossil animal had or had not a tail, and the os trapezium with reference to whether a fossil monkey had or had not a thumb*.

The inapplicability of the law of correlation, as contradistinguished from that of coexistence, to foreshow all the peculiarities of an extinct animal, is no argument against its applicability to a less amount of reconstruction.

After you have built up your Carnivore or Herbivore in a general way, agreeably with the correlations so truly and beautifully followed out, in either case, by Cuvier, he expressly teaches the necessity of careful and close observation of those secondary coincident structures by which you will be able to penetrate more deeply into the affinities,—in other words, to know more particulars of the structure—of the Carnivore or Herbivore under restoration.

The argument, therefore, against the Cuvierian rules of reconstruction is plainly devoid of force, which is based upon the inability to reconstruct, when the data, *e. g.* the *sacrum* for the tail and the *trapezium* for the thumb, are expressly excepted, whereby alone such reconstruction can be completed agreeably with the Cuvierian method.

Yet these relative shortcomings in the appliance of the principle, together with the mistakes which Cuvier sometimes made, on secondary points of affinity, in his surmises, before the requisite data for comparison were at hand, continue from time to time to be cast in the teeth of the disciples of Cuvier, as arguments against the principles by which they believe themselves guided and sustained in their endeavours to complete the glorious edifice of which their master laid the foundations.

I know no writer who more clearly defines, than Cuvier†, the limits within which the law of correlation of animal forms may be successfully and satisfactorily applied, by virtue of a knowledge of its physiological condition; or who indicates more candidly the numerous instances in which—the physiological condition being unknown, and the law, therefore, empirical, or one of coincidences,—careful and extended observation and rigorous comparison must supply the place of the more direct application of the physiologically-understood law. Through faith in Cuvier's interpretation of the physiological conditions of the correlations that flow from a hoof-bearing modification of the last joint of the toe of an animal, I accept his conclusions as to the herbivority of the extinct quadrupeds which he has called *Anoplotherium* and *Palæotherium*, and retain the conviction unshaken by any

* "De tous les os qui entrent dans le squelette du Magot, quel est celui, *sauf le sacrum*, d'où l'on puisse déduire qu'il n'a pas de queue?" p. 35. "Quel os, *si ce n'est le trapézoïde*, pourra vous conduire à assurer qu'un Sapajou de la division des Atèles n'a pas de pouce?"—*Ib.* p. 35.

† Discours, &c. pp. 49–53.

speculations as to the ease and possibility with which such hoofed quadrupeds might ride down and slay another animal. A domesticated recalcitrant animal may disable or kill his master by a blow of the hoof, but he does not therefore devour him.

The truth or fact of a physiological knowledge of the condition of a correlated structure and of the application of that knowledge to Palæontology is not affected or destroyed by instances adduced from that much more extensive series of coincident structures of which the physiological condition is not yet known. Nor is the power of the application of the physiologically interpreted correlation the less certain, because the merely empirically recognized coincidences have failed to restore, with the same certainty and to the same extent, an extinct form of animal.

Certain coincidences of form and structure in animal bodies are determined by observation.

By the exercise of a higher faculty the reason, or a reason, of these coincidences is discovered and they become correlations; in other words, it is known not only that they do exist, but how they are related to each other.

In the case of coincidences of the latter kind, or of "correlations" properly so called, the mind infers with greater certainty and confidence, in their application to a fossil, than in the case of coincidences which are held to be constant only because so many instances of them have been observed.

Because the application of the latter kind of coincidences is limited to the actual amount of observation at the period of such application, and because mistakes have been made through a miscalculation of the value of such amount, it has been argued that a rational law of the correlation of animal forms is inapplicable to the determination of a whole from a part*; and it has not only been asserted that the results of such determination are unsound, but that the philosopher who believed himself guided by such law deceived himself and misconceived his own mental processes! But the true state of the case, as I believe it to be apprehended by the working palæontologists since Cuvier's day, is, that the non-applicability of his law in certain cases is not due to its non-existence, but to the limited extent to which it is understood.

The consciousness of that limitation led the enunciator of the law to call the attention of palæontologists expressly to the extent to which it could then be applied, as, for instance, to the determination of the class, but not the order, or of the order, but not the family or genus, &c.; and to caution them also as to the extent of the cases in which, the coincidences being only known empirically, he consequently enjoins the necessity of further observation, and of caution in their induction. Cuvier expresses, however, his belief that such coincidences must have a sufficient cause, and that cause once discovered, they then become correlations and enter into the category of the higher law. Future comparative anatomists will have that great consummation in view, and its result, doubtlessly, will be the

* De Blainville, *op. cit.* p. 34.

Fig. 3.

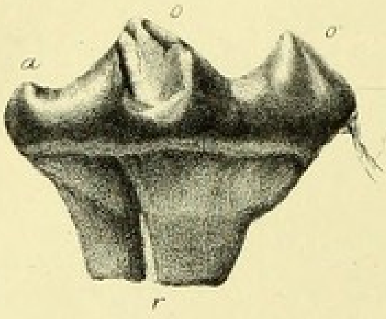


Fig. 4.

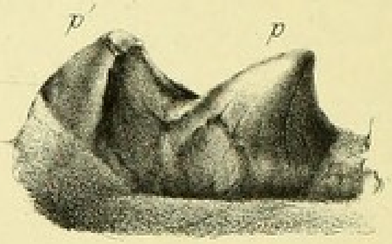


Fig. 5.

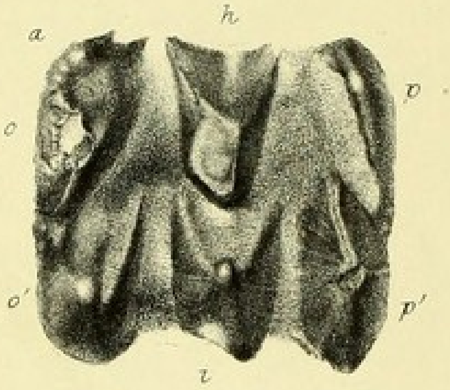
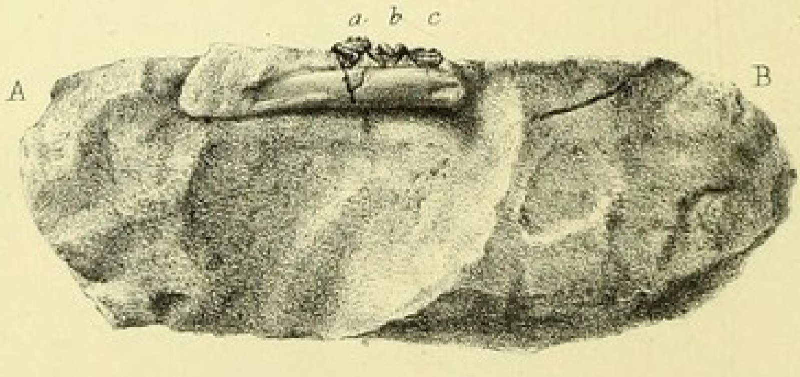


Fig. 2.

Fig. 1.



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W. West. Imp.

STEREOGNATHUS OOLITICUS. (Figs. 1 & 2 nat. size.)
from Stonesfield.

vindication of the full amount of the value of the law in the interpretation of fossil remains, as defined by the illustrious founder of Palæontology.

EXPLANATION OF PLATE I.

Stereognathus ooliticus.

Fig. 1. Side view of the portion of lower jaw and three teeth, with the matrix: nat. size.

Fig. 2. Upper view of the same: nat. size.

Fig. 3. Outer side of the middle one (*b*) of the three teeth: magnified 8 diameters.

Fig. 4. Inner side of the same, similarly magnified.

Fig. 5. Upper or grinding surface of the same tooth, similarly magnified.

[The letters are explained in the text.]