

486 Professor R. Burckhardt—On *Hyperodapedon Gordoni*.II.—ON *HYPERODAPEDON GORDONI*.

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(PLATE XIX.)

THE fossil to be discussed in the present memoir is the specimen which formed part of the classical material used in the discussion which was carried on amongst British geologists during the second half of the present century. So important a controversy could hardly be restricted to the geographical limits of England alone.

In the question of the age of the Elgin Sandstones, considered by Sir Roderick Murchison to be Palæozoic, it was Huxley who pronounced upon it finally,¹ after the discovery of and in his subsequent description of *Hyperodapedon*.² His decision in this geological controversy was given on the evidence derived from a far less perfect specimen than the one represented on Plate XIX. It also supplied Huxley with an opportunity for speculations concerning the affinities of the animal with *Sphenodon*, from New Zealand, a reptile which Dr. Günther had just then presented in all its scientific aspects. On the other hand, these speculations carried Huxley far out upon an ocean of geographical as well as of geological hypotheses.

A second specimen, which was obtained much later, afforded Huxley a welcome opportunity to supplement his earlier description of *Hyperodapedon* as regards its most prominent differences from *Sphenodon*, the details of its skull and diverse other anatomical points of no less importance. The motives which have impelled me to undertake a re-examination of the subject may appear scarcely obvious and require some explanation.

During the perusal of the literature relating to the Rhynchocephalians I was confronted very frequently by differences, essentially anatomical in character, tending to a separation of the Rhynchosauridæ from the Sphenodontidæ. In the first place I was unable to assign any valid reason for a closer relationship existing between them, whilst, on the other hand, the Rhynchosaurians appeared to me to possess characters important enough to justify the conclusion of a complete connection between Chelonians and the remaining Theromorphæ. Further investigation into the literature of the subject and the material available disclosed so many enigmas, that I at last decided to visit London and obtain permission to study the original specimens in the Natural History Section of the British Museum.

According to Huxley's illustration of the skull I expected the original object to be only a cast of the coarsest description, but in this I was speedily undeceived after a personal inspection, and to my great delight I perceived that I had one of the choicest of originals before me which grace the grand collection of fossil reptiles in the British Museum.

¹ Quart. Journ. Geol. Soc., 1859, vol. xv, p. 460.² Op. cit., 1887, vol. xliii, pp. 675–693, pls. xxvi–xxvii.



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Hyperodapedon Gordoni, Huxley; ventral aspect. One-fifth nat. size. The right anterior extremity being absent, the left, which is preserved in the counterpart, has been added to this plate. Original in the British Museum (Natural History).

I very much doubt whether it would have been possible to comply with my request in a more generous manner than was done by the respected Keeper of the Geological Department of the British Museum, Dr. Henry Woodward, F.R.S., to whom, as to Drs. A. Smith Woodward and C. W. Andrews, of the same Department, and to Mr. G. A. Boulenger, F.R.S., of the Zoological Department, it gives me the utmost pleasure to tender my heartiest thanks for their ever ready assistance and advice.

As might be supposed, a re-preparation of such a valuable original object was totally out of the question, though I have no doubt that, if performed with the necessary care, many minute anatomical details would be brought to light.

In my drawings, therefore, I filled in with black all those parts which were left untouched by the chisel like the rest of the matrix of the stone. The artist employed on Huxley's sketch has failed to convey any precise information as to which is stone and which is bone, and has produced as structures shapes which only existed in the imagination of the mason as having belonged to the skull itself.

In my drawing of the skeleton *in situ* I have carefully confined myself to a representation of the exposed portions of the actual bones, thus avoiding the risk of reproducing anything foreign to it on the face of the stone. This ought to remove all doubts that may exist as regards serious mistakes, especially where parts are concerned which are of importance.

An ordinary photographic reproduction of the fossil would not have been a great gain for the student, as the observer would have been under the necessity of making out the details of the actual fossil for himself, not to mention the disturbing effect of countless ochre spots which are distributed all over the surface of the matrix.

Plate XIX is a photographic reproduction of the entire skeleton, reduced to $\frac{1}{2}$ of its natural size, from the original in the British Museum. With the exception of the distal part of the left limb, which is better preserved on the counterpart, no other portions of the skeleton are seen on that slab. I therefore have transferred it from that side on to the plate also, as otherwise I should have had to dispense with its reproduction altogether. This plan, moreover, had the advantage of completing the representation of the skeleton in one view.

It should also be pointed out here that in consequence of having had recourse to photographs, the lower part of the leg, and the foot, are diminished in size by $\frac{1}{2}$ on account of the focal distance from the main portions of the skeleton, which further tends to increase the disparity already existing between the two extremities.

For a general description of the skeleton I would refer the reader to Huxley's memoir (see *Quart. Journ. Geol. Soc.*, 1887, vol. xliii, pp. 675-693, pls. xxvi and xxvii, and 8 text-figures). To this I am obliged to add merely that I feel by no means sure of his statement that the præ-sacral portion of the vertebral column terminates with the 23rd vertebra, or even with the 22nd; but of this I feel confident, that there are not twenty-four vertebræ, as

asserted by that author, who also gives the number in *Sphenodon* as twenty-five. Apart from this, the entire pelvic region appears to me to be scarcely well enough preserved to positively assign to it two sacral vertebrae.

Whether the above inference was possible from the first specimen at Huxley's disposal, or not, I do not know, as he does not express himself on this point in his first description of this portion of the skeleton of *Hyperodapedon* in Quart. Journ. Geol. Soc., 1859, vol. xv, p. 460. From analogy in *Sphenodon*, Huxley has estimated the length of its tail to be about 110 mm., though no reliable data are obtainable from the fossil itself. I would also wish to remark here that the sacral vertebrae are only $\frac{3}{4}$ the length of the hindmost thoracic vertebrae, and from this fact alone it may be seen that Huxley's computation of the length of the tail appears to be an over-estimate.

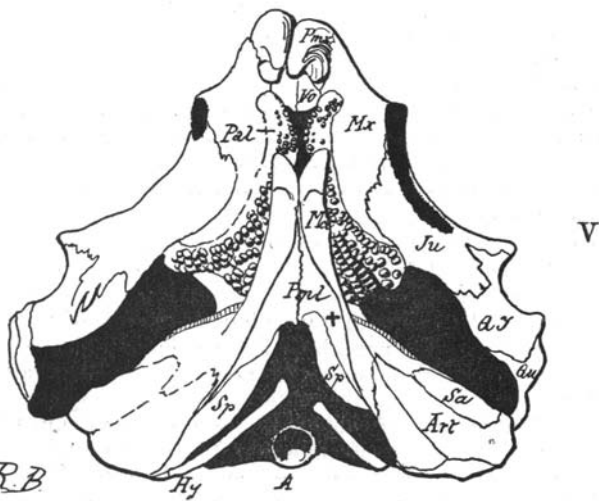
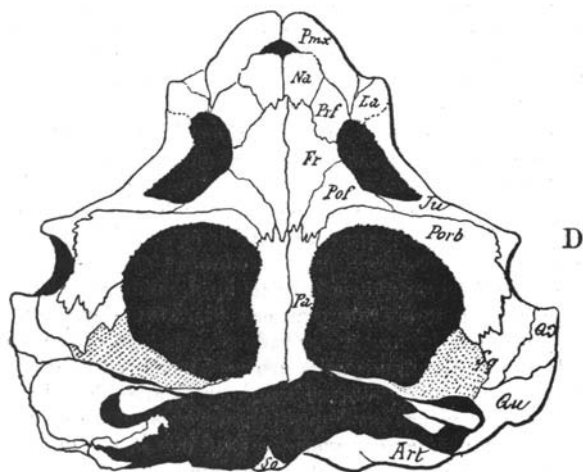
Of the remaining portions, the shoulder-girdle alone calls for some remarks here. The position assigned by Huxley to the inter-clavicle is the correct one, but there is an error as regards the spatulate shape of its posterior margin which requires modification. Posteriorly the episternum terminates in quill-like processes, separated from each other by a deep incision, as is the case in a great number of Lacertilians. Besides this, but noticeable only on the right side, its clavicular margin bifurcates into two pointed projections, as in *Rhynchosaurus*. The bone which Huxley designated the coracoid is really composed of two parts, the coracoid and the præcoracoid.

The most important part of this fossil is its skull, and it is here principally that I dissent from Huxley's interpretations. I therefore felt compelled to refigure and re-describe it, a proceeding to which I shall add also those inferences which I have been enabled to draw from other fragmentary specimens deposited in the British Museum (Natural History).

The general topography of the skull has been admirably rendered by Huxley. As a further adjunct to his admission that, although *Hyperodapedon* was essentially terrestrial in habits, yet it had at the same time a predilection for leading an aquatic life, may be mentioned the anomalous position of the orbits, which are so strangely directed upward and situated forward as to deserve to be specially pointed out here.

The first attempt towards a more precise knowledge of the component parts of the skull than that by Huxley was by Dr. A. Smith Woodward, who partly traced the boundaries of the nasals, the postorbitals, the jugular and other bones. It has been a great satisfaction to me, as the result of my endeavours to make out the sutures, to find myself so entirely in accord with Dr. Smith Woodward, without any deviations whatever, the more so as I did not consult his sketch at the time. Numerous fresh details having come to light, during a more protracted study of the fossil, a fresh illustration of the skull cannot be dispensed with under the circumstances. I have therefore executed the accompanying drawings from photographs taken by myself.

In these figures I have also blackened those parts of the matrix which have not yet been laid bare, in order to avoid any misconceptions arising from the supposed shape of the most important parts of the slab.



Outlines of the skull of *Hyperodapedon Gordoni*, dorsal (D) and ventral (V) aspects, from photographs and drawings by the author. One-half nat. size. A. atlas; Art. articular; Fr. frontal; Hy. hyoid; Ju. jugal; La. lachrymal; Md. mandibular; Mx. maxillary; Na. nasal; Pa. parietal; Pal. palatal; Pmx. premaxillary; Porb. postorbital; Pof. postfrontal; Prf. praefrontal; Pspl. praesplenial; Qu. quadratum; QT. quadratojugal; Sa. supra-angular; So. supraoccipital; Sp. splenial; Vo. vomer. The cross shows the centrum of crushing, which disordered the surrounding bones.

The general impression which these figures convey is that, even on a more complete development of the skull than has already been executed, the dorsal side, at any rate, would not present very massive proportions. Yet, the surfaces of the bones themselves are of a very hard and dense structure, and are possessed of ridges and protuberances which leave no doubt as to their homogeneity with the respective bones, even where their sutures are more indistinct. These anatomical characters are especially well defined on the maxillary and the jugular.

The sutures form slightly serpentine lines, except between the parietal and the præfrontal, where they are serrated. The præmaxillaries, which enclose the nasal cavity, as mentioned elsewhere, terminate caudally in blunted points, which are broken off, but the original form of which is preserved still as an imprint on the præfrontal. The margin of the nasal impinges somewhat on the median contours of the præmaxillaries, apparently to lend them additional strength, and to prevent their breaking out easily. Laterally they are held in position similarly, by a coarsely indented margin of the maxillary.

The limits of the lachrymals are more difficult of determination; firstly, because their ventral sides are embedded in the stone, and secondly, because their dorsal surfaces are damaged. Their existence, however, cannot well be doubted, if we may judge from analogy in *Rhynchosaurus*, where they are most clearly defined.

I fully concur with Dr. Smith Woodward in his determination of the middle of the cranium, although the lateral margin of the præfrontal appears to me to be clearly enough circumscribed.

Features actually new as to their interpretation appear again only behind the orbit, where the postorbital is conspicuous both by its shape, its position, and by being entirely excluded from participation in the orbital foramen. It forms the whole of the anterior portion, and part of the lateral contour of the temporal fossa. Its posterior end is unfortunately broken off, but no doubt can be entertained as regards its original shape, from the evidence supplied by the surface of its underlying squamosal, on which the outlines of its margin can be identified distinctly.

The squamosal itself is in a very imperfect state of preservation. It is connected with the præorbital, and participates in the formation of the supratemporal foramen; a ramus of the quadrato-jugular ascends to the latter, on the outer side of the squamosal. The squamosal is represented in its greater part only by the mould which it has left in the stone. It is quite probable that a posterior temporal fossa was formed by the squamosal and a branch of the quadrate bone, but on this point the information to be obtained from literature is of too vague a nature to allow our arriving at any definite conclusions thereon.

The quadrate itself is a broadish, disk-like bone, deepened in the centre. Its complete immobility can be ascertained from the fact that it is joined to the squamosal and the quadrato-jugular by suture. It could not have participated in the formation of the lateral temporal foramen; that office was reserved to the quadrato-

jugular lying in front of it, which in its turn is connected again with the peculiarly shaped jugular. This latter bone borders the anterior portion of the temporal fossa, and forms, as far at least as it is exposed, the base of its posterior limits. Two strongly developed longitudinal ridges stretched across it, of which the lateral one, which is the shorter of the two, is projected towards the quadrato-jugular by means of rough spines. Its normal situation on the skull is preserved only on the left side, from which it has been figured. Leaning against it and to the front of it, is the maxillary, which I found to deviate considerably from previous descriptions. The maxillary is edentulous, and separated from the exclusively dentigerous palate-bone by a distinct suture, which is not only the case in this skull, but I have been enabled to verify it in another separate fragmentary bone in excellent preservation. Only a narrow branch of it separates the anterior margin of the palatine from the præmaxillaries, without any indication of a ridge on the inner nasal foramen. Dorsad it interlocks by means of a small angle only with the præmaxillary and the lachrymal bone.

Not more than three bones are discernible in the roof of the mouth.

The vomers join each other along the median line, but both their anterior as well as their posterior margins are covered in this case by matrix. On the right side they are in their natural relationship to the palatal bone, the maxillary, and the præmaxillary. Not so on the left, where the original contact has been disturbed by crushing in such a manner that Huxley was tempted to suggest the existence of inner nares in this particular place. For my own part I find it most difficult to adopt this view, as I opine that they are more likely to be found in the gap between the posterior margin of the palate-bones, if the lower jaw could be separated from the rest of the skull.

The palatine bones themselves are curved, thinnish plates, with their anterior margins rounded off. Their posterior margins articulate with the subcircular pterygoids, of which only the right one is completely preserved.

The mandibular ramus is composed of several separate bones similar to many other reptiles. They do not articulate on their margins by means of jointed sutures, but overlap each other like flakes, and therefore render a clear and precise description somewhat difficult. No doubt can prevail about the mandibulars. Their curved sulci, placed at a short distance from the apices, appear to me to be a good indication of the limits to which the horny sheaths come in close contact with the bone, which, however, is not so far as might have been assumed at first sight. Their posterior margin is very indistinct, through injury to the outer crust of the bone, and can therefore only be guessed. The mandibular at this place is in contact with two bones, one of which I take to be the articular, from the fact that it articulates with the quadrate bone, whilst the other, the supra-angular, though represented only by its impression, nevertheless agrees with Owen's statement in regard to the corresponding bone in *Rhynchosaurus*. The ventral margin of the

inframaxillaries is formed by the splenials. It is these latter which contribute principally to the formation of the symphysis, at least externally. Indeed, they are so strongly united as to form a process on their posterior margin.

The angular is not preserved here, but it is present in *Hyperodapedon minor*,¹ in which a portion of the coronoid bone seems to be also partly preserved. In the latter species the position of the opercular can be made out with tolerable clearness. It reaches to about the middle of the inferior ridge of the lower jaw.

The remains of the hyoidal bones have already been referred to by Huxley.

(To be continued.)

III.—A SUMMARY OF OUR PRESENT KNOWLEDGE OF EXTINCT PRIMATES FROM MADAGASCAR.

By C. I. FORSYTH MAJOR, M.D., F.Z.S.

ALTHOUGH the present summary covers the same ground reviewed only a few months ago by the junior bearer of the name which will always be gratefully and prominently remembered in connection with the scientific conquest of Madagascar,² the following lines will show that, short as the interval has been, the new additions are not unimportant.

If it might be regretted that many of the new facts are being served out, as it were, by dribblets, this in most cases is scarcely to be avoided, as many of the specimens on which the evidence rests are very fragmentary, and besides dispersed in various Museums. In the case of more complete materials, the preparation for publication requires, for obvious reasons, a longer time, so that the provisional sifting of the material may not be out of place, were it only to keep as much as possible within reasonable limits the often unavoidable increase of synonymy.

As far as the remains recorded by M. G. Grandidier² are concerned, mention is made in the present notice only of those about which I have something new to say.

I. MEGALADAPIS.

At the December meeting of the Zoological Society³ I briefly noticed under the name of *Megaladapis insignis* a new species of this genus, based on fragments of the upper and lower jaw, which I have fully described in another place.⁴ The Geological Department of the British Museum has since acquired the anterior portion of another skull of the same species, probably ♀, which shows that in the adult condition, at any rate, this animal was devoid of upper

¹ I wish to give this name to a fragment mentioned by Huxley, Q.J.G.S., 1859, p. 146, and specifically different from *H. Gordonii*.

² Guillaume Grandidier, "Sur les Lémuriens subfossiles de Madagascar": C. R. Ac. Sci. Paris, 28 Mai, 1900.

³ Proc. Zool. Soc. London, 1899, p. 988.

⁴ "Extinct Mammalia from Madagascar. I. *Megaladapis insignis*, .sp.n.": Phil. Trans. Roy. Soc. London, vol. cxcciii (1900), p. 47.