

48. NOTE on some DINOSAURIAN REMAINS in the Collection of A. LEEDS, Esq., of Eyebury, Northamptonshire. By J. W. HULKE, Esq. (Read June 23, 1887.)

IN a short visit which I made with Dr. Woodward in May 1886 to Eyebury to see the very rich and highly instructive collection of Saurian fossils made by Mr. A. Leeds from the Kimmeridge Clay of Northamptonshire, two series of remains arrested our attention by the close resemblances they bore to those of the Wealden *Ornithopsis*, H. G. Seeley, to *Omosaurus*, R. Owen, and to certain of the American Jurassic Dinosaurs described and figured by Prof. O. C. Marsh. We had not at that time with us on the spot the materials for instituting an exhaustive comparison, but on a second visit to Eyebury, recently made, I took with me Sir R. Owen's and Prof. O. C. Marsh's memoirs, and with these by me I re-examined the two series of fossils. The results of this renewed inquiry are so interesting that I venture to bring them under the notice of the Geological Society.

Part I.—ORNITHOPSIS LEEDSII.

ORNITHOPSIS, H. G. Seeley.

Synonyms: *Eucamerotus*, Hulke; *Cetiosaurus*, R. Owen, partim; *Cetiosaurus*, Phillips, partim; *Chondrosteosaurus*, R. Owen, partim; *Bothrospendylus*, R. Owen, partim.

The remains in Mr. Leeds's collection referable to this Dinosaur, or to a very nearly allied form, comprise several vertebrae, ribs, both pubes, both ischia, the right ilium, and many small fragments too imperfect for reunion and identification.

Vertebrae.—All the vertebrae are, I think, referable to the trunk; they comprise four centra, and some portions of neural arches and processes. All the centra are much crushed and distorted, and they have lost their arches. They display the large chambers opening externally in the lateral aspect of the centrum, and excavating this latter so deeply that the chambers of opposite sides nearly meet in the median antero-posterior plane of the centrum under the neural canal, being separated there only by a thin, bony partition, remains of which are preserved in one specimen. The following measurements will give some idea of the bulk of the least mutilated of four centra; but it should be borne in mind that these very imperfectly represent the dimensions of its true figure. The present horizontal diameters of the two articular faces are 29 centim. and 28·5 centim. The same diameter taken at the middle of the centrum is 19·5 centim. The length of the centrum between the two articular faces, taken at the under surface, is 14 centim. This surface is much incurved in the longitudinal direction, which gives the centrum the appearance of being strongly constricted at its middle. I think it probable that some degree of constriction

originally existed, but that this has been greatly exaggerated by compression since death.

Ribs.—A nearly complete vertebral rib, being about three times as large as the longest rib in the articulated skeleton of an Elephant of average stature preserved in the Museum of the Royal College of Surgeons, gives an idea of the great girth of the thorax in this Dinosaur. This rib presents a distinct neck and shaft, which include between them a present angle of about 90° . The vertebral end of the rib is unforked; the capitular and the tubercular articulations were therefore both seated above the level of the neuro-central suture on the transverse process of the corresponding vertebra. In extant Crocodylians this arrangement obtains first at the 11th or 12th vertebra, and this rib is usually the third in that segment of the vertebral-costal series in which the vertebral ribs are connected with the thoracic sternum by sterno-costal cartilages. So far, therefore, as the Crocodylian analogy warrants the inference, this Dinosaurian rib belonged to the scapular region of the thorax. The length of the neck of the rib, taken from its capitular end to the angle which it includes with the shaft, measures 34.5 centim., and that of the shaft, which has a slightly *f*-shaped double curve, taken along a straight line between its extreme points, is 152 centim. The upper border of the neck is approximately straight, while the lower border makes a regular downward curve, and this part of the rib rapidly expands in its vertical dimensions, attaining a maximum measurement of 20 centim. across the angle. From here the breadth declines, becoming only 9.7 centim. at the distance of 41 centim. from the angle. This reduced breadth continues with little variation for a considerable distance, and then augments towards the ventral end, where it is 13 centim. The expanded part of the neck and angle of the rib is a relatively angularly folded plate, exhibiting in its posterior or visceral aspect a deep, longitudinal hollow. The outer surface exhibits the commencement of a longitudinal ridge which subdivides this surface into a posterior part somewhat convex transversely, and an anterior part slightly hollowed. The part of the rib behind the ridge is stouter than that in front of it. In its vertebral third the cross-section of the shaft of the rib is a triquetrous figure; beyond this the shaft becomes flattened as its breadth increases towards its ventral end.

Pelvis.—The ilium, ischium, and the pubis all contributed to the composition of the acetabulum, the last-mentioned bone not being excluded from it as in Crocodylians. The pubis and the ischium diverge, the former being directed *forwards*, downwards and inwards, the latter *backwards*, downwards and inwards; the pubis also is not divided into a præ- and a post-pubic segment: in both these respects this pelvis differs from that of the Iguanodontidæ. One *ilium* only, and this in a very mutilated state, was obtained: I regard it as the right. Its present length is 84.5 centim. Of this the chord of the acetabulum is about 40 centim. long, and the length of the præacetabular portion 45 centim. The maximum breadth of the acetabular surface is 17.5 centim. between its inner and its

outer borders. The præacetabular portion of the bone is narrow relatively to its length, its depth, or width, near the middle measuring about 15·5 centim. Its borders through a great part of its length are roughly parallel. The sacral aspect of the bone is rough and much damaged. Attached to it are projecting fragments, which may be parts of the iliac extensions of sacral costoids. The

Fig. 1.—*Pelvis of Ornithopsis Leedsii, from the Kimmeridge Clay of Northamptonshire. About one-twentieth natural size.*



pubis has the form of an expanded, oblong plate, wider and stouter at its ends than at its middle. Its iliac end contributed about $\frac{1}{3}$ to the circle of the acetabulum. The roughness of its curved ventral end suggests the former presence of a cartilaginous lip for symphyseal union with its fellow of the opposite side. The anterior border is incurved. The posterior border for the space of 40 centim. is straight, and throughout this extent was connected with the corresponding border of the ischium, the suture, when the bones are articulated, lying in a nearly vertical plane transverse to the axis of the trunk. From the lower end of the ischial suture the posterior border of the pubis changes abruptly its direction, tending forwards for a space of about 38 centim. This part has sustained some mutilation, so that its extent is not shown; but a small part of the natural margin is preserved near the symphyseal end, and this suggests that the missing part was incurved. The outer surface of the bone, in its upper part, is sinuous in a direction transverse to the long axis, being gently concave behind and convex in front of the axis. The length of the bone from the acetabular part to its symphyseal end is 95 centim., the width of its symphyseal end 40·5 centim., that of the acetabular end is approximately estimated at 40 centim., and that at

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the lower end of the pubo-ischial suture is 50 centim. An oval foramen, 6·0 and 6·5 centim. in its two diameters, pierces the bone at a spot not far from the acetabular and ischiatic borders, and 31 centim. distant from its anterior border.

The *ischium* is a much narrower, less expanded bone than the *pubis*. Its long axis appears as if twisted, the outer surface in the upper part looking outwards and in the lower part of its extent having also a backward inclination. Its length is 91 centim., the breadth at its upper end, taken between the posterior angle of its iliac suture and the lowest point of its pubic suture, is 35 centim. Below this the figure rapidly contracts, so that at the middle of the bone the width is only 15·5 centim., and this continues till towards the lower end, where it enlarges to 17 centim.

The resemblances which these remains—I refer particularly to the pelvic bones—present to those of the Wealden *Ornithopsis* are so obvious as not to admit of any doubt respecting the very near affinity of these two Dinosaurs, if, indeed, they are not actually identical. The chief differences observable, the much larger size and the massiveness of the Kimmeridgian form, are of a kind which may merely express the greater age of this individual, and they do not indicate generic distinctness. Pending, therefore, the acquisition of new materials which, permitting the extension of the comparison to other parts of the skeleton, will furnish a decisive solution of the question of affinity or identity, it appears to me preferable to include the Kimmeridge Dinosaur in the genus *Ornithopsis* than to make a new genus for it. I propose for it the specific name *Leedsii*, in recognition of the liberality with which Mr. A. Leeds affords to scientific inquirers the opportunity of studying his valuable collection; and I am happy to express here my personal obligation to him and Mr. Ch. Leeds for much valuable assistance kindly rendered in the course of my inquiry.

In a former communication to this Society I expressed my conviction of the very near affinity of *Cetiosaurus oxoniensis* and *Ornithopsis**. This was based chiefly on their vertebral resemblances; for the ischium and pubis of the latter were then unknown. But the similarity is not less striking between their pelves, as will become evident upon a comparison of the figure of the inferior pelvic elements of *Ornithopsis* in pl. xiv. vol. xxxviii. of the 'Quarterly Journal' of our Society with the diagram at p. 277 in Phillips's 'Geology of Oxford' (London, 1871); only, because the bones are represented misplaced, each figure in this diagram must be turned over, the margins of the pubis and ischium in proximity to which the measurements 1, 2 occur should be removed from these numerals, and the roughened borders near the word "*ilium*" should be joined vertically below the letter "*a*." When this very excusable error has been rectified, the resemblances of the two pairs of pelvic elements are very significant.

* Quart. Journ. Geol. Soc. vol. xxviii. p. 36, vol. xxxv. p. 757, vol. xxxviii. p. 374.

Of the taxonomic position of *Ornithopsis* in the Order Dinosauria there cannot be any doubt. Accepting Prof. O. C. Marsh's classification as best representing our present knowledge of the order, *Ornithopsis* certainly falls into the group Sauropoda, and should find its place amongst the members of the Atlantosauridæ.

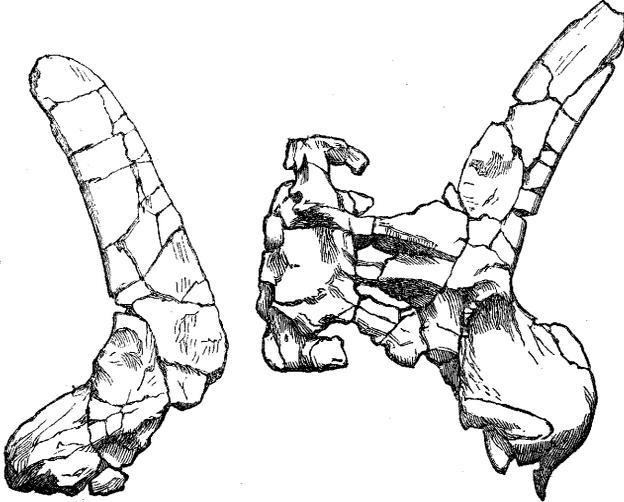
Part II.

OMOSAURUS.

The remains which in May 1886 were thought by Dr. Woodward and myself to be referable to *Omosaurus*, a Dinosaurian genus of which the type specimen, from the Kimmeridge Clay of Swindon, is preserved in the British Museum, comprise a sacrum with both ilia, a caudal vertebra, parts of the other vertebral centra, a femur, a metapodial bone, and many small and indeterminate fragments.

Pelvis.—The *sacrum*, still retaining its connexion with the ilia, is mutilated, and it has been flattened and otherwise disturbed by

Fig. 2.—*Pelvis of Omosaurus durobrivensis, Hulke, from the Kimmeridge Clay of Northamptonshire. One-tenth natural size.*



pressure, which has overthrown and squeezed down the spinous processes upon the right transverse processes, hiding the junction of these with the neural arches. The centra of the vertebræ have disappeared, so that in a ventral view the under or neural surface of the neural arches is seen. The arches appear synostosed, thus forming a continuous vault in which the original distinctness of its several segments is doubtfully traceable, a structural arrangement architect-

urally imitating the roof of a brain-case. The spaciousness of this sacral expansion of the neural canal may be inferred from the dimensions of the best-preserved part of the roof, which are 16·5 centim. longitudinally, and 8 centim. transversely. The transverse processes of the sacral vertebræ are long, the second on the left side measures 24·3 centim.; their vertical extent was considerable, their fractured and mutilated lower border suggests their downward extension below the neuro-central suture upon the lateral aspect of the centrum. The number of sacral vertebræ, inferred from that of the transverse processes prolonged to the ilium, is four. Two in front of these I am inclined to regard as lumbar, from the different direction and length of the transverse processes.

Iliæ.—The ilium is remarkable for the great length of the præ-acetabular process; that of the left ilium (the better preserved) is 53 centim., the present entire length of the bone being 85·5 centim. The breadth of the process taken just in front of the acetabulum is 18 centim., and at the distance of 15 centim. from its free anterior extremity it is 15 centim.; thus the borders of the process are almost parallel. The acetabulum is capacious, the length of its chord is 24·7 centim. The part lying above the acetabulum presents a stout crest, which now projects externally beyond the outer lip of this cavity, but which probably, before the bone was distorted by pressure, was more erect. The longitudinal outline of this crest ascends forwards in a convex curve from the posterior extremity of the ilium to above the middle of the acetabulum; in front of this it descends, becoming concave, and is lost upon the præacetabular process.

Vertebræ.—A caudal vertebra, well preserved, closely reproduces in its general features those of *Omosaurus armatus*. The total height of this vertebra from the apex of its spinous process to the lowest part of the posterior articular surface is 38·1 centim.; the height of the spinous process and arch is 26·5 centim.; the vertical diameter of the anterior articular face is 11·2 centim., and the transverse horizontal diameter 9·2 centim., the same diameters of the posterior articular surface being 12·6 and 11·2 centim.; and the antero-posterior dimension or length of the centrum is 6·8 centim. Thus the spinous process is lofty, the contour of the articular surface is nearly circular, the vertical dimension slightly preponderating. The figure of these surfaces is gently concave, the depression of the posterior slightly exceeding that of the anterior surface. The right transverse process, nearly entire, has the figure of a triangular vertical plate. Its lower border is directed nearly horizontally outwards, its upper border descends, its base, borne chiefly by the centrum, ascends above the neuro-central suture upon the side of the arch. The free end of the process, swollen and obliquely cut, exhibits appearances which suggest its having borne a rib, as occurs in a few anterior caudal vertebræ of some existing Lizards. The depth of the transverse process near its base is 14·8 centim., its length is 9·4 centim. Below the transverse process the surface of the lateral aspect of the centrum is depressed, being concave longitudinally and vertically.

Two other very imperfect vertebral centra have a slightly con-

stricted cylindroid form with plane or gently concave articular ends. The presence of a large internal space now filled with clay points to the persistence of an intracentral, nodal swelling of the notochord. I refer these vertebral centra to the lumbar region.

Femur.—This bone (the left) is in excellent preservation, though somewhat flattened by pressure. In its straightness, and scarcely observable axial twist, it closely repeats the femur in the type of *Omosaurus armatus*. Its proximal end bears a well-marked oval articular caput separated by a shallow depression from a massive external trochanter lying at the same level, and not divided from the shaft by the deep narrow cleft which is so marked a feature in the Iguanodontidæ. The distal end of the bone exhibits the common condylar division; the inner condyle is rather more prominent anteriorly, the outer condyle broader. The dorsal or extensor surface is traversed longitudinally by a depression, wide and shallow in its proximal part, narrower at the middle of the shaft, and deeper and wider distally, where it runs out between the condyles. A low, narrow, but perfectly distinct, crest-like inner trochanter is present at the inner border of the bone, at the middle of the shaft. The posterior intercondyloid groove is deep and wide. The length of this femur is 100 centim., the breadth of the proximal end is 28 centim., that of the distal end 27 centim., and that of the middle of the shaft at the level of the inner trochanter 13 centim.; the diameters of the caput femoris are 12·5 centim. and 14·5 centim.

Metapodium.—A bone which I refer to the metatarsus, from its likeness to the metatarsals of *Stegosaurus* (all the component bones of the foot of which are figured by Prof. O. C. Marsh), is 14·5 centim. long. Its shaft has a cylindroid figure flattened at one side. Its middle is gently constricted, and its ends expanded. The contour of the proximal end is a roughly quadrilateral figure, in which the side answering to the flattened sides of the shaft is straight, the opposite side being convex. The distal end is unequally subdivided into two condyles, the larger of which is prolonged much further on the plantar aspect than is the other. This longer condyle coincides with the convex border of the shaft and similarly convex aspect of the proximal end. I am disposed to refer this bone to the outer side of the left foot.

The correspondence of these remains with those of *Omosaurus armatus*, R. Owen, is so close that I cannot hesitate to refer to this genus the Dinosaur which they represent. The chief differences, the less massive forms of the bones and the hollowness of the vertebral centra, may only express differences of age. In these points and also in the more narrow and elongated form of the præacetabular process there is a closer approach to *Stegosaurus* O. C. Marsh, between which and *Omosaurus*, the very closest affinity exists. For this new species I propose the distinctive name of *Omosaurus durobrivensis*, from the name of a Roman settlement near the present site of Peterborough.

Dermal Armour.—All the remains just described were associated, affording a strong presumption of their having all been parts of one

individual; their general facies, also, and the character of the osseous tissues leave no doubt on my mind that they are parts of one skeleton. From the same locality Mr. A. Leeds has also obtained many fragments of large, thin, flat, bony plates, which cannot be referred to any part of the endoskeleton and which doubtless represent a dermal armour. Two of these shields, which have been reconstructed by accurately placing together their fragments, show that their original dimensions were very considerable, the present breadth of one being not less than 50 centim., and that of another about 80 centim. It has not yet been possible to reconstruct them so completely as to show their original contour. They are formed of two thin tables with an intermediate diploë. The free surface of one table is smooth and mostly of finer grain than the other, which is usually impressed by long pits and furrows, and these, as also the finer grain of the bone, show a radial arrangement starting from the stoutest part of the plate, which rises as a low hummock above the general level of that which I regard as the upper or outer surface. This, which presumably represents the centre of ossification of the plate, imparts a stoutness in one plate of 3 centim., thinning out towards the periphery to less than the thickness of a playing-card. Perhaps this has been reduced by pressure. A few fragments preserve a natural edge; this has the form of a slightly swollen lip, bounded towards the expansion of the plate by a submarginal groove, a construction which suggests that adjoining plates may have been linked together by intercalated flexible integument.

The evident close affinity between *Omosaurus* and *Stegosaurus* made it very probable that as the former possessed dermal spines it would likewise be provided with tegumental plates; I am therefore disposed to associate with the other skeletal remains the plates in Mr. Leeds's collection. Should this association be confirmed by new discoveries, the question may arise, Does not the association rather suggest that the remains should with greater justice be referred to *Stegosaurus* than to *Omosaurus*?

The Dinosaur they represent has, however, in its femur a distinct inerttrochanter; this also is present in the type of *Omosaurus armatus*; while it is stated that there is no evidence of its presence in *Stegosaurus*. Should this difference be confirmed, it appears decisive against the generic identity of these two Dinosaurs; but for the moment reservation is necessary upon this subject.

Up to the present time the reptilian fauna of the Kimmeridge Clay has been chiefly distinguished by the abundance of *Ichthyopterygia* and *Sauropterygia*, for the numbers of its *Ichthyosauri*, its *Plesiosauri*, and its *Phiosauri* in their many and distinctive modifications, not less than for the numbers of its Crocodilians, the *Teleosauri* and *Steneosauri*.

Evidence is now accumulating that the Dinosaurian group was also well represented, and this not by one but by several of its subgroups:— (a) The Ornithopoda by *Iguanodon Prestwichii*; (b) the Sauropoda by *Ornithopsis* or a nearly allied form; (c) the Stegosauria by *Omosaurus armatus* and *Omosaurus durobrivensis*.