

25. NOTE on the PELVIS of ORNITHOPSIS. By Prof. H. G. SEELEY,
F.R.S., F.G.S. (Read March 20, 1889.)

IN 1874, on the occasion of my first visit to Eyebury to examine the fossil reptiles of the Oxford Clay, Mr. Alfred N. Leeds, and Mr. Charles Leeds, M.A., mentioned to me the following circumstance. A well had been sunk at the gas-works at Peterborough, which, at the depth of 36 feet, came down upon a number of bones of a large terrestrial reptile. It is well known that to the west of Peterborough the Cornbrash and Lower Oolites rise from beneath the base of the Oxford Clay. The well passed through 24 feet of blue clay, which Mr. Leeds had no difficulty in recognizing by its fossils as typical Oxford Clay. Beneath the clay were 12 feet of grey sand, nearly white in places, and fine-grained, but it was uncertain whether the bedding which it showed was current-bedding. Beneath the sand were the bones resting on the underlying clay. Mr. Charles and Mr. Alfred N. Leeds were fully aware that the remainder of the skeleton was probably on the spot, and made overtures to the Gas Company to allow them to drive a horizontal shaft in the hope of finding it. The bones found remained exposed to the weather for some time till they began to crumble beyond recognition and ceased to be interesting, when they passed into the hands of the most enthusiastic and able explorers who have worked the Oxford Clay. These gentlemen had the bones still in the matrix when I first saw them in an outbuilding, and I was impressed by the grey sand as something to which I knew of no parallel on that geological horizon in that part of England. A large rib had been put together, as well as an ischium and part of a pubis; I also saw a part of the centrum of a dorsal vertebra. On these remains I formed and expressed the opinion that they were closely allied to, though probably not identical with, the large *Cetiosaurus* in the Oxford Museum. After an interval of eleven years I again had my attention directed to this specimen, when Mr. Charles Leeds wrote that he had determined the fossil to be *Ornithopsis*, on the basis of comparison with the Wealden specimens in the British Museum, and inviting me again to examine the remains. Being otherwise fully occupied and unable to leave London, I referred Mr. Leeds to Mr. Hulke as the author of nearly all that has been written on *Ornithopsis*; the result appeared in a memoir on *Ornithopsis Leedsii*, printed in the Quarterly Journal of the Geological Society.

These remains, still preserved in the wonderful collection at Eyebury, are the largest and most perfectly preserved pelvic bones of a Saurischian reptile known in this country. Their chief characters have been sufficiently, though briefly, given by Mr. Hulke, and I should not have added to that notice if it had not been that a new examination of the reptile has led me to take a divergent view of the mutual relations of the bones.

Sketches illustrating the Pelvic Characters of Species referred to Ornithopsis.

Fig. 1.—*Ornithopsis Hulkei*. (About $\frac{1}{18}$ nat. size.)

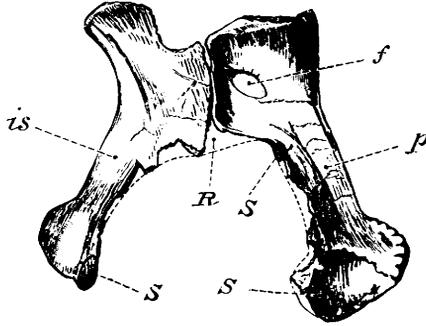


Fig. 2.—(*Ornithopsis*) *oxoniensis*. (About $\frac{1}{30}$ nat. size.)

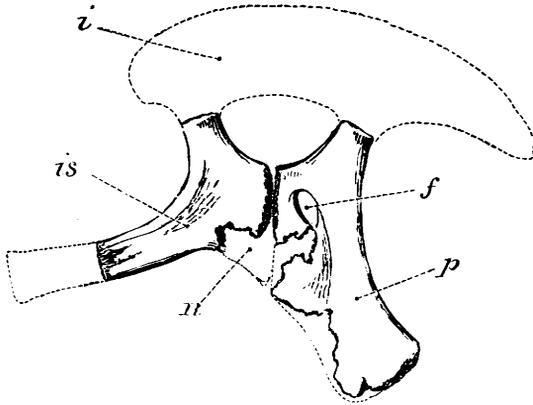
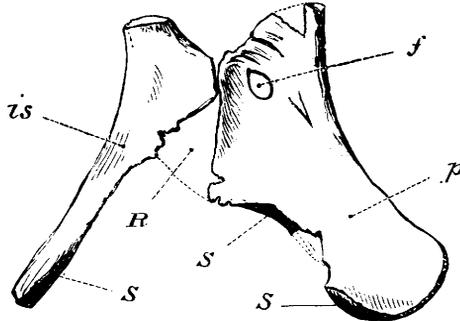


Fig. 3.—(*Ornithopsis*) *Leedsii*. (About $\frac{1}{18}$ nat. size.)



i, ilium; *is*, ischium; *p*, pubis; *f*, foramen.
R R, restorations; *S S*, sutural surfaces.

Mr. Hulke does not expressly determine these pelvic bones as right or left, and he is equally indefinite with regard to the remains of the Wealden *Ornithopsis*. Still the fact that Professor Marsh figured the external surface of the pelvis of *Atlantosaurus*, and that Mr. Hulke has copied that figure reversed in pl. xiv. Quart. Journ. Geol. Soc. vol. xxxviii. in illustration of what I regard as *Ornithopsis Hulkei*, is some evidence that the figured surface was regarded as external, and the bones as belonging to the right side of the skeleton*. However this may be, I had no doubt that the figured surface in *Ornithopsis Leedsii* is the internal or visceral surface, and therefore the bones are of the left side; and the Wealden specimen shows substantially the same characters. This difference in interpretation involves a totally different conception of the nature of the pelvis, and supposing the ilium to have been correctly determined, its chief extension may be varied, as I traced the sutural surface on the pubic bone which extends in the median line of the body of the animal. Mr. Alfred N. Leeds had the kindness to remove these massive specimens from their positions in his museum, so that the bones from the right and left sides of the body might be adapted to each other in the inclined positions which I regarded them as having occupied during the life of the animal. It then became manifest that the bones were united in the median line almost throughout their length by a median suture, and that they formed a saddle-shaped surface from front to back, as do the larger Plesiosaurs from the Oxford Clay.

The left pubis becomes thickened at its anterior extremity, which shows a cartilaginous surface; but internally there is a well-marked suture in the median line, which is bevelled at an angle of 45°. This articulation is six centimetres deep and about 24 centim. long, terminating posteriorly in a sharp point, where there is a small median foramen between the bones, with a well-ossified border. This suture ascends in level as it extends backwards. The internal surface of the pubis is flattened, and the external surface is convex transversely over this anterior portion of the bone. Behind this suture the bone is bent in an arch, so that its external surface is concave from front to back along the median line. On the inner margin the median sutural surface is prolonged for 25 centim., behind which the continuity of the bones is interrupted by a smooth border to a notch which may have separated the bones by 14 or 15 centim. In the middle, where it is strongest, this posterior part of the symphysis is 4 centim. in vertical depth. It is inclined to the internal surface, but to a less degree than the anterior part of the symphysis, consequent on the arched form bringing the hinder part of the pubic symphysis into a superior position, so that the bones of the two sides meet at a less acute angle. The two pubic bones are thus so inclined to each other as to enclose an anterior basin and a posterior basin, which are separated by the intervening saddle-shaped arch.

* Mr. Lydekker adopts this determination in the British Museum Catalogue, vol. i. p. 150, describing the bones as associated right ischium and pubis.

The suture with the ischium, which is nearly straight, may have been nearly vertical; it is 30 centim. long. The sutural surface becomes narrow as it descends, and the bone becomes thin towards the median line.

The ischium is curved in length, with the convexity on the inner side, and it is twisted at an angle of 45° , so that the superior distal surfaces are directed outward and upward, and the inferior margins converge and meet in a broad V shape. This union is assisted by the internal distal border of the bones being bevelled at an angle of 45° for a length of 30 centim., and this surface is marked with coarse parallel longitudinal sutural lines. Externally the distal extremity of the bone is thickened superiorly for 15 centim., as though for muscular attachment. The bone is imperfectly preserved, so that the larger part of the anterior sutural union with the pubis is broken away towards the median line of the body. At a distance of 43 centim. from the proximal end there is, on the internal border, a small portion of smooth ossified margin which is concave, and this I take to indicate the posterior termination of the proximal expansion of the bone. Externally the infra-acetabular surface is concavely excavated in the usual way. The sutural surface for the ilium is 15 centim. long; the acetabular interval between the ischium and pubis is 15 centim. wide, and the iliac attachment on the pubis is 19 centim. long, as preserved, and appears originally to have measured about 33 centim. The greatest thickness of the bone where it unites with the ilium is 5 centimetres. I am not aware that this type of pelvis has hitherto been observed. The antero-posterior arch between the anterior symphysis of the pubic bones and the posterior symphysis of the ischia is a well-marked characteristic of Saurischian reptiles; but it remains to be determined to what extent the median union of the pubic bones is developed in the group.

From the imperfect fragment preserved it is impossible to judge of the form of the ilium, but it does not make any recognizable approximation to the bone in those American genera which offer the closest resemblance of form to the pubis and ischium.

When the bones from the Oxford Clay are compared with those from the Wealden of the Isle of Wight there are several minor differences of proportion; but although the internal border of the Wealden pubis is badly preserved, its distal inner border shows an inclined symphyseal suture, and a symphyseal suture is present on the most convex part of the arch in the middle of the bone, which is more prominent than in the relatively wider, thicker bone of *Ornithopsis Leedsii*. In the Wealden specimen the obturator foramen in the pubis is relatively nearly twice as large as in the Oxford-clay specimen, and is more obliquely placed. The ischium in the Wealden specimen is relatively much broader and stronger than in the Oxford-clay fossil; it has a much wider iliac head, defined by a deep concave subacetabular notch, which is almost wanting in the other type; the distal end is expanded, and though its symphysis

is the same kind of oblique V-shaped union as in *Ornithopsis Leedsii*, it is very small and short, so that the bones did not converge towards each other in similar curves. The antero-posterior extension of these pelvic bones in the symphyseal line appears to me to have been relatively greater in (*Ornithopsis*) *Leedsii* than in *Ornithopsis Hulkei*.

These species may be further compared with (*Ornithopsis*) *oxoniensis*. In relative proportions of the ischium and pubis the bones, as represented in Prof. Phillips's figure, closely correspond with the Oxford-clay species; for, though there is a comparatively long articular head to the pubis as well as the ischium (absent from the Isle-of-Wight fossil), the forms and proportions of both sets of Oolitic bones are otherwise respectively nearly identical, and these two species are apparently referable to one genus. It is, moreover, interesting that the ilium of (*O.*) *oxoniensis*, which has some resemblance to the ilium of *Brontosaurus*, appears to have been prolonged anteriorly in a wedge-shaped mass, and that the imperfectly preserved ilium of (*O.*) *Leedsii* appears to show a similar character. But the ilium of *Ornithopsis Hulkei* is not known, and the nearly equal size in that species of pubis and ischium, seem, with the other differences pointed out, to justify a suspension of judgment as to its generic identity with the closely allied fossils from older strata; for the slender ischia give a good character for generic separation when compared with the expanded ischium of *Ornithopsis Hulkei*.

At the Bath Meeting of the British Association Professor Marsh expressed the belief that *Ornithopsis* held a systematic position midway between *Morosaurus* and *Diplodocus*. I have unfortunately no means of forming an independent opinion. But Professor Marsh defines the shaft of the ischium in *Diplodocus* as not twisted, and states that it "is directed downward and backward with the ends meeting on the median line"*. I fail to recognize in the condition here represented any approximation to the description of *Diplodocus*. The description of *Morosaurus* seems to me closely to approximate to the Ornithopsoid reptiles from the Forest Marble and Oxford Clay, while there is much to be said in favour of the view of Mr. Hulke that *Ornithopsis Hulkei* approximates to *Atlantosaurus*. I hesitate to formulate the inference of generic distinction between these Wealden and Oolitic reptiles from these resemblances to American types until it is shown that the American genera all have the pubic bones united by a long median symphysis as in these British types, which probably belong to closely allied genera, although they may be more distinct from each other than are *Morosaurus* and *Atlantosaurus*. The nature of the relation between the three British types may be better gathered from the accompanying figures of the pelvic bones (p. 392).

After the bones of (*Ornithopsis*) *Leedsii* had been put together in their natural anatomical relations, Mr. Alfred N. Leeds made a model of them in pasteboard; and I now submit a slightly restored model of these bones, which I think serves to establish the generic

* American Journal of Science, vol. xxvii., Feb. 1884.

distinction of this type from the American genus *Morosaurus**, and to show that *Brontosaurus* cannot be identified with it, although there is some resemblance to that genus in the ilium and pubis.

DISCUSSION.

Mr. LYDEKKER observed that the identification by Prof. Seeley of the proper ventral and dorsal surfaces of the pelvis of *Ornithopsis* was of considerable importance, since it removed all objections which had been raised as to the close affinity between that form and the American *Brontosaurus*, &c., which he had always believed to be closely related.

He was unable, however, to assent to the amalgamation of *Cetiosaurus* and *Ornithopsis* which the Author appeared to suggest, the difference in the pelvis of the two forms indicating a character of at least generic value.

The speaker had already pointed out the resemblance of the pelvis of *Cetiosaurus oxoniensis* to that of *Morosaurus*, and he was glad to observe that Prof. Seeley agreed with him in this respect.

With regard to nomenclature, after alluding to his previous statement that he believed the name *Cetiosaurus* ought to yield to the earlier *Cardiodon*, Mr. Lydekker observed that he had two days ago received a letter from Dr. Baur, pointing out to him that the tooth from the Wealden originally figured by Dr. Wright had been named, in 1852, *Hoplosaurus* † *armatus*. The speaker had suggested that this tooth really belonged to *Ornithopsis*, and Prof. Seeley had regarded this suggestion as a certainty. Under this circumstance there was no question but that, if the two are really identical, the name *Ornithopsis* must yield place to the much earlier *Hoplosaurus*, even if the latter had not to give way to the still earlier *Pelorosaurus*. It was curious, after the complex synonymy, to find that both the Wealden *Hoplosaurus* (? *Ornithopsis*) and the Lower Jurassic *Cardiodon* (? *Cetiosaurus*) were both based on the evidence of teeth, and were therefore strictly comparable.

Mr. LEEDS considered that Prof. Seeley had given the correct interpretation about these bones.

Prof. SEELEY said his thanks were due to Mr. Alfred N. Leeds for the opportunity of clearing up the structure of the Saurischian pelvis. He was not aware that the structures now described had been previously recognized by any other observer. He had endeavoured in his paper to make it clear that while on the one hand

* Since writing the note on *Aristosuchus pusillus* (Quart. Journ. Geol. Soc. vol. xliii. May 1887) I have been led to notice that the position of the pelvic bones in relation to the sacrum gives grounds for suspecting that the bone there regarded as pubis is likely to be an ischium, notwithstanding its resemblance in form to the pubis in some American genera. Professor Marsh's figure of *Ceratosauros* shows that the ischium may have an anterior symphyseal expansion, like the posterior expansion of the pubis in that genus and other types. Whether *Aristosuchus* may have had cervical vertebrae like that which I provisionally referred to *Thecospondylus* (Quart. Journ. Geol. Soc., Feb. 1888) may deserve consideration.

† Originally *Oplosaurus*.

he did not follow Mr. Hulke in referring the three Saurischians to *Ornithopsis*, and while he offered a restoration of the pelvis of *Cetiosaurus oxoniensis* to illustrate its relation to the Oxford-clay and Wealden types, the grounds had been stated on which the Oxford and Peterborough animals might be referred to another genus, when the evidence was more fully set out. The affinity of *Cetiosaurus oxoniensis* to *Morosaurus* cannot be determined, because the distal end of the ischium is not preserved. Prof. Seeley regarded nomenclature as a matter of scientific convenience, and he was not prepared to give up names associated with the history of research in favour of an obscure name that was casually exhumed and introduced doubt in our interpretations.