4. On PROTOSAURUS SPENERI, VON MEYER, and a new species, PROTOSAURUS HUXLEYI, from the MARL-SLATE of MIDDERRIDGE, DURHAM. By ALBANY HANCOCK, Esq., F.L.S., and RICHARD HOWSE, Esq.

(Communicated by Prof. Huxley, F.R.S., F.G.S.)

(PLATES XXXIX. & XL.)

IN the preceding paper it has been stated that the requirements of a railway company for increased accommodation of their traffic, and the continuous indefatigable exertions of our friend Joseph Duff, Esq., to enlarge the knowledge of the Marl-slate fauna of Durham, have led to the discovery of some fossil remains which are certainly the most interesting palæontologically of recent acquisitions. These consist of a considerable portion of the skeleton of that earliest-recorded and still oldest-known reptile, *Proterosauros Speneri*, v. Meyer, and also in close association with it of the greater portion of the skeleton of a smaller species, for which we propose the name *Proterosauros Huxleyi*. Through the obliging kindness of Mr. Duff these specimens have not only been placed in our hands for description, but have also been added to the collection of the Natural-History Society of Newcastle, Durham, and Northumberland.

Perhaps we may be allowed to reflect that in England we have now arrived, after the lapse of more than a century and a half, at the same point of palæontological discovery, bathymetrically considered, which was attained in Germany in the year 1706 through the intelligent observations of a learned physician of Berlin, whose name has been properly attached to this earliest discovered reptile; and also to consider this fact, that after the expiration of 164 years, and notwithstanding the exertions and multiplication of observers and enlarged fields of inquiry, these reptilian remains, described by Spener and compared by him to the Crocodile and Lizard, still continue to be the highest organisms up to this time recorded from the palæozoic rocks. And thus this discovery, though it increases our knowledge of the geographical distribution of ancient reptiles, adds nothing to our knowledge of their bathymetrical range, if we admit, as is generally done, that the English marl-slate was contemporaneous with, or deposited about the same geological period as, the German Kupferschiefer.

For the history and description of more complete specimens we must refer to the classical monograph of Hermann von Meyer, 'Fauna der Vorwelt—Saurier aus dem Kupferschiefer der Zechstein-formation.'

The geological position in which these reptiles were found has already been described in a former communication, so that it is unnecessary to repeat it here, further than to state that they were associated in the marl-slate proper on the same stratigraphical horizon with such fishes as *Flatysomus*, *Palæoniscus*, &c.

The two specimens which we are about to describe were much obscured in the matrix; but by the skilful aid of Mr. Thomas Atthey the whole of the bones have been perfectly developed at the

expense of much labour and judgment. One is the remains of a well-developed individual; but little more than vertebræ and a few of the ribs in a more or less dilapidated state are preserved; but on another slab three or four perfect ribs have occurred. The other specimen is in a much more perfect condition, the principal bones of three of the limbs being well displayed as well as one of the fore feet and most of the ribs, which lie in regular order on either side of the vertebral column. The former, as already mentioned, is undoubtedly the remains of *Proterosaurus Speneri*, and the latter a new species of the same genus, *Proterosaurus Huwleyi*.

PROTEROSAURUS SPENERI, v. Meyer. (Pl. XXXIX.)

The bones of the specimen of this species are in a very perfect condition, the surface of them being quite intact, and in places having even a semigloss. The vertebræ are lying articulated in a much curved line, the animal having apparently died with the spine arched violently backwards, as seems to have been the case with all the examples hitherto obtained. In our specimen the curve is even more sharp than usual, the remains of the column forming almost half a circle. The anterior portion of it is thrown suddenly back, and at the pelvic region it is as suddenly bent upwards.

In all there are thirty-five or thirty-six vertebræ and casts of vertebræ in continuous order, measuring, if placed in a right line, 22 inches in length. Of these vertebræ twenty-one appear to belong to the trunk, and fifteen or sixteen are caudal. Now if we deduct two or three for the lumbar vertebræ, there will remain seventeen or eighteen dorsal vertebræ. Meyer concluded, after carefully enumerating the joints in all the known individuals, that the number is "not under sixteen, and not over nineteen;" so that it would appear that the whole of the dorsal vertebræ are present, in front only the cervical being deficient. As Meyer estimates the tail-joints at more than thirty-six or thirty-eight, it would then appear that more than half of them are wanting in the specimen before us.

The centrum of the dorsal vertebræ is upwards of $\frac{3}{4}$ inch long, and about $\frac{1}{2}$ inch in height. In one of the largest specimens figured by von Meyer (tab. ix.) it is $\frac{7}{8}$ inch long and $\frac{1}{2}$ inch high. It would therefore seem that the Midderidge example is full-grown and a large individual. It is impossible to observe the ends of the vertebræ, as they are all articulated; but from the appearance of the joints where they gape a little, it would seem that both the anterior and posterior articular surfaces are slightly concave, and their margins appear as if reflected; the sides of the centrum are smooth and are a little concave.

The spinous process is $1\frac{1}{4}$ inch high, being more than twice the height of the centrum, and it is $\frac{1}{2}$ an inch from back to front; consequently it is considerably shorter than the body. It is much compressed, and is expanded a little above in the direction of the long axis of the vertebræ; and the dorsal margin or crest is slightly arched in the same direction, and exhibits on the sides delicate

longitudinal radiating striæ. The upper extremity of some of the anterior spinous processes are strongly roughened at the sides, as if for muscular attachment.

The anterior zygapophyses are stout and well produced; they incline outwards and upwards. The posterior pair are considerably shorter than the anterior, and stretch backwards or outwards to overlap them.

The transverse processes are not well preserved; but distinct traces of them are observed in most of the vertebræ, and on one or two the form is pretty well seen. They are simple, short, and obtuse, and are lengthened a little in the direction of the long axis of the centrum.

The caudal vertebræ are longer in proportion to their height than those of the trunk; and the neural arch, as in them, is completely united to the body, no suture or other trace of the junction of the parts being perceptible. The spinous process is as long proportionately, and those near the root of the tail are of the same shape as those of the trunk. But further down they become considerably contracted at the base in the direction of the long axis, and gradually widen in the same place upwards. The spine of the last joint on the slab, being the fifteenth or sixteenth of the tail, exhibits at the upper margin an indication of the peculiar bifurcation of the lower distal caudal spines of this saurian.

The anterior zygapophyses are considerably longer than those of the trunk-vertebræ, and are more inclined upwards. Immediately beneath the neural arch on either side of the centrum there is a longitudinal ridge, which, near the centre of the body, is produced a little into a short projecting tubercle, the transverse process. The chevron bones forming the hæmal arch are about as long as the dorsal spine, but are much narrower, and are of a spatulate form, being narrower at the proximal and flat and small towards the outer extremity. They are not fixed, like the processes, in connexion with the neural arch, but are articulated below to the broad reflected margin of the posterior extremity of the body, articulated, as it were, between the joints, and are inclined backwards. Only a few of them remain, but two or three are well displayed on a fragment of the counter-slab, which has fortunately been preserved.

The lumbar vertebræ are not well marked, and in this region the specimen is unluckily fractured. Certainly two, perhaps three, of the last vertebræ of the trunk are, however, apparently ankylosed. Von Meyer seems to have been uncertain whether there were two or three pelvic joints; but from what he states it would seem likely that three is the number.

A fragment of a flattened rounded bone, measuring $1\frac{1}{8}$ inch across, lies directly below the lumbar vertebræ. This is probably a portion of the pelvic girdle, and is the only indication of its presence. This resembles in form the rounded extremity of a bone (tab. iv. f. 1, 2, of von Meyer's work) lying in contact with the femur, and is probably a portion of either the pubis or ischium.

Immediately in front of the fragment lie the short ribs, which are

not more than an inch long; they are only slightly arched, with the head a little enlarged and the distal extremity obtusely pointed. Further in advance there are the remains of three or four other ribs, with more or less of the enlarged proximal extremity preserved and lying on the vertebræ apparently near to the point of articulation. One such extremity, the most anterior, is pressed down upon the sixth or seventh vertebra in advance of the sacrum. It lies immediately behind and below the distorted and broken transverse process, to which it is probably attached. Portions of the other heads occupy relatively exactly the same position on the two posterior vertebræ.

The head of each rib is of a triangular form, and is compressed, with the articulating surface simple and almost straight. The shaft at the proximal extremity is rather strongly bent; it is afterwards slightly and regularly arched, and at first it is narrow and almost cylindrical, afterwards it widens and flattens, and is grooved longitudinally; the distal end is truncated for the attachment of the ventral ribs, of which, according to Meyer, there are three to each vertebral rib. The ventral ribs are not preserved in our specimen, with the exception of one or two. Two or three ribs on a portion of the counter-slab measure $4\frac{3}{8}$ inches in length along the chord. The widened extremity is $\frac{1}{2}$ inch broad; the constricted portion above is not more than half that width.

PROTEROSAURUS HUXLEYI, n. sp. (Pl. XL.)

The small specimen of *Proterosaurus*, though far from being perfect, is not by any means so much mutilated as the large example of the genus above described. It lies apparently on its belly, with the two anterior limbs spread out, and the principal bones of the left posterior limb lying nearly in their natural order, though dislocated. In front of the trunk the neck-joints are scattered about in contact with the right coracoid; and a little further in advance towards the left is apparently a fragment of the skull, an arched bone $\frac{2}{3}$ of an inch in length. The lumbar vertebræ are not present, and the proximal caudal vertebræ are likewise deficient, the slab being broken away at this point; but a few of the distal ones can be traced. The ribs are spread out on either side of the spinal column, which strongly marks the central line. The trunk of the body from the pelvic region, or from the point where the slab is broken away, to a point level with the supposed cranial fragment, is about 5 inches in length.

The bones are in a peculiar state. The surface of most of the limb-bones and ribs is well preserved: these bones seem to have been hollow, and are filled up with galena; but the vertebræ and some of the smaller bones, such as the carpals, are almost entirely composed of that mineral; and when this is the case, the form of the bones is often much distorted, apparently by the influence of the lead-ore in assuming its usual cubic form.

The vertebræ are not in a good state of preservation; they are much injured by the deposition of the galena, as above referred to, which has so distorted the form of the bones that it is quite impos-

sible to make out the parts, or to say whether or not they are provided with the long characteristic spinous processes of *P. Speneri*. Indeed it is difficult to determine the number of joints, though twelve can be counted. As, however, there are fourteen or fifteen pairs of ribs, there must be at least as many dorsal vertebrae. It would still seem, nevertheless, that they are not so numerous in this species as they are in *P. Speneri*, in which we have seen there are seventeen or eighteen dorsal vertebrae. But it is quite possible, indeed it is likely, that there are more ribs than we have been able to enumerate, in which case we have underestimated the number of the vertebrae; and the two species may be found to agree in this particular more closely than is apparent. It is equally impossible to ascertain the character and exact number of the cervical vertebrae; but as six or seven lie scattered about in front of the trunk, it would seem that this species may have seven, the number of the neck-vertebrae of *P. Speneri* according to Meyer. All that can be said about the caudal vertebrae is, that the traces of their remains seem to indicate that the tail, when perfect, must have been of considerable length. About 2 inches of the distal extremity is determinable; and as about the same length of the proximal portion seems to be broken away, the tail, when complete, must have been longer than the trunk, which is nearly $3\frac{1}{2}$ inches in length.

The ribs lie, as we have already said, spread out in their natural order on each side of the vertebral column, and fourteen or fifteen pairs can be enumerated; but there is some difficulty in determining the precise number. They are well and regularly arched from end to end, and are moderately and nearly equally thick throughout. Towards the proximal end they are a little flattened, and terminate in a slightly enlarged simple head of a triangular form. The distal extremity is abruptly truncated, but is not flattened and widened to the same degree as the ribs of *P. Speneri*; neither are the ribs so decidedly grooved as they are in that species, but are, on the whole, more cylindrical. The ventral ribs appear to have been numerous and comparatively stout; they lie pressed in between the vertebral ribs near to the spinal column, but their relative number cannot be ascertained. The longest vertebral ribs are near the centre of the trunk; here they are $\frac{7}{8}$ inch long, measured along the chord; they shorten a little before and behind to about $\frac{7}{10}$ inch in front and $\frac{4}{10}$ behind.

Both the coracoids are well preserved, particularly the left, which lies nearly in its natural position at the left side on the fore part of the trunk. The right coracoid is removed a short distance in front. They are stout discoidal bones $\frac{5}{8}$ inch in diameter, with a deep, wide notch, apparently on the posterior margin, forming the glenoid cavity for the articulation of the humerus. At the inner margin of the notch there is an elevated boss; and from thence to the front margin there is a widish ridge indicating perhaps the compound nature of this bone, which is most likely composed of both the coracoid and scapula, the glenoid cavity being as usual at the junction of the two elements; but there is no distinct trace of a suture. There is a

straight narrow bone lying with one end in contact with the right coracoid, which may perhaps be a clavicle. A somewhat similar bone is also in contact with the left coracoid, but in this instance it has in some respects the character of a rib.

The humerus is one inch long, and is a slightly arched stout bone, with the extremities a little expanded; the distal end, which is the wider of the two, is fully $\frac{1}{4}$ inch across, while the most constricted part of the shaft is a little more than half that width. The proportional measurements of the humerus in *P. Speneri* differ considerably from the above. In that species this bone has the extremities extremely wide. One figured by von Meyer (tab. ix.), which is $2\frac{1}{2}$ inches long, has the shaft $\frac{3}{8}$ of an inch thick, while the proximal extremity is a little less than $\frac{9}{8}$ inch wide and the distal $\frac{3}{8}$. In *P. Husleyi* the proximal extremity is very little wider than the shaft, and the distal extremity is about twice as thick as the shaft. In *P. Speneri* the proximal and the distal extremities are three times the width of the shaft.

The radius and ulna are not by any means slender; they are about $\frac{7}{10}$ of an inch long, being considerably shorter than the humerus. The radius is not quite so stout as the ulna, and both exhibit a slight sigmoidal curve. The latter is $\frac{1}{10}$ of an inch thick at the centre of the shaft, but is a little enlarged at the extremity.

The hand, including the wrist, is a little longer than the lower arm. There are two rows of carpals, of which, though disposed in nearly regular order, it is not easy to determine the precise number. There seems, however, to be three in the proximal row, and four or five in the distal, in all seven or eight. The metacarpals are long, being not much short of the length of the toes, of which there are five. The number of joints in each will have to be estimated rather than precisely determined; for the extremities are considerably injured. The first is the shortest, and has apparently two phalanges; the second has three; the third has four, all of which are quite distinct; the fourth, which, judging from the size of the phalanges, is the longest, has four, but as no trace of the claw is present, there has no doubt been an additional joint, bringing the number up to five, and if so, agreeing in this respect with *P. Speneri*.

The left fore limb is almost as perfect as the right, and lies stretched out nearly at right angles with the trunk, with the front aspect exposed; the back of the right limb is uppermost. The proximal end lies upon the coracoid; the distal extremity is separated by a short space from the radius and ulna, both of which are extended in parallel order to unite with the projecting wrist and hand. The two latter, however, are so much injured by the accumulation of galena that the parts are much obscured.

The chief bones of the left hinder limb, though dislocated, are lying close to the pelvic margin in nearly their natural sequence. The femur is as stoutly developed as the humerus; it is $1\frac{1}{4}$ inch long, consequently a little more than $\frac{1}{8}$ of an inch larger than the upper bone of the anterior limb; it is slightly bent, and has the extremities gradually but not excessively enlarged. The shaft is $\frac{1}{2}$ of

an inch thick, and the proximal extremity is nearly double that thickness, the increase being due in part to a ridge, apparently at the outer or upper surface.

The tibia and fibula are $1\frac{1}{10}$ inch long, so that they are a little more than $\frac{1}{8}$ of an inch shorter than the femur. They are nearly straight; the fibula is slender, and does not seem to have been much enlarged at the extremities, which are, however, not perfect. The tibia is considerably stouter, but not by any means so thick as the femur. The distal end is gradually thickened a little, but the proximal extremity is considerably and rather suddenly enlarged. In this, as in all the other bones, the articular extremities, having been formed of cartilage, are wanting, the ends being truncated. It is therefore quite impossible to describe in detail the characters of the joints.

Fragments, apparently of the right tibia and fibula, and three or four of the phalanges, are scattered about in the vicinity of the bones of the left leg; but no other traces of the right limb are to be found.

The only portion of the pelvic girdle present is the extremity of a flat bone. This fragment is $\frac{3}{10}$ of an inch long, and $\frac{2}{10}$ of an inch wide; it slightly widens towards the anterior extremity, which is truncated. This is probably a portion of the ilium.

From the above description it seems evident enough that this small reptile is a true *Proterosaurus*, and that it is specifically distinct from *P. Speneri*. The long articulating limbs and extensively produced tail are common to both species. In both, too, the neck has been of considerable length, and the number of cervical vertebræ (seven) is apparently the same in both. And the number of the dorsal vertebræ would likewise appear to agree in both species, and in each there are numerous ventral ribs. The same harmony is found in the number and character of the hand-bones. Unfortunately no comparison can be instituted respecting the skulls and the individual features of the vertebræ, as these parts in the new species are too imperfectly preserved; enough, however, seems to be known to warrant the assertion that the two are generically coordinate.

It appears equally clear that the small individual is specifically distinct. The diminutive size alone suggests this, especially as there are no appearances of immaturity; and the form of the ribs would seem to prove its specific distinctness. In *P. Huxleyi* we have seen that they are flattened towards the proximal extremity, while in *P. Speneri* they are rounded at this part; and in the former they are not widened and grooved to any thing like the same degree at the distal extremity.

The limbs, too, are proportionately different. In *P. Speneri* the fore limb is $4\frac{1}{2}$ inches long, as figured in von Meyer's work, tab. ix. The hind limb is $7\frac{5}{8}$ inches in length; consequently the former is $\frac{1}{3}$ shorter than the latter. In *P. Huxleyi* the fore limb is $1\frac{7}{10}$ inch in length, the hind limb $2\frac{3}{4}$ inches long; the former in this species therefore considerably more than $\frac{2}{3}$ the length of the latter.

In the new species, then, the limbs vary more in length than they

do in the old ones, the hind limb being considerably longer in the former, in proportion to the fore limb, than is the case in *P. Speneri*.

The difference likewise is strongly marked in the proportions of the humerus. On referring to von Meyer's tab. ix., above quoted, the constricted part of the shaft of the humerus therein figured measures $\frac{3}{8}$ inch wide, while the distal extremity is $\frac{9}{8}$ inch across: thus it appears that the latter part is three times wider than the former. In *P. Huxleyi* the narrow part of the humerus is $\frac{1}{8}$ inch thick, and the distal extremity is $\frac{2}{8}$ inch wide: so here the disparity is only as two to one, but in *P. Speneri* it is as three to one. It must be stated, too, that in the old species the proximal end of the humerus is nearly as wide as the distal, while in the new species it is only slightly enlarged.

EXPLANATION OF PLATES XXXIX. & XL.

PLATE XXXIX.

Slab of Marl-slate from Midderidge, containing the vertebral column &c. of *Proterosaurus Speneri*, von Meyer.

PLATE XL.

Slab of Marl-slate from Midderidge, containing the skeleton of *Proterosaurus Huxleyi*, sp. nov., Hancock and Howse.

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DeWilde oel et lith.

W & N Harhart imp.

PROTEROSAURUS HUXLEYI.