

NOTICES OF MEMOIRS.

I.—ON A COLLECTION OF FOSSILS FROM THE JARROW COLLIERY, KILKENNY, IRELAND.¹

By E. PERCEVAL WRIGHT, M.D., F.L.S., Professor of Zoology, Dublin University.

WITH A DESCRIPTION OF THE VERTEBRATE REMAINS, BY T. H. HUXLEY, F.R.S., Professor of Natural History at the Royal School of Mines, Jermyn Street.

THE Coal-producing portions of the counties of Kilkenny, Queen's County, and County of Carlow, have been described more than half a century ago by Sir Richard Griffith, Bt., under the name of "The Leinster Coal District." The general appearance of the Coal country, when viewed from a distance, is that of a very steep ridge of high land, running in a direct line for many miles, rising from 800 to 1,000 feet above its base, and apparently flat on the summit. It preserves this character on every side; but when viewed from the eminence itself, it resembles a great barren table-land, rising precipitately above a flat and highly cultivated country.²

The portion of this district with which we are more immediately concerned, is the high table-land of Castle Comer, which is about 1,000 feet over the sea-level. The whole of this table-land is formed by a series of dark, sometimes black, shales, interstratified with sandstones and flagstones of various shades of gray, which series, from its occasionally containing beds of Coal, is spoken of collectively as "The Coal Measures."

The Coal Measures of this district have a more or less basin-shaped arrangement, resting on the Upper Limestone, beneath which is the calp or Middle Limestone, and then the Lower Limestone resting on the Granite. The depth of the Limestone in the centre of the district is about 1,850 feet, or more than a thousand feet below the level of the sea, while on the outer slopes of the table-land it rises to an elevation of some 250 feet above the sea-level.

The black shales generally contain fossils belonging to such genera as *Aviculopecten*, *Euomphalus*, *Goniatites*, *Bellerophon*, etc.; but the beds interstratified with the Coal are found to contain plants belonging to *Lepidodendron*, *Calamites*, *Sigillaria*, *Pecopteris*, *Sphenopteris*, etc., etc. Several new species of these latter genera, as well as two new species of the genus *Bellinurus*, have been lately described by Mr. W. H. Baily,³ from the coal of this district.

In one of these collieries, that of Jarrow, the Coal is worked at a depth of about 210 feet beneath the surface. The roof of the pit is formed of clay slate, immediately under which is a seam of inferior

¹ Abstract read before the Royal Irish Academy, on Monday, 8th January, 1866. The paper will be published in Vol. xxiv. of their Transactions, with a series of plates, by Mr. DINKEL.

² Vide Report on the Leinster Coal District, by RICHARD GRIFFITH, Dublin, 1814, p. 2.

³ Vide Explanation of Sheet 137 of the Maps of the Geological Survey of Ireland, p. 14.

Coal, about three inches in thickness. Then we find a seam of excellent Coal, about three feet in thickness, known as Stone Coal, which rests on a bad description of a foliated Coal, some fourteen inches in depth. Next is a layer of slaty Coal, nine inches in thickness, called by the miners the "wire sole;" then a four-inch Coal, under which is a white-coloured slate rock, and a six-inch bed of culm, resting on the "Coal seat."

The date of the first boring in this pit is 1812. It was first worked successfully in 1827, and continued open until 1832, after which it was not worked until 1853, when it came into the possession of its present proprietor, Mr. S. Bradley. There is some difficulty, from want of positive evidence, in deciding exactly what Coal bed is the one worked in this pit; but no fossil forms, save those of ferns, had been detected in it, or in the culm, until Mr. W. B. Brownrigg, visiting the pit late in the season of 1864, was struck by the remarkable appearance presented by some of the tail vertebræ of a Labyrinthodont Amphibian, named in this paper *Urocordylus Wandesfordii*. Believing it to be of the greatest interest, he collected all the specimens of fossils to be found from time to time; and, in the course of the following year, having mentioned the subject to one of the authors of this paper, a grant of money was obtained, in September, 1865, to work the deposit from the British Association. Since then, repeated visits have been paid to the colliery, the proprietor of which, and Mr. K. Dobbs, the agent of the property, not only gave every facility for the prosecution of these researches, but aided and assisted them in every possible way, giving the strictest injunction that every specimen found should be properly preserved.

By such systematic collecting a large series of fossils were very soon brought to light, and perhaps the largest number of specimens were those of many genera of plants, some of which, in all probability, will throw much light on existing genera of coal-plants, and others may eventually prove to be undescribed species. There is also a considerable collection of fish-remains; spines apparently referable to several species of *Gyracanthus*, with several other Elasmobranchs; large specimens, with the singular vertebral column wonderfully preserved, of some species of *Megalichthys*. Another ganoid fish, upwards of four feet in length, and especially provided with strong, long and much curved ribs, a broad head and rounded snout, large opercula, characterised by a raised longitudinal rib,—we refer to a new genus *Campylopleuron*. But although the plants and fish were both numerous and interesting, the most remarkable discovery was that of many novel forms of Labyrinthodont Amphibia; and, leaving the description of the former with that of some few strange forms of invertebrates to be described hereafter, our present object is more particularly to give detailed descriptions, drawn up by Professor Huxley, of the following new genera and species of amphibia.

1. The genus *Urocordylus* is distinguished by the remarkable size and strength of its tail, and by the great development of

the neural spines and chevron bones of the caudal vertebræ, which must have conferred upon the tail great power as a natatorial organ.

The tail is not less than nine times the length of the head; and is composed of, at lowest, seventy-five vertebræ. Throughout the anterior three-fourths of the tail, the centra of the vertebræ are short and bi-concave; but their neural spines and chevron bones are produced into long flattened plates of bone, narrower at their attached than at their free ends, where the bony substance becomes longitudinally grooved, and, as it were, frayed out. The height of one of these vertebræ, from the upper edge of its neural spine to the lower edge of its chevron bone (which is continuously ossified into the middle of its under face), is three times as great as the length of its centrum.

In the body the neural spines shorten greatly, their height not exceeding the vertical diameter of their centre; but they retain their antero-posterior elongation.

The number of vertebræ in the body cannot at present be ascertained with certainty. That they were not fewer than ninety is clear, but they may have been much more numerous.

The skull is broad and short, and is about 1.2 inches long in a specimen, the tail of which exceeds twelve inches in length.

Both the hind and fore limbs are completely developed, though small, and the posterior member is longer than the anterior. The hind limb, from the head of the femur to the extremities of the digits, nearly equals the centra of six anterior caudal vertebræ in length, or 1.5. There are five well-developed long and slender digits; but the carpus does not seem to have been ossified. The fore limb is not fully preserved, but it would appear to have resembled the hind limb.

The ventral surface of the body is provided with an armour of dermal ossifications, of an oat-like or spindle-shape, and each about 0.2 in. long by 0.05 in. broad.

We propose to confer upon the species, upon which the above description is based, the title of *Urocordylus Wandesfordii*, after Mr. Wandesford, the lord of the soil of the colliery from which it was obtained.

2. *Ophiderpeton*.—When the peculiar caudal vertebræ of *Urocordylus* were first discovered they were, for the most part, unconnected, not only with body vertebræ, or skulls, but with any other remains. Only in one instance did a series of such vertebræ present, at its anterior end (where it was obviously about to pass into the body, which was unfortunately broken away), a number of scattered oat-shaped dermal ossicles.

At the same time, however, certain slabs exhibited skulls, followed by long series of dorso-lumbar vertebræ and ribs, with a very complete ventral dermal armour, composed of elongated and oat-shaped ossicles. Thus one was naturally led to combine these disjointed anterior and posterior fragments, which seemed to be identified by their common armour. But it turned out, on strict comparison, that the ossicles of the anterior fragments, which are termed

Ophiderpeton, are more slender and rod-like than those of the posterior; and with the most complete specimens of *Urocordylus* and those of *Ophiderpeton* side by side, it is obvious that while the dorsal vertebræ are equal in length, the head is smaller in *Ophiderpeton* than in *Urocordylus*.

Again, although the series of dorso-lumbar vertebræ in the most complete *Urocordylus* is unfortunately interrupted, it seems difficult to imagine that the total number of these vertebræ (of which about twenty are now discernible) could have exceeded thirty or thirty-five, while in the original specimen of *Ophiderpeton* there are between forty and fifty such vertebræ following the head; and, in another, nearly a hundred vertebræ, apparently belonging to the same genus, succeed one another without being commenced or terminated by head or tail.

Neither of these specimens exhibits any trace of limbs; but a much smaller one, apparently (though not certainly) belonging to the same genus, shows a pair of minute anterior limbs, and what looks like a jointed filamentous appendage posteriorly. The phalanges of the digits in the anterior limbs are thick and short, and only three digits are preserved.

The study of new specimens will, doubtless, speedily clear up all these ambiguities and difficulties. The species at present known thus far, attained a length of three feet. We propose to call it after the indefatigable explorer of the produce of the collieries, to whom we are so much indebted, *Ophiderpeton Brownriggii*.

3. *Ichthyerpeton*.—We have, at present, only the hinder half of the body of a single individual of this genus, which is, however, extremely well marked by its deep and, comparatively, short tail, covered with small truncated and apparently horny scales. The hind limb is remarkably short and broad, and appears to have been sheathed in a rugose or scaly integument as far as the bases of the short digits, of which five can be counted. The vertebræ are short and deep, and either biconcave disks or rings; they seem to have been only incompletely ossified in the caudal region. The ventral region in front of the posterior limb, presents transversely directed rows of curved spiculiform ossicles.

What remains of the body of this remarkable animal is ten inches long, and its total length could hardly have been less than fourteen inches.

We have named the species *Ichthyerpeton Bradleyæ*, after the wife of the proprietor of the colliery, to whom we are indebted for leave to collect these fossil remains.

4. *Keraterpeton*.—This is the genus which is best represented in the collection; very complete specimens having been obtained, showing all needful details of the structure of its skeleton.

It is a salamander-like animal, which attained a length of between eight and nine inches. The tail is rather longer than the body and the head taken together. The broad and short head, with large and forward orbits, is remarkably characterized by the prolongation of the epiotic bones into the long and somewhat

curved horn-like processes, which have determined the name of the genus. There appear to have been not more than twenty vertebræ, all provided with strong curved ribs, between the head and the commencement of the caudal region; and, probably, there were about as many in the tail.

All the vertebræ have long, but not high, lamellar neural spines, the length of which is hardly increased in the caudal region, where the chevron bones take a form corresponding with that of the neural spines, and like them are fimbriated or grooved at their free edges.

The tail is thus, in principle, similar to that of *Urocordylus*, but differs widely in its details.

The hinder limbs, somewhat larger than the anterior, have five long and slender digits, and an unossified carpus, as in the recent *Proteidea*. The fore limb had certainly four and probably, five, similar digits.

The ventral surface of the thorax was provided with the sculptured bony plates, characteristic of the Labyrinthodonts, and between these and the pelvis is a dermal armour, composed of minute granular ossicles, and apparently in some parts of broader plates.

This genus was first brought to Prof. Huxley's notice by his friend and colleague, Prof. Jukes, who forwarded to him a drawing of a specimen obtained by Mr. Galvan, of the Irish Survey.

Prof. Jukes' letter is dated Nov. 8th, 1865, and contains the information that Mr. Baily says "it is not unlike the things figured in Pl. 7 and 10 of Dunker and Mejer, vol. vii. These however are called *Andrias Tschudii*, and come from the Brown Coal." It does not appear that Mr. Baily ever gave a more definite opinion than this as to the nature of these remains.

Prof. Huxley returned the sketch, with the information that the animal represented was certainly a new Labyrinthodont Amphibian, and named it *Keraterpeton Galvani*.

5. *Lepterpeton*. This new form is readily distinguished from all the others by its slender body, its elongated head, and especially by the prolongation of the symphyseal part of the mandible, somewhat approaching what occurs in the *Ichthyosauria*, and certain *Crocodylia*.

The body and head are shorter than the tail, and the hind limbs, which have remarkably long digits, are twice as long as the fore limbs. There seem to be about eighteen vertebræ, with hour-glass shaped centra, in the dorso-lumbar region. The largest complete specimen of this genus is six inches long; but some fragments indicate that it attained greater dimensions.

We name the species *Lepterpeton Dabbsii*, after Mr. K. Dobbs, the agent of the property.

6. *Anthracosaurus*. The sixth genus is represented by a specimen containing the posterior half of the skeleton of an animal, probably not less than seven feet long, and displaying caudal and dorsal vertebræ, many ribs, the relatively small hind limbs, and part of the pelvis. From the character of the vertebræ and ribs we are greatly

disposed to refer these remains to the genus *Anthracosaurus* (Huxley) of the Glasgow Coal-field. If it be different from *Anthracosaurus* it is a new genus.

Besides the genera thus diagnosed there are indications of the existence of several others; but the evidence is not sufficient to justify us in saying more, at present, than that such indications exist.

The importance of the discoveries which have been made in the Kilkenny Coal-field may be estimated by calling to mind the fact that two months ago the total number of genera of vertebrate animals of higher organization than fishes, known to exist in the Carboniferous rocks of Europe, amounted only to eight, viz., *Archegosaurus*, *Sclerocephalus*, and *Apateon*, in Germany; *Parabatrachus*, *Anthracosaurus*, *Loxomma*, *Pholidogaster*, and *Anthrakerpeton*, in Great Britain. In addition to these, America had yielded the five genera, *Baphetes*, *Baniceps*, *Dendrerpeton*, *Hylerpeton*, and *Hylonomus*, making a total of thirteen genera for the Carboniferous formation in general.

One Irish Coal pit has thus yielded, in the course of a few months, by careful exploration, more genera than are known from all the American Coal-fields, and nearly as many as have been obtained from Europe generally.

Five-and-twenty years ago only one genus of *Vertebrata* higher than fishes (*Archegosaurus*) was known to occur in the Coal; and, curiously enough, this genus, by the imperfect ossification of its vertebral column, and the persistence of its branchiæ, lent strong support to the opinions of those who believe that Palæozoic vertebrates must necessarily be of low organisation.

Dr. Dawson's discoveries in the Nova Scotia Coal-fields first shook this view, which finally ceased to be tenable when the great *Anthracosaurus* of the Scotch Coal-field was found to have well ossified biconcave vertebræ.

The Jarrow discoveries afford a most important aid in the same direction, shewing as they do that the Labyrinthodont type was abundantly represented in the Carboniferous epoch, by animals with well ossified vertebræ; with no trace of persistent branchiæ; and, to all appearances, just as highly organised as their congeners in the Trias.

Furthermore these discoveries have a value of their own in the circumstance that they make us acquainted with forms of Labyrinthodonts of a new character. All previously known Labyrinthodonts have the form of salamanders,¹ with long tails and moderate limbs.

But *Ophiderpeton*, with its snake-like body, seems to represent among the Labyrinthodonts the type of *Amphiuma*, or perhaps of *Cecilia*, among existing *Batrachia*. Should further investigation bear out this suggestion, three groups will be recognisable among the Labyrinthodonts: a perennibranchiate division represented by *Archegosaurus*; a salamandroid group, comprising most of Laby-

¹ The current restorations of the genus *Labyrinthodon* under the form of a great toad have no justification, but are contradicted by well-known facts.

rinthodonts at present known; and an ophiomorphous division, typified by *Ophiderpeton*. The anurous frog-like form will be alone wanting to complete the representation of the existing Amphibia in ancient times.

In concluding, it is but right that we should return our best thanks to Mr. Brownrigg, Mr. S. Bradley, and Mr. K. Dobbs, not only for what they have done in collecting these remains, but for the generous manner in which they have placed all their collections at our disposal. Our thanks are also due to the Rev. Prof. Haughton, M.D., the Rev. J. Emerson, and Dr. Swan, for the loan of specimens; and to the Directors of the Irish Great Southern Railway for liberty to bring from Carlow any quantity of Coal-fossils, carriage free.

II.—ON A POSSIBLE CAUSE OF CLIMATAL CHANGES.¹

By JOHN EVANS, F.R.S., F.S.A., Sec. Geol. Soc.

THE Author called attention to the great climatal changes which have taken place in the northern hemisphere, and suggested that corresponding changes have in all probability taken place in the southern hemisphere; but on account of our more limited geological observations we are unacquainted with them.

The extreme refrigeration of this portion of the globe at the glacial period is constantly receiving fresh corroboration, and various theories have been proposed to account for this accession of cold in a satisfactory manner.

Variations in the distribution of land and water, changes in the direction of the Gulf stream, the greater or less eccentricity of the earth's orbit, the passage of the solar system through a cold region in space, fluctuations in the amount of heat radiated by the sun, alternations of heat and cold in the northern and southern hemispheres consequent upon the precession of the equinoxes, and even changes in the position of the centre of gravity of the earth, and consequent displacement of the polar axis, have all been adduced as causes calculated to produce the effects observed.

Mr. Evans referred to the observations of Laplace and other astronomers as rendering untenable any theory involving a material change in the earth's axis of rotation.

Sir Henry James (*Athenæum*, Aug. 25, 1860) appears nevertheless to have concluded that it was impossible to explain certain geological phenomena without recourse to the supposition of constant changes in the position of the axis of the earth's rotation. The late Sir John Lubbock's observations (*Quart. Jour. Geol. Soc.*, Vol. v., p. 5), were also quoted by the author.

Sir John Lubbock, in common with other astronomers, appears to have regarded the earth as consisting of a solid nucleus with a body of water distributed over a portion of its surface, and upon this

¹ Abstract of a paper read before the Royal Society, March 15th, 1866.