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ORIGINAL ARTICLES.

I.—NOTICE OF SOME SAURIAN FOSSILS DISCOVERED BY J. H. HOOD,
ESQ., AT WAIPARA, MIDDLE ISLAND, NEW ZEALAND.

By Prof. OWEN, F.R.S., F.G.S., &c.

PLATE III.

IN the year 1861 I communicated to the Geological Section of the British Association, which that year met at Manchester, a description of certain fossils discovered by J. H. Cockburn Hood, Esq., in the Canterbury Settlement of the Middle Island of New Zealand; which fossils, kindly submitted to me for description by that gentleman, were afterwards presented by him to the British Museum.

These fossils, having characters most nearly resembling those of Sauropterygian Reptiles, were referred to a species named, provisionally, *Plesiosaurus Australis*.

On Mr. Hood's return to New Zealand, in 1869, he resumed his researches for evidences of Meozoic deposits in the Middle Island;¹ and I received from him, in August, 1869, the following notice of his success:—

“Christchurch, Canterbury, New Zealand, May 15th, 1869.

“MY DEAR PROFESSOR OWEN,—I have already written to you this month, telling you that I had spent another week in the exploration of the ravines at the ‘Waipara,’ and have been very successful in obtaining fine specimens of the remains of Reptilians of at least three species. The head I mentioned having obtained seems to be that of a creature resembling *Teleosaurus*: perhaps the portion of the femur, found near, may have belonged to the same; if so, he must have carried himself well off the ground when crawling along the old river banks (?), or by the shores of the gulf of the old Southern Continent (?).

“Since discovering these remains, in another ravine, some six miles distant, my friend Mr. Innes and I found other very interesting fossil bones—a portion of backbone (12 vertebræ), concave on both sides, coracoid and other bones, of a very large lizard fish (*Plesiosaurus*, perhaps); the vertebræ are rather more hollowed on the anterior than the posterior side; also tail-vertebræ, humerus, &c., I think of an *Ichthyosaurus*.

“My geology of the district is not very easy to map out, and, without further

¹ In the North Island the regular and highly-inclined beds of marl on the South Head of Waikato and western shore of Kawhia Harbour have been referred by Hochstetter to the “Secondary period,” on the ground of his discovery therein of Ammonites of the family *Canaliculati* and *Belemnites*. I believe the Reptilian remains about to be described afford as sure ground for a like reference of their matrix.

research, somewhat puzzling. As I told you, it is no easy matter exploring it, the deep impassable ravines making it, in places, almost inaccessible. I am writing in an uncomfortable Colonial steamer, rolling most horridly, but must try and give a rough sketch, for your information. In the clay-beds in which the boulders are imbedded I have found no fossils, except those surrounded by crystalline concretions. If it were certain that the beds are marine, it might be that the fossils were washed out of the cliffs of an older rock into the Eocene sea; but, as it is, I see no reason for calling them Tertiary.

"SKETCH.—No. I. shows the deep gorge of a tributary of the Waipara river, cut up by floods in the most fantastic and strange manner; the precipitous cliffs, in places only 30 ft. or so apart, are many hundreds of feet in height; so that the great concretionary boulders stand out in relief against the sky.

"No. II. is the deep ravine in the Limestone plateau, with large caves and a natural bridge; the Limestone here passes into Chalk, and is full of a peculiar cup-shaped Coral, Bryozoon (?) and Echini. Cetacean remains are plentiful.

"No. III. Waipara river-gorge, surrounding the plateau called 'Rau paddock,' formed by great subsidence and denudation of Red Crag. This plateau is about $3\frac{1}{2}$ miles long and 3 miles wide.

"I am afraid that my wretched writing material and worse drawing will not make this hasty attempt to show the peculiar conformation of the place very intelligible; but it may serve to give an idea, meantime, until I have the pleasure of seeing you, or can send something better, if I do not go on to England.

"I think that the conclusion you will come to is that these beds are the equivalents of the Wealden. I am very sorry that I had not another week to spend there, to have enabled me to examine the clay-beds more thoroughly, and underlying sand-rock, not sand-stone. I am sure, however, that their being Miocene or Newer Tertiary strata is incorrect.

"Yours very sincerely,

(Signed)

"J. H. COCKBURN HOOD."

"P.S.—There are undoubted Triassic beds in the adjoining province of Nelson.

"The boxes have gone in the 'Matoaka' to London."

I soon after received the following:—

"Christchurch Club, Canterbury, New Zealand, May 18th, 1869.

"MY DEAR PROFESSOR OWEN,—I wrote to you by last mail, and send this to let you know what I have sent home by the 'Matoaka,' in case it reaches England before I do myself. The numbers I give to distinguish the fossils found in each Boulder, some being 10 miles apart.

"I am, yours sincerely,

(Signed)

"J. H. COCKBURN HOOD."

LIST OF FOSSILS AS FOUND IN THE DIFFERENT BOULDERS.

- No. 1. Portions of head, upper and lower jaws.
- No. 1*. Point of *ditto*, of a large Crocodilian (*Teleosaurus*?).
- No. 2. Caudal vertebræ, *Plesiosaurian*; the two last broken.
- No. 3. Lower part of femur (of a land-Saurian); with this were vertebræ and ribs; 6 and 8, very cylindrical; second rib 15 inches long; one was 18 inches.
- No. 4. Ribs, etc., etc.
- No. 5. Vertebræ and humerus (*Ichthyosaurus*?).
- No. 6. Large, *ditto*.
- No. 7. T-shaped bone of sternum.
- No. 8. Vertebræ, fresh teeth, *Ostrea*, etc.; shells from coal-seam underlying Saurian (boulder)-bearing deposit.
- No. 9. Vertebræ, convex on anterior, concave on posterior, side (from boulder, apparently from coal bed).
- No. 10. Clavicle (found alone).
- No. 11. Ulna (found alone).
- No. 12. Coracoid bone (found alone).
- No. 13. Paddle 1 (alone).
- No. 15. Part of backbone (12 large vertebræ); bones of sternum, pelvis, etc., etc., apparently allied to *Teleosaurus*.
- No. 16. Cetacean, from overlying Tertiary.
- No. 17. Fucoids, etc., etc., from bone-bearing boulders.
- No. 18. Sulphureous clay, shells, etc., from boulder-bearing strata.

Mr. Hood returned in safety to England about two months after my reception of his last letter. He informed me that a vessel which left Christchurch, with a quantity of the *Phormium tenax* on board, had perished through spontaneous combustion of the cargo, and that the crew had been picked up after much suffering in the boats. The "Matoaka" had left with a similar lading, before tidings of the catastrophe had reached Christchurch, and as nothing has been heard of that vessel, now some months overdue, it is feared that she has also perished.

Some fossils from the locality at Waipara, explored by Mr. Hood, and from another locality, of the Nelson Province, have fortunately been preserved in the Colonial Museum at Wellington, New Zealand; and I have been favoured by receiving from Dr. Hector, F.R.S., the experienced Government Geologist of that Province, outline drawings of some of these fossils, of the natural size. From these drawings I have selected subjects which most unequivocally represent a species of Sauropterygian Reptile. They are represented, reduced, in Plate III.

Figs. 1-3 are of a cervical vertebra. It is broad and flat on the under surface of the centrum; the sides, also, of which, between the terminal articular surface, are more flattened than usual, and converge toward the neural surface, giving somewhat of a triangular figure to the vertical transverse section of that part. The pleurapophyses (*pl.*) come off from the lower part of the sides, and are confluent therewith, like transverse processes. The characteristic pair of venous foramina open upon the middle of the under surface; fig. 3. This vertebra most resembles one from the bone-bed of Aust-Cliff, near Bristol, described in my "Report on British Fossil Reptiles," 1839, p. 78. and referred, with a note of interrogation, to the *Plesiosaurus trigonus* of Cuvier. The articular surface of the centrum, fig. 1, is moderately concave, with a transversely oblong depression in the centre, and the margin rounded off. The neural arch is ankylosed to the centrum. The neural canal, fig. 1, is contracted, as usual, in cold-blooded air-breathers, and shows the ordinary proportion of that in *Plesiosaurus*. The pleurapophyses (*pl.*) are short and thick; the fore and aft diameter of their base equals two-fifths of that of the entire centrum: they are somewhat inclined downward. A distance of twice their vertical basal diameter intervenes between them and the ankylosed base of the neurapophysis, (*n*) figs. 1, 2.

This vertebra gives the following dimensions:—

	In.	Lines.
Length of centrum	2	1
Breadth of articular end of ditto	2	2
Height of do. do., at the middle	1	7

The New Zealand specimen shows an exceptional form among the extensive series of modified plesiosaurian cervical vertebræ already defined or recognized. Moreover, it is that form which, hitherto, from British deposits, has not been met with associated with other parts of the frame, yielding the characters of proportionate length of

neck; proportion of head to body; shape and number of teeth; form, structure, and proportions of limb-skeletons, either in relation to the trunk, or in that of the pectoral pair to the pelvic pair. In short, materials have been wanting for assurance that the degree of modification of the cervical vertebra, represented in Pl. III., may not have been associated with so much modification of the rest of the skeleton as to warrant a generic section of *Sauropterygia*, or a subgeneric one in the Plesiosaurian family. I leave, however, to him, who may have the good fortune to receive the requisite evidence, the privilege of propounding the generic term.

Meanwhile, one has the satisfaction of seeing this type of Sauropterygian cervical vertebra, which appears, with us, to be geologically related to a Triassic deposit, repeated in fragments or boulders of a broken-up part of, what the present evidence suffices to convince me has been, an old Mesozoic shore or sea-bed in New Zealand.

In Fig. 5 of Plate III. is given a reduced copy of a sketch of part of the skeleton of a Plesiosauroid, in which twelve ribs of the left side succeed each other. Whoever may glance at a specimen or figure of a similarly preserved trunk of a *Plesiosaurus*, from the old type *Ples. dolichodeirus* of Conybeare, now in the British Museum (*Trans. of the Geol. Soc.*, 2nd Sec., vol. i., pl. xlviii.), to the *Ples. homalospondylus* of my last Monograph on the subject (vol. for 1865 of the Palæontographical Society, tab. v.), will appreciate the generic character of the ribs in the New Zealand fossil. They are robust, subcircular in section, expanding somewhat, or thickening, at their middle, obliterating there, or leaving very little of intercostal space, at least in the collapsed condition of the chest: they are, likewise, solid (as indicated by the representation of a fractured end).

The extent, in a straight line along the mid-part of this costal series, is about 18 inches. The extent of vertebral column to which they have been articulated may be reckoned, accordingly, to have included twelve vertebrae, averaging an inch and a half in length.

Now, this is the fore-and-aft diameter of each of the five consecutive cervical centrums figured at the fore part of the costal series. If the foremost is rather shorter, the hindmost proportionally gains; but the increase of breadth is more marked than that of length, as is usual at the base of the cervical series in *Plesiosaurus*. The diagrammatic character of Dr. Hæctor's drawing—perfectly trustworthy in reference to general form and dimensions of the bones—leaves me in some doubt whether the riblets be indicated by the fractured ankylosed bases, or by pleurapophysial articular surfaces. In either case, these elements projected from the low level of the centrum, as in the single vertebra, Figs. 1-3. The foremost vertebra, represented in the sketch, from which the proportion figured in Plate III., Fig. 5, is reduced, is a cervical seen from an oblique side view, showing that the pleurapophysis is ankylosed, and its expanded end—if it had an expanded end—has been broken off. But the difference in the fore-and-aft as compared with the transverse diameter in each of the eight cervical vertebrae in the sketch—there are two intervening between the consecutive five and the detached one—forbids my refer-

ring the single vertebra (Figs. 1–3, Plate III.) to the same species as those represented by Fig. 5.

If no other indications of an enaliosaurian reptile had been obtained from the Triassic (?) beds of Nelson Province, or from the Waipara beds or boulders, the part of a limb-bone—I believe femur—sketched by Dr. Hector, and of which a reduced view is given at Fig. 4 and 4a—would have sufficed.

It shows the hemispheroid articular head, coarsely pitted by the characteristic circular depressions, with slightly raised margins. The degree of contraction of the shaft to the broken and the indicated retention, so far, of a subcylindrical shape of shaft, are incompatible with any known modification of an Ichthyosaurian humerus or femur. These are more angular, and transversely oblong at the proximal end, and more rapidly compressed and expanded towards the distant one in the fish-like sea-lizard. The fragment of limb-bone, in the Museum at Wellington, is plainly plesio- or plio-saurian, and most probably part of the same species, if not individual, as the trunk sketched in Fig. 5. The long diameter of the head of the bone is 3 inches, 6 lines; the short diameter is 3 inches. The peripheral contour is flatter or less convex on one side than the other, as it is in the same part of the femur of *Pliosaurus portlandicus* (Monograph, in the volume for 1869, of the Palæontographical Society, tab. iv., fig. 3), in which the small crateriform pits of the articular surface are shown; but this character is common to *Plio-* and *Plesio-saurus*.

Other genera of Mesozoic saurians are suggested by the "List" drawn up by my friend, the explorer of this dangerous but richly-stored locality: but the difficulty of precise determination from outline-sketches, even as to whether an obviously cup-and-ball vertebra be "pro-" or "opistho-coelian," decides one to wait, for the present.

PLATE III.

Plesiosaurus Hoodii, Owen.

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| Fig. 1. Cervical vertebra, end view. | } Half nat. size. |
| " 2. " " side view. | |
| " 3. " " under view. | |

Plesiosaurus crassicoelatus, Owen.

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| " 4. Proximal part of femur. | } One-third nat. size. |
| " 4a. Articular end of femur. | |
| " 5. Trunk-ribs and vertebrae from base of neck, | one-sixth nat. size. |

II.—ON THE AGE OF THE STRATIFIED DEPOSITS, WITH MAMMALIAN REMAINS AT CROFTHEAD, NEAR GLASGOW.

By JAMES GEIKIE, District Surveyor of the Geological Survey of Scotland.

(With Two Woodcuts.)

IN the GEOLOGICAL MAGAZINE for September, 1868, I described a section of Drift deposits which had been exposed in the cutting of the "Kilmarnock and Crofthead Extension Railway." If the reader refers to that paper he will find it stated that the Lower