neighbourhood, in the hope that by the collection of a few observations (however erroneously interpreted) it may to some extent assist and lighten the labour of those whose wisdom and experience enables them to interpret correctly those signs which record the geological history of the later periods.

ART. LXIII.—*On the Remains of a Gigantic Penguin* (Palæeudyptes antarcticus, *Huxley*) *from the Tertiary Rocks on the West Coast of Nelson.* By JAMES HECTOR, M.D., F.R.S., Director of the New Zealand Geological Survey.

(With Illustrations.)

[*Read before the Wellington Philosophical Society, 13th November*, 1869.*]

THE fossil remains I have to describe were forwarded to me by Mr. James Duigan, telegraphist at Brighton, a goldfield township on the west coast of Nelson province, between the Grey and Buller Rivers. They were discovered by him in a ledge or reef exposed only at low water, and forming part of the Seal Rock, a bold headland which protects the anchorage of Woodpecker Bay.

With considerable difficulty, owing to the inaccessible position and toughness of the rock, he succeeded in extracting the slab in which the bones are imbedded, together with a few other fossils from the same strata.

The bones are thoroughly mineralized, and resemble the condition in which fossil reptilian bones are usually found, the osseous tissue being completely replaced by calcareous matter of dense close structure and dark brown colour.

The rock matrix is an impure sandy limestone, having a compact but flaky structure. The skeleton appears to have been complete when imbedded, but has been so crushed and broken that only wing and leg bones can be now identified and cleared from the matrix.

The most perfect bones are:—1. The femur of the right side. 2. Both humeri. 3. Part of left ulna, and metacarpals of each side. 4. Portions of ribs, vertebræ, pelvis, and sternum, all in a very fragmentary state, can be traced on the slab, but no portions of the skull can be recognised.

The clearing of the matrix from the bones had to be effected with great care, as the fossils are apt to break transversely into splinters, on which account only one surface has been exposed in some cases.

It was the character of the distal articulation of the humerus, showing enormous strength without much freedom of motion, that led me to recognise this bone as belonging to the wing flipper of a Penguin. (*a'* and *a'*, Pl. XVIII., figs. 1 and 5.)

* For preliminary notice see *Proc.* N.Z. Inst., Vol. II., p. 403. The publication has been delayed for the illustrations.

In examining these remains I have compared them with the largest sized Penguin commonly found on the New Zealand coast, which is the Crested Penguin (*Eudyptes pachyrhynchus*, Gray), and which is about 30 inches in total length, and stands about 22 inches high when alive.

In Plates XVII. and XVIII. the fossil bones have been drawn along with the corresponding bones of the recent bird, so that the enormous excess in the proportions, size, and massiveness of the extinct bird may be the more easily realised.

1. *Femur* (Pl. XVII. fig. 1).—This bone has only been partly freed from the matrix, but the whole of the anterior surface and both extremities of it are fully exposed. Its length is 5 inches, and the least diameter of the shaft ·7 inch. On comparing it with the femur of the recent *Eudyptes*, which is 3 inches in length, the chief difference observable is the great massiveness of the fossil bone, which is more cylindrical, and with less decided ridges and muscular impressions than that of the recent bird, which, though smooth, is almost triangular in its cross section. The angle at which the neck of the bone is set to the shaft is also less obtuse in the fossil, and the neck itself is proportionally longer, the length from the great trochanter to the articular surface being only two and four-fifths in the total length of the bone, while in the recent bone it is four times. The trochanter, also, instead of forming an acute crest-like ridge, smooth and convex externally, and excavated internally, is an expanded deeply pitted process that sends off two ridges on the external surface of the shaft that inclose a shallow depression. The external condyle has been partly destroyed, but there is sufficient to show that the anterior groove for receiving the patella was much wider and shallower than in the existing bird.

2. *Humerus.*—That belonging to the left side has been quite freed from the matrix, but has evidently been much bruised and injured before fossilization took place. The articular surface, where in contact with the ulna on the same side, is fortunately well preserved. The right humerus, the internal aspect and head of which only are freed from the matrix, is in perfect preservation. It is a strong compressed bone of greater proportionate size to the same bone in *Eudyptes* than was found to be the case with the femur. Its total length is 6 inches, while the humerus of the recent skeleton with which it has been compared is only 3 inches—the proportion being thus two to one, while the femur was only as five to three. The greatest width of the fossil bone is at the neck, where it is 1·7 inch, whilst the recent bone is widest at its lowest third. The marked difference in the outline of the bones thus produced is very obvious in the drawings (Pl. XVIII. figs. 1 and 4). Where most compressed, which is at one-third from the distal extremity, its thickness is only ·2 inch. The powerful processes for the capsular and ligamentous

attachments of the bone with the scapula are well shown in figs. 2 and 3, and far exceed in proportion the same parts in the recent bone. But, on the whole, in this and all the other bones compared, there is a marked agreement in structure and anatomical characters with those of the existing bird, the chief differences being in the total and proportional measurements.

3. *Ulna.*—There is only a fragment of the upper end of this bone, belonging to the left side (Pl. XVIII. fig. 6), which was found in the slab with its articular surface applied to the corresponding posterior condyle of the humerus.

4. *Metacarpals.*—On the surface of the slab the metacarpals of both wings are exposed, but not cleared from the matrix. Their length is 3·5 inches, and greatest width 1·1 inch. It happens that in the Museum there is a beautifully preserved fossil bone, that was collected by Mr. C. Traill from the white Kakanui limestone of Otago, and which the study of these remains led me to recognise as the left metacarpal probably of the same species of Penguin, though belonging to an individual of slightly larger dimensions, the total length being 4 inches. This very perfect fossil has been figured (Pl. XVII. fig. 3) along with an outline of the corresponding bone of *Eudyptes* (fig. 4), which is only 1·7 inches in length.

The Oamaru specimen possesses great interest, from its connecting the fossil remains from the West Coast, which are under consideration, with a discovery made by Professor Huxley in 1857, who recognised from a single bone of the foot (*tarso-metatarse*), which had been submitted to him by the Hon. W. B. D. Mantell from the same formation that yielded Mr. Traill's specimen, that a gigantic Penguin existed in New Zealand during the early tertiary period. The bone described by Professor Huxley has been re-figured from his woodcut,* along with the same bone of the Crested Penguin (Pl. XVII. figs. 5 and 6), for comparison with the other bones of the fossil bird, of which we have now fragments of probably three distinct specimens, unless, by some rare chance, Mr. Traill's specimen, gathered many years later, should be part of the same skeleton that Mr. Mantell's bone belonged to. As there is no reason for ascribing the bones from the east and west coasts to different species, I propose to include them under the name given by Professor Huxley—*Palæeudyptes antarcticus.*

In forming this new genus Professor Huxley states that the fossil bone he described approximates most to the characters of the Crested Penguin (*Eudyptes*), the skeleton of which I have used in the foregoing comparisons, but that it indicated the former existence of a bird twice as tall and massive as the largest existing species of this genus, and probably from 4 to 5 feet high. From the comparisons I have been able to make with the larger series of bones now obtained, I am convinced that this estimate is rather under than over the size of the extinct bird.

* "Quart. Jour. Geol. Soc.," XV., 672.

The age of the strata containing these fossil bones is a matter of some interest, and on this subject Professor Huxley remarks :—

"Whatever be the precise age of the fossil, it is not a little remarkable to find in strata of such antiquity the remains of a bird, the whole of whose congeners are at present absolutely confined to the southern hemisphere, and, therefore, in a broad sense, to the same great distributional area. If the strata be of pliocene age, the fact is in accordance with the relations which have been observed to obtain between the recent and pliocene faunæ of the northern hemisphere. On the other hand, the little that is at present known respecting the distribution of birds in time is not inconsistent with the ascription of a far greater antiquity to a genus as closely allied as *Palœeudyptes* to those which now exist."

I am now inclined to the opinion that the fossils belong to the earliest tertiary formations of New Zealand for the following reasons.

The Kakanui limestone, which is the same as the Ototara series of Mantell, and from which the specimen submitted to Professor Huxley came, was considered by Professors Forbes and R. Jones, who examined the associated fossils, to possess mixed characters of the eocene and upper cretaceous formations of Europe.*

This limestone is very widely distributed round the sea-board of the North Island, and affords a very distinct horizon, which closes the earlier tertiary deposits, as it nowhere, so far as I am aware, passes conformably into the marine tertiary formations of later date.

On the west coast of the Island, although the tertiary strata occur in detached areas, their relative age can be observed with a considerable amount of certainty.

Without entering fully into the discussion of the geology of these formations, they may be shortly described as follows, to explain the stratigraphical position of the bed from which the fossil bones were obtained :—

1. Underlying the gold drifts (*pleistocene*) in the county of Westland, and extending northwards up the valley of the Grey River are blue sandy clays passing upwards into a coarse shingle conglomerate, and which together represent the upper marine tertiaries on the west coast. Towards the base of this formation, which is at least 1,000 feet thick, calcareous nodules occur, containing *Struthiolaria, Ancillaria, Dosinia, Cucullœa*, and other fossil shells characteristic of the younger tertiary series, and closely allied to, or identical with species that still exist in the neighbouring seas.

2. Unconformably disposed to these, and of much higher antiquity, are the following groups of strata, to which I have collectively applied the term cretaceo-tertiary, as no well marked break that is common to all the sections

* "Quart. Jour. Geol. Soc.," VI., 329.

that can be inspected has been observed in their sequence; and, moreover, certain fossil forms are found in all the members of the series.

a. The highest beds are green calcareous sands, generally ferruginous, which are followed by tabular limestones, having a thickness of about 700 feet. These beds abound in fossils, of which *Pecten Hochstetteri* is the most constant and characteristic.

b. These calcareous beds, which represent the Ototara series, pass gradually into a compact chalk marl and then to tough argillaceous marl, which contain, along with *Pecten Hochstetteri*, many large forms of *Echinoderms* and a very large species of *Inoceramus*. The thickness of these beds is at least 800 feet.

c. Beneath the foregoing are finely laminated and extremely friable marly shales of a chocolate and grey colour, with thin, hard calcareous bands, with only few indistinct fossils, which are chiefly *Foraminiferæ*. The thickness of these shales is over 400 feet.

d. Tough blue clays, having a globular structure and ferruginous partings, succeed these, and gradually pass into a brown argillaceous and micaceous sandstone, with concretions of limonite, which contain a few characteristic fossils, chiefly littoral forms, such as *Cardium*, *Natica*, and a small *Echinoderm* (*Schizaster ?*) being forms that are not found higher in the series. The thickness of the clays and sandstones is probably not less than 1,000 feet.

e. They rest on an irregular surface of a great fluviatile formation, the upper portion consisting generally of conglomerates, which attain a thickness of 800 feet, and rest on fine micaceous sandstones, grits, and shales, but sometimes the conglomerates are absent, and the sandstones pass insensibly into the previous group.

On the surface of the conglomerates, and immediately succeeded by the fossiliferous sandstone, is frequently a seam of brown pitch coal, from 4 to 30 feet in thickness, but this, as might be expected, is by no means constant.

In the lower sandstone there is always more or less coaly matter, and abundance of fossil leaves of dicotyledonous trees, zamias, and palms, and locally fine seams of excellent, though friable, bituminous coal, attaining a thickness of 10 to 20 feet.

In some places on the west coast this formation passes downwards into a breccia of green and blue slate rock fragments, cemented with quartzose porphyry, but more frequently it rests directly on the primary slates and granite formation that constitute the framework of the district.

The section which I have thus described may be seen on the coast north of the Grey River, where the strata have a dip to the seaward of 10° to 12°, but they also present the same general character and order of succession in mountains in the northern part of the Nelson province, at the source of the Karamea River, where almost vertical sections, of 2,700 feet in height, can be

observed, the cap of the mountain being formed by the tough marly limestone, so that the upper and friable members of the series are wanting, probably having been removed by denudation.

The strata at the Seal Rock, in which the Penguin bones were found by Mr. Duigan, appear to belong to group *a*, the fossils found *in situ* along with the bones being *Scalaria lyrata*, *Pecten Hochstetteri*, *Gryphœa*, sp., *Brissus Crawfordi* (a species of the same size and form as *B. eximius*, but with the ambulacræ radiating equally), *Cidaris*, sp. (with large plates), *Turbo*, sp. (with a flat base); and a large shark's tooth, *Carcharodon*, sp.

The following fossils received along with the above were stated to have been obtained from rolled stones on the beach:—*Venus*, *Dosinia*, *Lima*, *Fusus*, *Cassidaria*, *Echinus?* and the large *Inoceramus*. The *Inoceramus* is imbedded in white chalk, but all the other shells are in the same sandy limestone that incloses the bones. Although none of these fossils resemble recent forms, and the *Gryphœa* and *Inoceramus* are decidedly of cretaceous type, yet from other parts of the same formation, where more extensive collections have been made, sufficient evidence has been obtained to prove that it has to some extent the character of a tertiary deposit, but until the fossils have been thoroughly examined, and the per centage of existing forms ascertained, the equivalent age of the strata whether miocene or eocene, for they must be at least as old as these, cannot be determined.

From the evidence I have now advanced there can be little doubt that this fossil Penguin was entombed at a very early period, when the seas in this area were inhabited by several forms of the invertebrata that are now extinct.

Description of Plates XVII. and XVIII.

Plate XVII. fig. 1.—Front view of Right Femur of *Palœeudyptes antarcticus*, the Fossil Penguin from the Seal Rock.

Fig. 2.—Front view of Right Femur of *Eudyptes pachyrhyncus*, the existing Crested Penguin of New Zealand, 22 inches high.

Fig. 3.—Metacarpus of Fossil Penguin from Oamaru limestone, Otago.

Fig. 4.—Metacarpus of Recent Penguin.

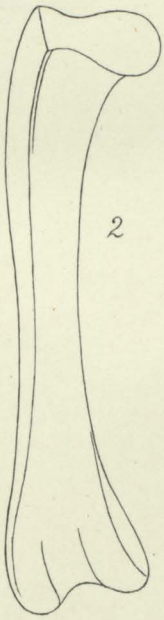
Fig. 5.—Tarso-metatarse of Fossil Penguin from Kakanui limestone, Otago, from Professor's Huxley's drawing.

Fig. 6.—Tarso-metatarse of Recent Penguin.

Plate XVIII., Fig. 1.—External, fig. 2—internal, and fig. 3—posterior aspect of Right Humerus of Fossil Penguin from the Seal Rock.

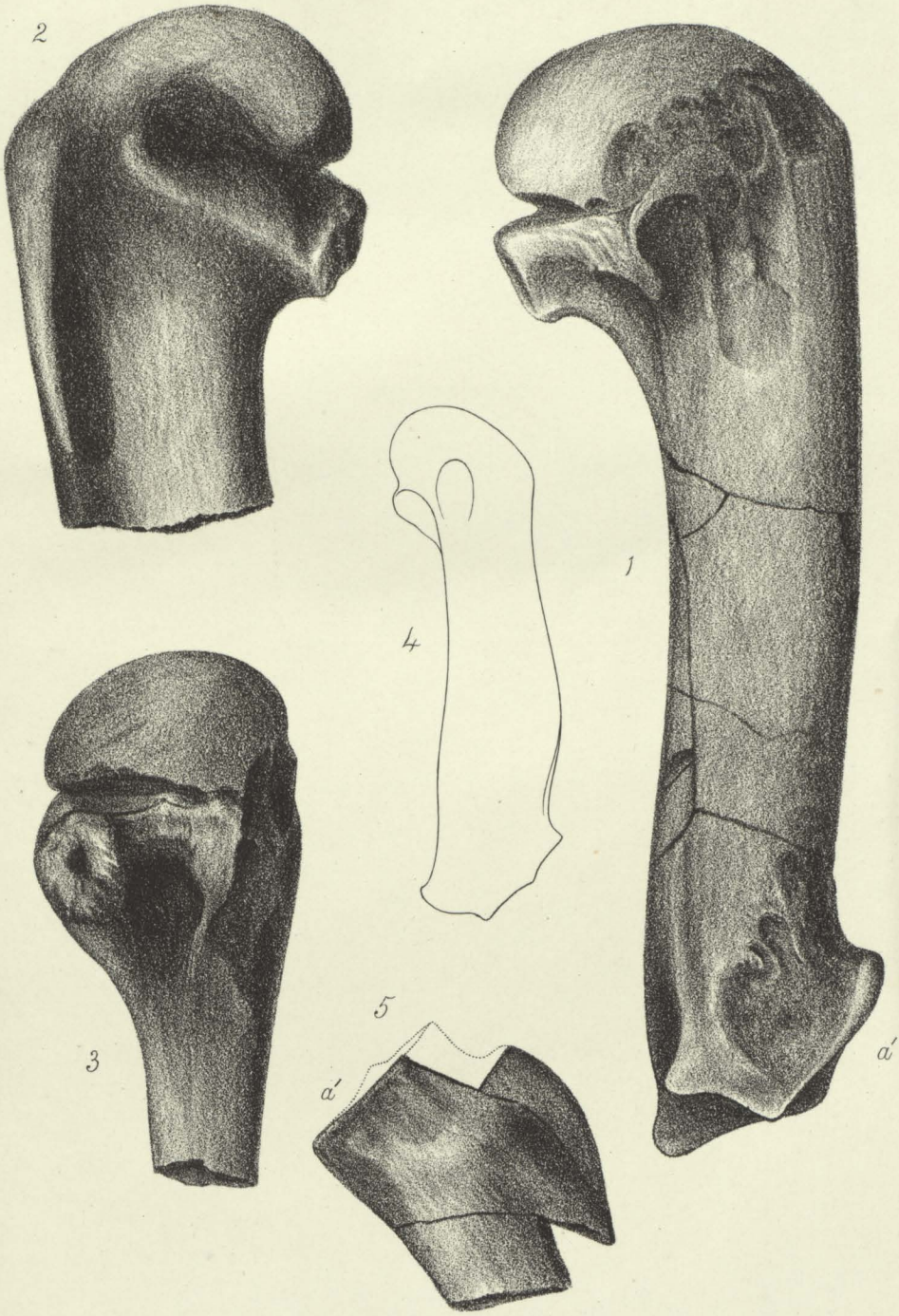
Fig. 4.—External aspect of Right Humerus of Recent Penguin.

Fig. 5.— Head of Ulna of Fossil Penguin, articular surfaces marked *a'* were in contact.



FOSSIL PENGUIN.

J. Buchanan, del. et lith.



FOSSIL PENGUIN.

J. Buchanan del. et lith.