

rhinoceros, hippopotamus, hyæna, and tiger, which are so common in the old European gravels." This extract seems to confirm the destructive properties of peat; and I believe that all the remains of the Irish elk from the bogs of Ireland are from the clay- or marl-beds immediately at the base of the peat.

Since writing the above I have seen large peat-deposits in Southland at a much lower level. In one place, at the Mararoa Station, near Mount Excelsior, the peat has been regularly worked for years for burning. Here also moa-stones occur in profusion. The process of cutting also exposed the fragments of perished bones. I carefully examined this deposit, and found it to consist almost entirely of *Calorophus*; and the *Sphagnum* which forms the majority of peat-mosses in England was entirely absent.

I should have mentioned above that the nearest place at which the quartz pebbles could be procured is at the outcrop of the Otago schist formation, distant from Swampy Hill about four miles. The weight of the largest stone in the two collections is a little over 1½ oz.

ART. VII.—On the Genus Aptornis, with more Especial Reference to Aptornis defossor, Owen.

By A. HAMILTON.

[Read before the Otago Institute, 8th November, 1891.]

As long ago as the year 1842 Dr. Buckland received from New Zealand a collection of moa-bones from the east coast of the North Island, forwarded to him by the Rev. W. Williams. On examining this collection Professor Owen found ample confirmation of his previous determination of the cursorial character of the specimens on which he had founded his genus *Dinornis* in the year 1839.

Among the bones in this collection he found a tibia "which unequivocally establishes a fourth species of Cursorial bird, which, from the agreement of the bone in its general characters with the tibiæ of the larger species, most probably belonged to the same genus—*Dinornis*—but did not surpass in size the great bustard" (*Otis tarda*). This species the Professor named *Dinornis otidiformis* (1843).

Time passed on, and further collections of bones were made in New Zealand and sent Home (1846), and in the memoir on the genus *Palapteryx* a fragmentary femur is allotted to the

previously-described tibia. The bone was, however, so imperfect that only the circumference could be given in the table of measurements of the bones of the leg in *Dinornis*.

On the arrival of the great collection of Dinornithic remains made by Mr. Walter Mantell in the South Island (1848), several "tarso-metatarsal bones, with the articular surface for a very strong hind-toe, and a conformation more resembling the dodo than those of *Dinornis* or *Palapteryx*," were recognised, and the special and extraordinary characters presented by the bone decided the professor to establish a new genus under the name of *Aptornis*, placing in this new genus the bones hitherto ascribed to *Dinornis otidiformis*. A cranium in the same collection was figured as probably that of *Dinornis casuarinus*; but when, in 1865, the Ralline characters of the skull were recognised and fully and clearly pointed out by Professor W. K. Parker,* this skull was also assigned to *Aptornis*.

A further addition to the knowledge of the skeleton was made by a description of the sternum, which was included in a collection of bones from Waingongoro, on the west coast of the North Island (1850). This was described and figured both in the Proceedings of the Zoological Society and in the "Extinct Birds of New Zealand," although in the text it is assigned to *Notornis* or *Brachypteryx*. All of the bones hitherto noticed may probably be classed as belonging to the smaller of the two species now known, *Aptornis otidiformis*, Owen.

No other bones of the genus were figured or described till a memoir appeared on the Anserine genus *Cnemiornis* (1865), and a humerus was then figured and described which has since been more correctly assigned to *Aptornis*. From a collection of bones forwarded by the Rev. Richard Taylor, of Wanganui, Professor Owen found himself called upon to name a second species of the genus, which he named *Aptornis defossor*, principally from a beautiful specimen of a skull and some other bones "discovered in a cave of soft sand about fourteen miles from Oamaru, which was filled with bird-bones." The monograph which resulted from the examination of these bones concluded with a comparative table of the measurements of the chief bones of the skeletons of the two species.

From another collection of bones from a fissure at Albury, near Timaru (1871), the sternum and pelvis of the larger species were described, and a restoration of the complete skeleton given.

In 1873 two important papers on *Cnemiornis* appeared—one read before the Wellington Philosophical Society by Sir

* Phil. Trans. Royal Soc., vol. clvi., p. 113: "On the Structure and Development of the Skull in the Ostrich Tribe;" by W. K. Parker, F.Z.S.

James Hector, on a collection of bones found by Captain Fraser in a cave near Alexandra, in the Otago Lake District;* and the other by Professor Owen, being a restoration of the *Cnemiornis* skeleton from additional material received by him.

The coracoid which Professor Owen there figures on plate cii., Mr. H. O. Forbes identified in 1889 before the Philosophical Institute of Canterbury as belonging to *Aptornis*; and this identification I can now confirm, and show that the bone does not need the conjectural additions shown in pl. cii., as the union with the sternum is a ragged one, sometimes ankylosed, and not by a synovial joint. I must also claim from this *Cnemiornis* paper not only all the vertebræ figured on plate cii., but also those given on plate lxvi., "Extinct Birds of New Zealand," as vertebræ of *Aptornis defossor*.

Sir James Hector only figures a few dorsal vertebræ of *Cnemiornis* in his paper, but these are quite sufficient to show the great difference in almost every character from *Aptornis*:†

With the exception of the phototype of the nearly complete skeleton of an individual of the smaller species, now in the Canterbury Museum, published in Dr. von Haast's "Geology of Canterbury and Westland" (1879), and the figures of the type specimens accompanying the papers in the Proceedings of the Zoological Society (reproduced in the "Extinct Birds of New Zealand"), little else has been published on this genus.

It has fallen to the lot of Mr. W. S. Mitchell, of Lake Manapouri Station, Southland (1889), to find a number of bones of *Aptornis defossor* in some limestone caves on the Oreti River, in Southland, and through his kindness I have the opportunity of describing this important find, and I shall endeavour to supply a little information on points which could not well be made out from the original types.

All the bones came from a series of limestone caves, and are still partly covered with incrustation of fine limestone dust, but in the majority of cases the bones are in perfect condition. After careful and prolonged examination, I find that six or seven individuals are represented, and that in four cases the bones can be allotted to the skeleton without much doubt as to their having formed part of an individual bird. But the most important fact to be observed is that here there is no mixture of "doubtful" bones, all the other bones obtained from these caves and fissures at the same time and in the same neighbourhood being easily-distinguished species of *Dinornis*, kiwi, kakapo, (*Stringops*), &c., and in no instance have any *Cnemiornis* bones been found

* Trans. N.Z. Inst., vol. vi.

† Trans. N.Z. Inst., vol. vi., pl. xiv.

here, so that such bones of this kind as are present can be identified with almost absolute certainty as being those of *Aptornis*, and, as I have before said, can by their peculiarities be allotted to definite individual skeletons. As will be seen from the table of measurements, the dimensions of the limbs agree very closely with the measurements given by Owen (p. 315, *op. cit.*), but the individual distinguished as B is slightly larger in all its measurements.* It is just possible that it may be found that this represents the species provisionally named by Professor Owen *A. bulleri*, in a letter to Sir Walter Buller, quoted at p. xxii. of the introduction to Buller's "Birds of New Zealand" (new edition). I am at present, however, inclined to regard the difference as due to sex.

The Skull.—Apparently the first *Aptornis* skull received by Professor Owen was a very fine specimen of the smaller species in Mr. Mantell's collection in 1848, and for a time it figured as the skull of *Dinornis casuarinus*; but in a paper in the Philosophical Transactions of the Royal Society of London, 1866, the late Professor W. K. Parker wrote very fully on the essentially Ralline characters presented by the skull, which he incidentally calls "nearly as precious and quite as unique as the skeleton of the *Archæopteryx*," and he goes on to say that in his opinion the skull has great affinities with *Psophia*, the trumpeter crane, specially drawing attention to the greatly-developed basi-temporal pterygoid processes, the decurved lower mandible, and the almost complete ossification of the interorbital septum. Professor Parker considered the bird a *Notornis*, and proposed the name of *Notornis casuarinus* for it.

For his work on the "Extinct Birds of New Zealand," Professor Owen was fortunate enough to receive a beautiful skull of *Aptornis defossor* from Oamaru, and it is excellently figured in plates lxxxiii. and lxxxiv. of that work.

The collection obtained by Mr. Mitchell contained one skull which is absolutely perfect, and three others more or less damaged. There are three lower maxillaries.

The Vertebrae.—At present I have only been able to select one complete set of the vertebrae. Fortunately, one atlas vertebra occurred, and, on comparing it with the three or four specimens of the axis vertebra, one was found to fit it exactly. Thus an important part, and one often missing from fossil skeletons, is now known. The cervical vertebrae immediately succeeding the axis rapidly increase in size, and

* I have given the measurements in decimal notation, as being more generally useful than inches and lines or tenths. Some of the slight differences may be accounted for by the system of measurement adopted. All my measurements are made on the lines of major axis of the bones, or at points at right angles to it.

are relatively enormous and very massive, and Professor Owen says (p. 373, *op. cit.*), "No Anserine comes near *Cnemiornis* in this respect. Its cervical vertebræ recall the proportions of those in *Megaceros*, and have a like relation to the muscular force brought to bear on the head. . . . This is probably related to the grip and tug exercised by the . . . strong beak upon the vegetable growths torn up for food." The professor, in the note at the foot of p. 372, states that twelve cervical vertebræ of *Cnemiornis* were collected by the Hon. Captain Fraser in the Earnsclough Cave, and that Dr. Hector attributed them to the same individual bird. If figures of these had been available, the professor would have doubtless corrected his identification, as they would have differed greatly from those put forward in plates lxvi., cii., and lxxvii. of his memoir on the "Extinct Birds of New Zealand."

The whole of the vertebræ figured by Professor Owen as belonging to *Cnemiornis* may be taken as representing vertebræ of *Aptornis*. I do not now intend to go into the details of the structure of the bones of the axial skeleton of this bird, but I may say that every vertebra will well repay careful examination, the whole forming a series quite unique in its proportions, and I have no doubt that some day a most interesting paper will be written concerning it. I have not yet succeeded in finding any caudal vertebræ.

The Pelvis.—The series of bones of *Aptornis* included four specimens of that compound bone called the pelvis; and one of the specimens is absolutely perfect, just as if it had been prepared by maceration in the workshop. The others are more or less imperfect, the only point of interest about them being that in the one marked C an additional vertebra has coalesced with the sacral portion of the pelvis, making three rib-bearing vertebræ in the pelvic mass. The pubic bones in the best specimen are quite entire, and enable the figure given in plate lxxxix. of the "Extinct Birds of New Zealand," and plate xiv. in the 8th volume of the Transactions of the Zoological Society, to be completed. As already noticed by Professor Owen, the structure of the pelvis of this bird is pre-eminent as an example of strength combined with lightness.

The Sternum.—The much-reduced sternum of this bird is represented by four specimens, three of which are perfect, the other being very slightly injured. They agree almost exactly with the one already figured. The coracoid has been figured by Owen as the coracoid of the extinct goose (*Cnemiornis*), and a portion added in outline to show how it fitted the coracoid notch in the sternum. Now, in this collection there are three specimens of this important bone, and, as if to prevent any possibility of error, one is completely anchy-

losed to the sternum of the skeleton marked A. The corresponding bone (the left) is present, but is free, and shows that the whole of the bone was present in the specimen figured on plate lxxxix. of the "Extinct Birds of New Zealand."

The Scapula.—The remaining element of the scapulo-coracoid arch is represented by three specimens; and, as the exact fit of the bone with the coracoid, and the resulting angle, is a matter of some considerable interest, I hope Professor Parker will investigate it, and collate the results with those he has so elaborately worked out in his paper on the skeleton of *Notornis*.

The Humerus.—This bone is represented by five specimens, and has been figured and described already. The engraving gives a good idea of the bone; but the small tubercle or prominence on the lower third of the shaft is not present in any of the specimens examined by me. It should be noted that on page 378 of the book Professor Owen corrects his previous identification, and ascribes it to *Aptornis*.

The Femur.—Represented by six specimens. The published figures of this important bone are not satisfactory.

The Tibia and Fibula.—The figures on plates lxxxiv. and lxxxvi. not being taken from very perfect bones, I hope to give a figure taken from complete specimens. The metatarsus is an exceptionally interesting bone, and quite easily recognised. There were six metatarsi, and a sufficient number of the phalanges to partially restore the feet.

The *ribs* have not hitherto been described or identified; they are of a unique character, and some have very curious epipleural appendages; others are very long and thin—very different from the Dinornithic ribs of the restoration on plate xciv. of the "Extinct Birds of New Zealand."

The few tracheal rings found with the skeletons are quite different from those assigned to *Aptornis* on plate xcii. (*op. cit.*). There is no notch on the rings, and a section of the circumference is merely circular, and not flat as in most of the Dinornithidæ. The diameter of the rings, which are oval, is as 2 to 1. I am somewhat inclined, after all, to consider these as belonging to *Anomalopteryx didiformis*, found in the same locality.

TABLE OF ADMEASUREMENTS OF APTORNIS DEFOSSOR, OWEN
(IN MM.)

	Owen.	A.	B.	C.	D.	E.
<i>Skull—</i>						
Length	182	183	..	..	..	..
Breadth across paroccipitals ..	82	80	86	..	..	..
" across post-frontals ..	80	86	88	..	..	..
" across temporal fossa ..	57	49	..	..	..	..
" of middle of upper mandible ..	35	32	..	..	..	..
" of fore-end of upper mandible	16	16	..	..	..	..
Width of basi-sphenoid ..	27	27	35	29	29	..
<i>Pelvis—</i>						
Width at post-acetabular prominence ..	..	108	109	105	102	..
Extreme length .. .. .	..	280	..	265	..	..
<i>Sternum—</i>						
Length in central line	141	134	147	134	137	..
Extreme width .. .. .	..	90	104	84	96	..
<i>Coracoid—</i>						
Greatest length .. .. .	..	90	92	..	..	..
<i>Scapula—</i>						
Greatest length .. .. .	..	112	110	103	..	..
<i>Humerus—</i>						
Greatest length .. .. .	..	132	136	135	..	133
<i>Femur—</i>						
Length	190	184	191	187	190	190
Breadth of proximal end in the axis of the neck	55	55	53	54	57	..
Breadth of distal end	55	54	53	54	57	..
Circumference of middle of shaft ..	69	71	67	68	72	71
<i>Tibia—</i>						
Length	259	259	278	260	262	264
Breadth of proximal end	57	71	74	71	71	66
" of distal end	47	37	41	37	39	37
Circumference of middle of shaft ..	63	63	63	60	64	63
<i>Metatarsus—</i>						
Length	107	107	118	109	110	110
Breadth of proximal end (transverse) ..	41	41	47	43	42	42
" of distal end (transverse) ..	42	42	45	50	44	44
" of calcaneal process ..	35	35	40	37	37	37

TABLE OF REFERENCES TO FIGURES OF THE BONES OF THE SKELETON OF *APTORNIS DEFOSSOR*, OWEN.

—	Figure.	Description.	Remarks.
Skull ..	Trans. Zool. Soc., vol. vii., pl. xl. and xli., figs. 1-3	Vol. vii., p. 354 ..	The mandible of <i>Aphanapteryx</i> is figured on these plates, ex <i>Ibis</i> , 1869.
Vertebrae ..	Ext. Birds of N.Z., vol. ii., pl. lxxxiii. and lxxxiv.	Vol. i., p. 291.	
	Trans. Zool. Soc., vol. v., pl. lxiii., figs. 3, 4 ..	Vol. v., p. 396 ..	All cervicals, described and figured as belonging to <i>Cnemiornis</i> .
	" vol. ix., pl. xxxvi., fig. 1 ..	Vol. ix., p. 260 ..	
	Ext. Birds of N.Z., vol. ii., pl. lxvi., figs. 3, 4 ..	Vol. i., pp. 239-372	
	" " pl. lxvii., fig. 1 ..	Vol. i., p. 240 ..	
	Trans. Zool. Soc., vol. v., pl. lxiv., fig. 1 ..	Vol. v., p. 396 ..	
	" vol. ix., pl. xxxvi., fig. 6 ..	Vol. ix., p. 261 ..	
	Ext. Birds of N.Z., vol. ii., pl. lxvii., fig. 1 ..	Vol. i., pp. 372-4 ..	
	" " pl. cii., fig. 6 ..	Vol. i., p. 240 ..	
	Trans. Zool. Soc., vol. ix., pl. xxxvi., figs. 11, 12	Vol. ix., p. 262 ..	
	Ext. Birds of N.Z., vol. ii., pl. cii., figs. 11, 12 ..	Vol. i., p. 240 ..	
	Trans. Zool. Soc., vol. ix., pl. xxxvi., figs. 15, 16	Vol. ix., p. 262 ..	Dorsals, described and figured as belonging to <i>Cnemiornis</i> .
	Ext. Birds of N.Z., vol. ii., pl. cii., figs. 15, 16 ..	Vol. i., p. 240 ..	
	Trans. Zool. Soc., vol. ix., pl. xxxvi., fig. 17 ..	Vol. ix., p. 262 ..	In the figure in the Transactions the restored outline is indicated.
	Ext. Birds of N.Z., vol. ii., pl. cii., fig. 17 ..	Vol. i., p. 240 ..	
Pelvis ..	Trans. Zool. Soc., vol. viii., pl. xv., figs. 1, 2 ..	Vol. viii., pp. 122, 126	
	Ext. Birds of N.Z., vol. ii., pl. lxxxviii., figs. 1, 2	Vol. i., p. 342.	
	Trans. Zool. Soc., vol. viii., pl. xiv., fig. 1 ..	Vol. viii., pp. 122, 126.	
	Ext. Birds of N.Z., vol. ii., pl. lxxxix., fig. 1 ..	Vol. i., p. 342.	
Sternum ..	Trans. Zool. Soc., vol. viii., pl. xiv., figs. 2, 3, 4	Vol. viii., pp. 119, 121.	
	Ext. Birds of N.Z., vol. ii., pl. lxxxix., figs. 2, 3, 4	Vol. i., p. 340.	
Coracoid ..	Trans. Zool. Soc., vol. ix., pl. xxxvii., figs. 4, 7 ..	Vol. ix., p. 264.	
	Ext. Birds of N.Z., vol. ii., pl. ciii., figs. 4, 7 ..	Vol. i., pp. 376, 377.	

Humerus	Trans. Zool. Soc., vol. v., pl. lxvi., figs. 7, 10 ..	Vol. v., p. 399, and vol. ix., p. 266.
	Ext. Birds of N.Z., vol. ii., pl. lxix., figs. 7, 10 ..	Vol. i., pp. 242, 243; p. 366, and p. 378
Femur ..	Trans. Zool. Soc., vol. vii., pl. xliii., figs. 5-7 ..	Vol. vii., p. 371.
	Ext. Birds of N.Z., vol. ii., pl. lxxxvi., figs. 5-7 ..	Vol. i., p. 306.
Tibia ..	Trans. Zool. Soc., vol. vii., pl. xli., fig. 9.. ..	Vol. vii., p. 372.
	Ext. Birds of N.Z., vol. ii., pl. lxxxiv., fig. 9 ..	Vol. i., p. 309.
	" vol. ii., pl. lxxxvi., fig. 8 ..	..
Fibula ..	Trans. Zool. Soc., vol. vii., pl. xli., figs. 10, 10A..	Vol. vii., p. 373.
	Ext. Birds of N.Z., vol. ii., pl. lxxxiv., figs. 10, 10A	Vol. i., p. 310.
Metatarsus	Trans. Zool. Soc., vol. vii., pl. liv., figs. 1-5 ..	Vol. vii., p. 374.
	Ext. Birds of N.Z., vol. ii., pl. lxxxvii., figs. 1-5 ..	Vol. i., p. 311.
Ribs ..	.. ..	Vol. i., p. 210 ..
Tracheal rings	Trans. Zool. Soc., vol. vii., pl. xlvi., fig. 7 ..	Vol. vii., p. 392.
	Ext. Birds of N.Z., vol. ii., pl. xciii., fig. 7 ..	Vol. i., p. 333.
Restoration of skele- ton	Trans. Zool. Soc., vol. viii., pl. xvi.	Vol. viii., p. 126.
	Ext. Birds of N.Z., vol. ii., pl. xciv.	Vol. i., p. 339.
Table of ad- measure- ments	Ext. Birds of N.Z.	Vol. i., p. 315.

In the index of plates in the "Extinct Birds of New Zealand" the humerus is said to be on pl. lxvii. It, however, appears on pl. lxix., but is not noticed in the index when describing that plate.

Head of tibia, from above. Not mentioned in description of plate in index.

Casual mention, as occurring in the Timaru fissure.

