MEMOIR
ON THE
EGGS OF SPECIES OF DINORNIS.

In 1843 the Rev. Richard Taylor, of the Missionary Station at Wanganui, visiting the shore of the coast of Waimate, near the river Waingongoro, found a sandy plain covered with a number of little mounds, entirely composed of Moa bones: "it appeared," he writes, "to be a regular necropolis of the race"1. Here fragments of shells of some large egg were first met with. "When I next visited Waingongoro, expecting to carry off another load of Moa bones, I found, to my surprise, that they had disappeared. I afterwards heard that Mr. Mantell had passed that way after me, and had cleared the place of all worth taking"2.

The collection so obtained by Mr. Mantell was purchased by the British Museum (ante, p. 223); and, after the determination of the species of Dinornis represented by the bones, I proceeded to compare the numerous fragments of egg-shell. These had previously yielded the following generic character:—"The shell in Dinornis is not only absolutely thinner, but relatively much thinner than in the Ostrich, and, à fortiori, than in the Æpyornis. The air-pores also have a different form, being linear, not rounded; and the external surface is smoother. In the smoothness and thinness of the shell the egg of Dinornis resembles that of Apteryx." But, "viewed under a moderately magnifying power, the surface of the egg of the Apteryx presents a very fine fibrous or spicular character; the raised lines, like spiculae, crossing in opposite directions, the air-pores scattered here and there, and barely perceptible to the human eye"3.

After a general comparison and sorting of the shell-pieces and fragments, they indicated eggs of two, if not three sizes. That to which the most numerous fragments

1 Transactions of the New-Zealand Institute, vol. v. 1872, p. 98.
were referable gave grounds for an estimate of size of the entire egg. The convex surface showed two degrees of curvature, one indicating the length, the other the breadth of the egg. The direction of the linear air-pores ran mainly in that of the long axis of the egg, as inferred by the major curve. A few fragments, by shorter curves coinciding with the direction of the air-fissures, indicated proximity to one or other of the ends of the egg.

A comparison with corresponding curves in answerable portions of an egg of an Ostrich led me to the conclusion as to comparative size, which is illustrated in Plate XC. The middle circle, inclosing the words *Struthio.... Struthio*, gives the extreme transverse girth, the dotted line of the middle oval, inclosing *Struthio*, gives the longitudinal girth, of the egg of the Ostrich. The outer circle, inclosing "*Dinornis.... Dinornis,*" gives the extreme transverse girth, the outer oval, in dotted line, gives the extreme longitudinal girth, of the egg of a Moa. Guided by the proportion of the number of shell-fragments indicating the same species of bird to that of the number of bones referable to one species, I was led to the conclusion that the form and dimensions of the egg of *Dinornis elephantopus* had thus been worked out. The portions of egg-shell, indicating by their curvatures a smaller kind of Moa, were of larger size; and long and patient attempts at fitting them together were ultimately rewarded by a reconstruction of one of the eggs, now in the British Museum, the most perfect side of which is figured in Plate CXV.

As the Mantellian collection, besides its illustrations of the then new species *Dinornis elephantopus* (p. 223), included many specimens confirmatory of *Dinornis crassus*, previously indicated by bones discovered by Percy Earl, Esq., at Waikawaite (p. 132), it seemed probable that the smaller egg belonged to that smaller species.

In the Plate CXV. are given illustrations of the structure of the egg-shell: fig. 2 shows the markings on the outer surface, nat. size; fig. 3 the same, magnified three diameters; fig. 4 shows the thickness of the shell of the egg of *Dinornis elephantopus*; fig. 5 a portion magnified three diameters, to show the proportions of the inner and outer layers of the shell.

Such was the degree of knowledge of the egg-characters of *Dinornis* to which I had got in 1856.

In the year 1865 an egg of a *Dinornis* was sent from New Zealand to London, and was submitted to my inspection. A small portion of the shell had been broken away at one side of the egg; but the pieces were transmitted. The egg measured 10 inches in length and 7 ½ inches in breadth; the shell was 1/12 of an inch in thickness. showed the external linear air-pores and the smooth inner layer characteristic of the *Dinornis* egg-shell; but the shell in this instance had been stained of a dirty brownish colour, probably from the decomposition of the body of the native with which it had been buried, added to the natural colour of the grave-soil.

Judging from the degree of superiority of size of this egg in comparison with that of
the *Dinornis elephantopus*, and deeming it probable that some slight variation of breadth to length in the egg might accord with a similar modification of robustness to height of the body in the species, I inferred that the specimen was the egg of *Dinornis ingens*. As such it was offered for sale by auction, 24th November, 1865.

The 'Note of Sale' stated that "A man in Mr. Fyfe's employment at Kai Koras was digging the foundation of a house; and when on the side of a small mound, he suddenly came upon the egg in question and the skeleton of a man, supposed to be a Maori. The body had evidently been buried in a sitting posture; and the egg must have been placed in the hands, as, when found, the arms were extended in such a manner as to bring the egg opposite the mouth of the deceased." In corroboration of this story I received from J. Davies Enys, Esq., of Christchurch, New Zealand, the following Note:—"I beg to state that, being on a visit to the Kaikouras at the latter end of 1861, I was shown by Mr. Fyfe the Moa-egg, together with a human skull and a blackstone adze, which he kept in a box together, as having been found together when digging the foundation for a Store close to his house. Mr. Fyfe observed at the same time that he had only preserved the skull of the skeleton with which the egg was found, and that the Maories had no traditions whatever of a burial-place in that locality, although one of their Pas is situated about a mile from the spot...... Since writing these notes, I have asked Mr. John Innes, who was living at a station in the neighbourhood shortly after the time the egg was found, if he remembered the circumstances under which it was discovered. He entirely confirms the correctness of the account I have given, and adds that the egg was found in the early part of the year 1860, or at the end of 1859."^{1}

The unique subject of this communication was purchased by George Dawson Rowley, Esq., F.Z.S., and is now in his Museum of Ornithological Treasures at Chichester House, East Cliff, Brighton. I am indebted to him for the opportunity of figuring the specimen in Plate CXVII, of the present work.

In 1866 two eggs were discovered in the alluvial sandy loam of the "Upper Clitha Plains, Otago." The first was 2 feet from the surface, the second about a foot apart, and 3 inches deeper. Of the first and most perfect egg, pieces were extracted which, when fitted together, made nearly one complete side of the egg, from which its dimensions were estimated at—long diameter 8·9 inches, short diameter 6·1 inches"^{2}. The egg-shell had been eroded by the solvents of the soil; but on the granular surface so produced the characteristic linear pores were distinctly visible. A portion of shell yielded 0·9 per cent. of organic matter, that of a recent Emu's egg yielding 7·89 of organic matter^{3}. The Moa's egg-shell had thus not been long enough in the soil to part with all its soluble constituent, though much, doubtless, had been dissolved. The second egg was too far decomposed to admit of removal.

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1 See also Mr. Enys's letter in the 'Christchurch Press' of August 3rd, 1871.
2 Hector, Dr. J., P.R.S., 'Proceedings of the Zoological Society,' 1867, p. 991.
3 Ibid.
Supposing the two eggs to have been laid in superficial dry soil, as in the oviposition of the Ostrich, they might have been subject to some amount of incubation before the surface was overflowed and the 2 feet of alluvium was accumulated above them. That this had been the case was proved by the discovery, in the first egg, of bones of an embryo chick. These were of a brown colour, of a light spongy texture, adhered to the tongue through loss of organic matter, and were free from traces of membrane or ligament. Of the long bones of the hind limb the shaft only was ossified.1

Of a somewhat more advanced embryo from an egg of a *Dinornis crassus*, one half of the sternum was obtained (Plate CXV, fig. 8), showing the ossification of that bone, as in *Apteryx*, from two lateral centres. The pelvis of the same embryo showed a confluenve of pubis and ischium at their acetabular ends, the ilium being distinct (ib. fig. 6). The scapula and coracoid had coalesced (ib. fig. 7) at this early period, and showed no trace of glenoid cavity for a humerus.

Among existing birds I infer, from characters of the sternum, scapular arch, conformity of number of cervical and dorsal vertebrae, structure of pelvis and of caudal vertebrae, character of bones of the hind limbs, palatal and other modifications of the beak and cranium of the *Apteryx*, that the wingless Kivis are most nearly allied to the extinct family of *Dinornithidae*.

In comparison with the existing *Struthionidae*, the *Apteryx* lays a much larger egg in proportion to its size (Plate XCIX, fig. 2); and in the thinness of the shell it more closely resembles that of *Dinornis*, though the air-pores are minute and indistinct. The Kivi lays but one egg at the season of oviposition; it is usually placed in leaves or moss in a dry nook or hollow at the root of a tree. Evidence has been obtained from New Zealand that the *Apteryx* breeds twice a year, and, if fortunate, rears two chicks in that period, one at each half-yearly sitting. The discovery of the two Moa-eggs at Otago may indicate that the *Dinornis* laid and sat on two eggs at the breeding-period. The large relative size of the egg also points to such limited number for each sitting.

From the relative size of the egg of the *Apteryx* to its pelvis, and a like relation in *Dinornis crassus*, *D. elephantopus*, and *D. ingens*, I have hazarded in fig. 1, Plate XCIX, a scheme of the egg of *Dinornis maximus*. The confirmations which have favoured the previsions of size and shape of extinct Moas, before their skeletons were discovered, encourage me in the belief that a future find of the egg of the hugest kind of Moa may show that its estimated size has not been exaggerated.

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