

M E M O I R

ON THE

O R N I T H I C H N I T E S,

O R

F O O T - P R I N T S O F S P E C I E S O F D I N O R N I S.

THESE impressions were first noticed in or about the year 1866 by a ferryman on the right bank of the Taruhero river, just below high-water mark, at Turanganui, Poverty Bay, North Island of New Zealand¹.

The discovery being reported to the Rev. Archdeacon W. L. Williams, he communicated his observations to the Auckland Institute, and presented impressions of the foot-prints and casts of the same to the Museum of the Institute. The locality was subsequently inspected by the Hon. T. B. Gillies, who has added a record of his observations on the locality².

Examples of these ornithichnites have successively reached me through the kindness of my friend T. W. Cockburn Hood, Esq., and by a donation to the British Museum by the Rev. Henry Davies, M.A., who had received the specimens from his brother, now resident in Auckland, New Zealand.

The conditions of the preservation of these foot-prints are those which are not uncommon in connexion with the 'ichnites' of various extinct animals in Europe and America³. A stratum of uniform character, soft enough to receive and hard enough to retain the impression, is alternately exposed and submerged through its position on a tidal shore between high- and low-water mark.

During the period that elapses between one spring tide and the next, the highest part of the stratum or deposit is exposed long enough to receive many foot-prints. During the hours of hot sunshine the so trodden surface may become baked hard and dry; and before the return of the tidal wave, turbid with the comminuted materials of a second stratum, has power to break up the preceding one, the impressions may

¹ 'Transactions of the New-Zealand Institute,' 1872, vol. iv. p. 124, pl. 8 (sketch-map).

² *Tom. cit.* p. 127.

³ Owen, 'Palæontology,' 8vo (2nd ed. 1861), pp. 177-181.

have received a deposit of such comminuted materials, whereby a cast may be taken of the mould previously made, and such mould be preserved.

Or, the impressions made at low tide may receive before the turn sand drifted by the wind, and that in such quantity as to preserve the impression from being broken up by the eddyings of the returning tide. The comminuted materials of the sea-bed will then be deposited upon the drift-sand blown into the foot-prints during the ebb; and such layer of sand will be interposed between the strata forming the sea-bed, such strata varying in thickness according to the intervals between the atmospheric movements which have spread the sand over the bed. In due course of time this stratified sea-bed acquires the consistency of rock, as in the case of the New Red Sandstone of Cheshire and Connecticut.

The stratified deposits which have received and retained impressions of a *Dinornis* at Turanganui are described "as a portion of rock about 14 feet in length, and about 5 feet in width"¹; but further on the Archdeacon describes "the rock" as being "very soft, containing a large proportion of fine pumiceous sand"². "Soon after the impressions were made a quantity of sand, much coarser than that which enters into the composition of the rock, must have been drifted over it by the wind, filling up all the foot-prints, and covering the whole surface to a moderate depth; the general thickness of the layer, after having been compressed by subsequent deposits, is about five eighths of an inch. That this must have happened soon after the impressions were made, and before the mud had become quite dry, is indicated by the way in which this coarser sand is imbedded in the bottom of the impressions"³.

The tract of impressed 'rock' is just below high-water mark. "Subsequent deposits of [fluviatile] silt have taken place, covering that in which the impressions are found to the depth of about 2 feet." "Overlying the whole is a layer of sand, gravel, shells, and soil to the depth of 4 feet"⁴.

The account given by the Hon. Mr. Gillies is essentially in accordance with that by Archdeacon Williams. The height of the land above the (present) high-water mark is about 5 feet. This is composed of sandy alluvium containing shelly layers of recent species. Below this occur successive strata of imperfectly solidified pumiceous sandy mudstones, or muddy pumiceous sandstones, each from four to six inches thick, but separated from each other by a thin layer of from a quarter to half an inch thick of pure coarse sand. "These foot-marks are found on about the fourth or fifth layer below the alluvial [*qu. æolian*] deposit above referred to, and are protected from the superincumbent layer by this thin layer of pure sand. These layers have a dip of about six degrees to the southward, and the foot-marks were found about 2 feet 6 inches below the level of the alluvial deposit above, the rock, however, dipping eastward to about ten degrees"⁵.

¹ Williams. *loc. cit.* p. 124.

² *Ib. ib.* p. 125.

³ *Ib. ib.*

⁴ *Ib. ib.*

⁵ *Tom. cit.* p. 127.

The matrix of a foot-print of the size of that figured in Plate CXVI. fig. 1 consisted of quartzose sand and finely comminuted clay; no tufaceous deposit was detected in it. The impressed slab was presented to the British Museum by the Rev. R. H. Davies, of Chelsea, who had received it from a brother resident at Auckland. It was accompanied by the following note:—"This specimen was found at the junction of the Waikanai Creek with the Turanganui River, at Gisborne, Poverty Bay, New Zealand."

The formation is of a recent character, geologically.

From the evidences of the foot-prints which have reached me, I refer them to three species of *Dinornis*. The largest series agree in size with the foot-bones of *Dinornis ingens*, and they exhibit indications of the tip of a hind toe having touched the sand after the sole of the foot had sunk about an inch therein. (See the three impressions, fig. 2, in Plate CXVI.)

From the tip of the middle toe (III.) to that of the back toe measures 1 foot 6 inches; the extreme breadth of the foot is 13 inches; the length of the middle toe, including the end of its metatarsal, would be about 15 inches; but the skin covering that end would probably not touch hard ground, nor would the back toe, on such ground, reach the surface. These impressions were probably made by a *Dinornis ingens*.

The second series of ornithichnites, fig. 3, I refer to *Dinornis struthioides*; the third series, fig. 4, to *Dinornis dromioides*. Of this series a cast of one of the foot-prints is lithographed of the natural size, fig. 1. It indicates a greater proportional extent of the interdigital connecting membrane than in the Emu or Cassowary, and a foot better adapted for progression over yielding or swampy ground. The presence of a back toe, as in fig. 2, I., would give, on the foot sinking to a certain depth, additional resistance in traversing boggy land.

DESCRIPTION OF THE PLATE.

PLATE CXVI.

Fig. 1. Cast of foot-print of *Dinornis dromioides*: nat. size.

Fig. 2. Reduced outlines of impressions of three of a consecutive series of foot-prints of *Dinornis ingens*.

Fig. 3. Reduced outlines of impressions of three of a consecutive series of foot-prints of *Dinornis struthioides*.

Fig. 4. Reduced outlines of impressions of a series of five consecutive foot-prints of *Dinornis dromioides*.