*Cucullæa inflata*, Römer, but the umbones are not so prominent, and the posterior angle is more acute.

Locality. Kelloway rock, near Trowbridge.

EXPLANATION OF PLATE XXX.

Fig. 1. Nucula Phillipsii.
Fig. 2. Astarte carinata.
Fig. 3. Astarte?
Fig. 4. Corbula Macneillii.
Fig. 5. Arca subtetragona.
Fig. 6. Ammonites Reginaldi.

2. *Notice of the Remains of the* DINORNIS *and other Birds, and of* FOSSILS AND ROCK-SPECIMENS, *recently collected by* Mr. WALTER MANTELL *in the* MIDDLE ISLAND *of* NEW ZEALAND; *with Additional Notes on the* NORTHERN ISLAND. By GIDEON ALGERNON MANTELL, Esq., LL.D., F.R.S., G.S. &c. *With Note on* FOSSILIFEROUS DEPOSITS *in the* MIDDLE ISLAND *of* NEW ZEALAND. By Prof. E. FORBES, F.R.S. &c.

THE remoteness of New Zealand, and the long period required for the transmission of specimens to England, together with the very limited information we at present possess of the geology and palæontology of that interesting antipodean colony, impart a certain degree of importance to any accession of knowledge, however slight, relating to the physical structure, and the ancient fauna and flora of those distant islands.

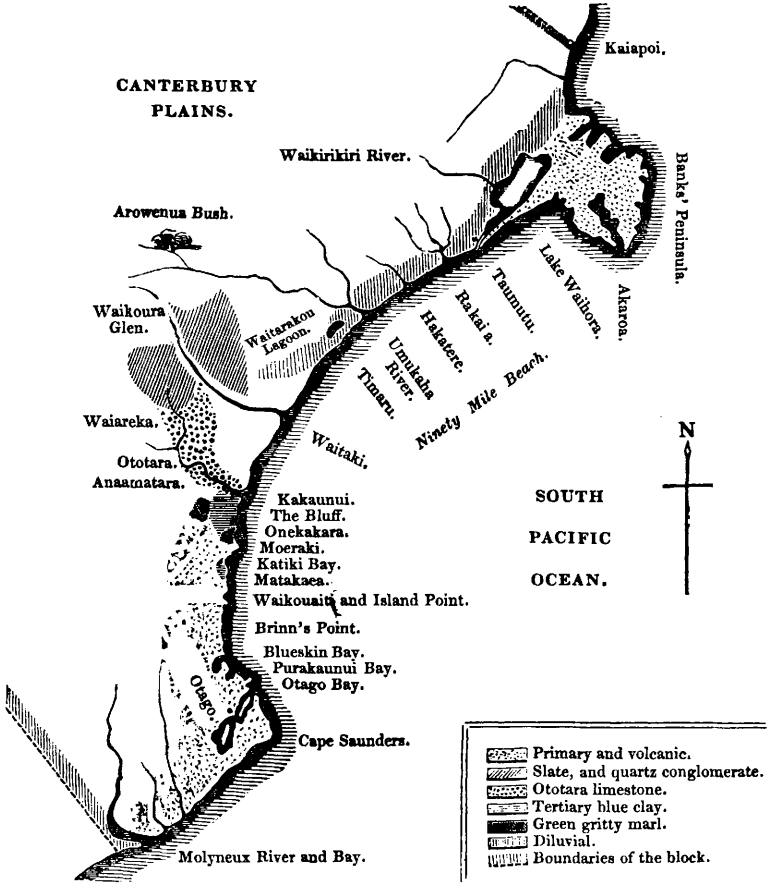
These considerations induce me to submit to the Society the following remarks on a large collection of the bones of several species of Dinornis and other birds, of rock-specimens, and of fossil shells, corals, and infusoria, received a short time since from my eldest son, Mr. Walter Mantell, of Wellington; and although the information afforded by this collection respecting the geological structure of the country is but scanty, I would fain hope that this brief communication will not be deemed an uninteresting supplement to the memoir on the Fossil Birds of New Zealand, which I had the honour to lay before the Geological Society in 1848.

The specimens were accompanied by numerous sketches of the country, and a copy of the official report on the colonial capabilities of the eastern coast of the Middle Island, from Kaiapoi to Akaroa in Banks' Peninsula, and thence to the Scotch settlement at Otago, a distance of about 260 miles, made during my son's exploration of that tract in 1848, as Government Commissioner for the final settlement of native claims.

Such parts of this report as throw light on the geology of the Middle Island of New Zealand, together with remarks on any particular locality, are embodied in the following extracts. As an apology for the brevity of his notes, my son dwells on the arduous character of a pedestrian journey through a country but very thinly inhabited; the engrossing nature of his official duties, and the limited time

allowed him, in the most unfavourable season of the year, for the accomplishment of the object of his mission. Premising, therefore, that the route was restricted to the sea-coast, diverging inland only when the depth and force of the streams that empty themselves into the sea rendered their passage dangerous, and compelled a detour to a more narrow or shallow part of the river-channels, and that no leisure was permitted for the accurate investigation of geological phænomena, I proceed without farther comment to the extracts from my son's note-book: I will afterwards briefly describe the specimens of rocks and organic remains, and conclude with a few general observations on the facts submitted to the consideration of the Society.

Fig. 1.—*Sketch of the Geology of part of the Eastern Coast of the Middle Island of New Zealand. By* WALTER MANTELL, *Esq.*



*Extracts from Mr. Walter Mantell's Notes.*—"Banks' Peninsula, in the centre of the east coast of the Middle Island of New Zealand, is chiefly composed of a group of mountains of igneous origin, apparently the result of submarine eruptions. The two principal harbours, namely Port Cooper (now called Port Victoria), and Port Levi (now Port Albert), are separated by a lofty range almost destitute of wood; along the crest of this range metamorphic rocks crop out, dipping eastward, whilst on the opposite side of Port Cooper they incline at a considerable angle to the west.

"From the summit of a hill at the south-west angle of this Peninsula, a magnificent view is commanded of those extensive plains which stretch from the Double Corner, a headland north of Port Cooper, to Te Timaru, a distance of 130 miles. Below is seen the dreary 'Ninety-mile Beach,' which is a continuous line of shingle without bay or headland. Within the northern part of this shingle-bank is the lake Waihora, which is eighteen miles in length. In the middle distance, plains of vast extent stretch out, and are bounded by that part of the snowy mountains, now called the Wakefield range. The level country consists of a substratum of slightly coherent gravel, principally composed of pebbles of schist, jasper, and white, yellow, pink, and green quartz, covered by a layer of rich loam, which varies in thickness from a few inches to ten feet. These magnificent plains extend uninterruptedly from thirty miles north of Port Cooper to 100 miles south of it, having an average breadth of thirty-five miles. From the sea-shore to the ridge of high mountains covered with perpetual snow, a gentle rise only is perceptible; but it is probable that near the foot of the mountains the elevation of the plain above the level is not less than from 350 to 400 feet: there is likewise a slight rise to the south, for at Te Taumutu the land is but eight or ten feet above the sea-level, while at Hakatere it is at least from thirty to forty feet.

"Along the junction of the plain with the Peninsula there are many isolated sand-hills; and farther north, the river Waimakariri near its mouth cuts through a bed of finely laminated sand, under which, at a depth of about ten feet, there is a deposit of various kinds of wood, that appears to have been drifted down when the mouth of the stream was some miles inland of its present position, and the Peninsula an island, and the plain covered by forests, of which a few vestiges only remain. A similar deposit of wood is said to exist near where the Waikirikiri discharges itself into the Waihora. Should future examination prove that these vegetable accumulations have been drifted to their present sites, and not have resulted from forests that grew on the spot, it may be inferred that Banks' Peninsula has but recently been united to the main land, and that the western shore of the lake Waihora formed, at no very distant period, part of a bay of the sea.

"The wood from the above localities is so little changed, as to serve for fuel to the natives of the neighbouring district. It has the usual appearance of the drifted trunks and branches that are stranded on the beach, and burns in the same mouldering manner*.

* "The natives informed me, that at a day and a half's journey inland of Tau-

"The rivers that intersect the plain are generally rushing torrents, which have excavated deep channels; they mostly terminate in a lagoon, separated from the sea by beach: through this barrier of shingle some of the streams periodically burst, but others always discharge themselves by filtering through the bar. The water of a river on whose bank we were encamped, and which was completely blocked up by a dam of beach twenty feet high, fell two feet during the night.

"The Waihora and some others of the lagoons are opened periodically by the natives, for the purpose of capturing the fish with which these waters abound. Numerous narrow trenches are cut, and as the water gushes out, nets are spread, and eels, &c. caught as they are carried down by the stream. A trench about two feet wide will yield some hundreds of eels, three or four feet long, in a single day. In a short time the rushing waters wear away the intervals, unite the trenches, and scour away the entire barrier; the lake rapidly sinks to the sea-level, and leaves dry a tract from a quarter to half a mile in breadth; the tide then ebbs and flows into the bay, till a southerly gale drifts in the sand and shingle, and the bay is again converted into a lagoon. Each of the largest rivers has an extensive denuded tract at its mouth, commencing a mile or two inland, and gradually widening towards the sea; and this is intersected by flood-channels. These triangular delta-like areas are bounded by cliffs, and have evidently been produced by the wearing down of the table-land nearly to the sea-level.

"From Rakaia to Wakanui the water from the interior finds its way through the gravel bed, and by undermining it, has formed along the sea-board innumerable chasms and gullies, which are yearly increasing in depth and length: the country here has no other drainage. Some of these gullies or subterranean courses are from one to two miles long; and it seems probable that many of the now open river-channels of the plain have originated in this manner.

"Scattered here and there in the immediate subsoil of these extensive plains, bones of the larger species of Moa have occasionally been found: I could not ascertain that any had been observed in the more ancient diluvial deposits; but I believe that, sooner or later, the swamps and river-beds will yield a rich harvest of these interesting remains.

"At about ten miles south of the Waiteruaiti the plain ends in the undulating country of Timaru*.

"The superficial deposits of Timaru are of the same nature as those of the plains, and are superposed on a vesicular volcanic rock, which

mutu there is coal in constant ignition, and that they are in the habit of procuring fire from it when they travel that way. In the Chatham Islands a bed of burning peat or lignite is also said to occur; a native of Taumutu, who had seen it, said the substance burning on the plain was very different."

* "About ten miles inland of *Arowenua*, the *Kāurĕke*—the only native quadruped besides the field-rat in which we have any reasonable grounds for believing—is said still to exist." My son gives a long account of the appearance and habits of this unknown quadruped, derived from the most intelligent natives, but which would be foreign to the present notice.—G. A. M.

reaches a height of fifteen feet, and, gradually dipping to the south, disappears in the course of a few miles. The country then resumes its former aspect, save that instead of one vast continuous tract of level land, there are small narrow plains intersecting gently-undulating downs.

"A bed of coal, ten feet in thickness, is said to crop out on the bank of a stream inland of Timaru. Specimens were obtained from this locality by Mr. Torlesse; it resembled the lignite from Mount Grey, but was more bituminous.

"Striking from the coast across a plain about four miles wide, forming the north point of the Waitaki valley, we reached Te Morokura. The river, a torrent with a freshet channel half a mile in width, cuts through the gravel of the plain, which in the river-bed is intermingled with basaltic and porphyritic pebbles, brought down from the interior of the country by the stream. On the south side the plain is bounded by the Pukehuri range, a spur from the Southern Alps, about 1000 feet high, composed of highly-inclined strata of slate, covered by a ferruginous conglomerate of quartz pebbles.

"In Awaamoko, the next transverse gulley west of Waikoura, I observed beds of slate with veins of quartz, dipping south 70°; but I could not, in my rapid passage, make out the relative position of these slates and the quartz conglomerate in the next valley, east of Waikoura, by which we left the Waitaki plain.

"Beyond Morokura the country of Waiareka commences, and strata of a yellow and fawn-coloured limestone appear, and continue to Kakaunui. This limestone is generally friable and porous; it almost wholly consists of shells and corals, and contains terebratulæ, echinites, a species of pseudo-belemnite, teeth of sharks, &c. A microscopical examination shows that the calcareous cementing material of the larger shells and corals is made up of Textulariæ, Rotaliæ, and other common genera of Foraminifera, as will be particularized in the sequel.

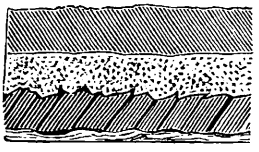
"The beds are gently inclined and in various directions; a section north and south at the low caves at Te Anaamatara, where the last traces of these deposits were visible, showed a slight dip to the north.

Fig. 2.—*Caves in the Limestone at Te Anaamatara.*


"This limestone, both at Ototara and Te Anaamatara, is very cavernous; and two large caves at the former place afforded a comfortable night's lodging to myself and my companion, Mr. Alfred Wills, and our party; and it was no small gratification to me to collect from the walls of our cavern the next morning, terebratulæ, shark teeth, and other fossils, which, if not identical with, seem closely allied to, those I used to obtain, when a lad, from the chalk near Chichester; and which now seeing again for the first time since I left England nine years ago, appeared like old familiar faces greeting me from the rocks of the Antipodes.

"I had no opportunity of ascertaining the relative position of this formation, and the volcanic grit of Kakaunui: the latter on the coast is exposed to the height of eight or ten feet, and dips to the south at a considerable angle; it contains a great variety of crystalline volcanic products, as hornblende, augite, garnets, &c. It is covered unconformably by the usual diluvial beds of gravel and clay, as in the annexed sketch.

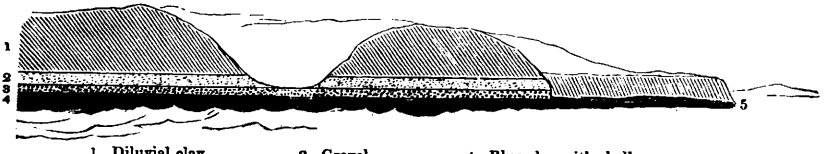
Fig. 3.—*Section of the Coast at Kakaunui.*




"A mile south of Kakaunui, strata of a tertiary blue clay first appear; they contain numerous shells of species that inhabit the neighbouring sea, corals, a few traces of fishes, and small portions of wood. In some localities the clay is capped by a thin layer of sandstone.

"The following section of the coast will show the relative position of this tertiary clay.

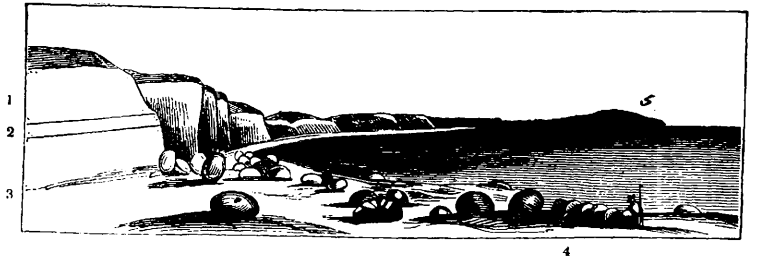
Fig. 4.—*Section of the Coast near Kakaunui Point.*




1. Diluvial clay. 2. Gravel. 4. Blue clay with shells.
3. Indurated sandstone with shells. 5. Volcanic grit, at Kakaunui Point.

"Midway between the Bluff and Moeraki, the clay contains layers of septaria, varying from one to five feet and more in diameter. Hundreds of these nodules, which had been washed out of the undermined clay cliffs by the encroachment of the sea, were scattered along the beach, as represented in the sketch, fig. 5. Some were subglobular,

Fig. 5.—*Onekakara Bay, looking northwards.*




1. Diluvial clay.
2. Gravel.
3. Tertiary clay.
4. A group of Septarian boulders, called by the whalers the "Ninepins."
5. The White Bluff.

others spherical; many were entire, whilst others were broken, and glittering with yellow and brown crystals of calcareous spar, with which all the interstices of the septaria were lined or filled. Some of these masses were hollowed out by the action of the waves into regular basins, which at low-tide stand up from the sands full of water, and are three or four feet deep, forming excellent foot-baths for the weary pedestrian.

"Many of these septaria struck me as curious from the zone or belt of cone-in-cone clay with which they were encircled, as in the subjoined sketch (fig. 6), which represents the usual form and appearance of one of these zoned nodules.

Fig. 6.—*Septarium with a zone of Cone-in-cone Clay.*

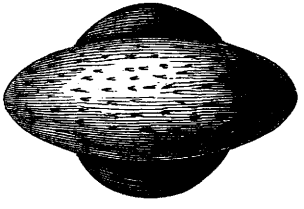
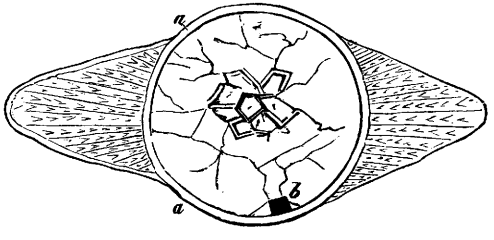


Fig. 7.—*Section of a Septarium, from Onekakara.*




*a, a.* Spherical body of the Septarium.

*b.* Fragment of bone imbedded in the Septarium.

"Fig. 7 is a section of the same, exhibiting the cone-like structure. The direction of the apices of the cones is towards the centre of the nodule; the coating of the other part of the sphere (fig. 6, *a*, *a*) is composed of clay with crystals of selenite; the cones are represented disproportionately large, to render the structure intelligible. These septaria, with the exception of the belt of cone-in-cone clay, are so like those I recollect seeing extracted from the London clay off the coast of Sussex, and used for Roman cement, that I think they may be applicable to the same economical purpose. I gave some to Capt. Collinson, R.E., who had it burnt and ground by a mason, who pronounced it worthless; but I still put faith in my cement, and not in the lime-burner*.

* A portion of one of these nodules has, through the kindness of Sir Henry De la Beche, been analysed at the laboratory of the Museum of Practical Geology;

"In one of these septaria I perceived the fractured end of the portion of bone enclosed (fig. 6, *b*); it ran straight into the mass, which was two feet in diameter. This fragment of bone is flattened, and is $1\frac{1}{2}$ inch in its longest diameter; its cancellated structure appears to me to resemble that of the Moa: as it is the only vestige of a fossil bone I have found in the ancient tertiary strata of New Zealand, I hope you will deem it interesting*.

"At Onekakara, strata of a green gritty marl, much contorted, and in some places almost vertical, crop out from beneath the blue clay; these are traversed here and there by veins and layers of nodules of iron pyrites. The water which flows from these beds is highly saline and chalybeate, and of course extremely nauseous; but as no better can be obtained within a considerable distance, it is constantly used by the natives at the Kaika for domestic purposes.

"On the south, immediately beyond the native settlement at Moeraki, a dark porphyritic rock with broken crystals of felspar appears; it is traversed in every direction by veins of quartz and chalcedony, often very beautifully coloured. This rock continues to the end of the native Reserve at Waimataitai, where the tertiary blue clay again emerges, and forms the low cliffs of Katiki Bay. In the bight of this bay the bed of septaria previously described reappears; the nodules in this locality contain a far larger amount of iron and less lime than those before mentioned. The space at the foot of the cliffs left bare at low water was literally covered by septaria of various sizes, from a few inches to thirteen feet in diameter. The spot is known to the whalers by the name of '*Vulcan's foundry*.'

"I much regret that it was out of my power to leave the inland path from Katiki Bay to examine Matakea Point, where good coal is said to occur; but a smith at Onekakara, who had tried it, informed me, it was so sulphurous, that he was obliged to discontinue its use.

"Before reaching 'Pleasant River' I again traversed the beach for

and the results confirm the opinion that the New Zealand septaria will afford excellent cement.

| | |
|---|---|
| Carbonate of lime | 66·7 |
| Silica | 16·2 |
| Alumina | 10·4 |
| Peroxide of iron | 4·7 |
| Organic matter | 2·0 |
| | 100·0 |

estimated without water; of which, when sent, it contained two per cent.—G. A. M.

* The external form of this fragment conveys no idea of its nature; but slices carefully prepared for the microscope, present, under a moderately magnifying power, a structure which shows that the bone belonged to a bird; there is however no proof that it can be referred to the Dinornis. Mr. Tomes and Mr. Bowerbank, who have obliged me by examining the specimen, concur in this opinion. Insignificant as this fact may appear, still, in these early pages of the palæontological history of our antipodean colonies, it is worthy of remark, that the first-discovered fossil relic of the terrestrial vertebrata in the tertiary strata of New Zealand should belong to that class which, in later periods, constituted the principal types of the warm-blooded animals of the fauna of that country, to the almost entire exclusion of the mammalia.—G. A. M.

some distance, and found the cliffs were composed of the blue tertiary clay. The hills inland seemed to belong to the same age (clay-slate) as the Pukehairi range at Waitaki.

"At Waikouaiti, seventeen miles north of Otago, I found Mount Watkins to belong to the same class. Dikes of columnar trap, the columns at right angles to the sides of the veins, occur at Island Point, the Bluff, and Brinn's Point. These dikes traverse a deposit of pale buff-coloured sandy clay, distinctly stratified, and dipping about 40° to the south-west.

"In the little bight south of Island Point, in front of the native Kaika, named Makuku or Waipipipaika, is the exposed part of the so-called 'turbary deposit,' whence bones of the Moa have been obtained in such numbers and perfection. This bed is about three feet in depth, and not more than 100 yards in length, and lies immediately on the tertiary blue clay; it is visible only at low water. It consists almost wholly of decayed vegetable matter, and its surface is studded with the undisturbed roots of small trees, which appear to have been burnt down to the ground at some remote period. It is a light sandy elastic earth, of a blackish brown colour, emitting a strong fetid odour when first collected. From the large quantity of flax fibres (*Phormium tenax*) it contains, I conceive it was originally a swamp *.

"At Blueskin and Purakaunui Bays, the primary country of Otago begins, and boulders of serpentine of various shades of green are plentifully scattered on the sand-hills around Purakaunui. These bays afford an interesting illustration of the manner in which the harbours are gradually filled up when they are situated in a curve of the coast, and are exposed to a prevalent wind, and unprovided with a river having a current of sufficient strength to keep open a serviceable channel. Like Otago, each has a dry sand-spit running from its western nearly to its eastern head, that has been formed by the joint action of the sea and the land drainage: this constitutes a barrier, behind which the detritus brought down by the inland streams from the mountains tranquilly subsides, and eventually accumulates into a sand flat, through which the water flows into the sea. Blueskin Bay lying in the very bight, is the nearest advanced towards this state, to which Purakaunui and other similarly situated bays are rapidly tending."

---

I proceed to the examination of the specimens of rocks, minerals, and organic remains, collected by my son during the journey, and which are now in my possession.

### Rocks and Minerals.

The collection contains between 200 and 300 specimens. With the kind and able assistance of Prof. Tennant, I have carefully examined such as seemed likely to prove interesting in an economical point of view; but a very general notice will suffice for my present purpose. They are chiefly pebbles and boulders from the line of

* Further remarks on this deposit will be given in another part of this notice.

coast traversed by the exploring party, with examples of the rocks and strata exposed in the low cliffs in the various localities mentioned in the report.

By far the greater part belong to plutonic, volcanic, and metamorphic rocks: the unaltered sedimentary deposits are limited to the limestones of Ototara and Anaamatara, the argillaceous strata of Onekakara and Kakaunui, and the newer beds of aggregated iron-sand and sandstone containing recent species of shells. Of the igneous products, the most abundant are *obsidian* (called by the natives *tuhua*), basalt, and many varieties of amygdaloids; some of these could not be distinguished from the toadstones of Matlock and Crich Hill, in Derbyshire. Nephrite or jade (*ponamu* of the New Zealanders), gneiss, serpentine, greenstone, chlorite slate, micaceous schist, siliceous slate, clay-slate, &c. There are no specimens of granite.

Sulphate of barytes, compact zeolite, and garnets; many varieties of chalcedony, agates, quartz, and jasper; some masses resemble the green or chlorite jasper of India; semi-opal, onyx, &c. There are no examples of any of the ores of tin or copper. Of iron, there are clays largely charged with oxide, sulphuret, and phosphate. Titaniferous iron (*menaccanite*) forms, with crystals of augite, extensive beds of sand on the shore of the North Island, near New Plymouth, &c. This sand constitutes the bed in which the bones of the Moa, &c. occur, near the embouchure of the Waingongoro, as mentioned in my former Memoir.

To this list may be added a fine white rock, resembling the meerschaum-stone, and consisting of carbonate of magnesia.

A very hard conglomerate of small pebbles of variously coloured quartz, jade, &c., cemented together by a ferruginous paste, is worthy of remark, from its close resemblance to the matrix in which diamonds occasionally occur in some parts of the Brazils.

A few fragments of lignite, and of bituminous wood, are the only indications of fossil fuel: no true coal, nor strata that are carboniferous in other countries, were observed in any part of the island comprised in the present notice.

## Sedimentary Deposits and Organic Remains.

### *Ototara Limestone.*

Of the stratified fossiliferous deposits, the most ancient is the limestone which stretches from near Morokura to beyond Anaamatara, and within five miles of Kakaunui. From the general lithological resemblance of this rock to the coralline cretaceous deposits of Faxoe and of Maestricht, and the presence of terebratulæ, sharks' teeth, echinites and spines, and fossils allied to the belemnite, the geologist might naturally conclude that the Ototara strata are referable to the chalk formation, and may be regarded as the equivalents of certain upper beds of the series. The microscopical examination would still further strengthen this idea, the Foraminifera of which the calcareous cement is almost wholly made up, belonging to those forms which prevail in the English chalk; even the soft bodies of

these animalcules are preserved in many instances, as in our cretaceous deposits. But I do not think that the facts are sufficient to warrant a decision, as to whether the strata in question should be considered as secondary or tertiary, for there are many eocene beds in which the organic characters are very similar: however this may be, these deposits are the most ancient unaltered sedimentary in the country under survey, of which specimens have been transmitted to England. A list of the fossils collected is subjoined.

I would here express in the warmest manner my obligations to Mr. Morris, for his kindness in determining the characters of many of the organic remains given in the following pages; and to Mr. Lovell Reeve, for the comparison of the shells with recent species; and to Mr. Williamson, and especially to Mr. Rupert Jones, for assisting me in the determination of the Foraminifera and Diatomaceæ. In the attempt to name with precision the organisms imbedded in the strata of our Antipodes, I gladly availed myself of the knowledge of those scientific friends who were most conversant with the respective subjects, and I now gratefully acknowledge the liberality and kindness with which at all times they afforded me their valuable aid.

### *Fossils from the Ototara Limestone.*

Scales of fishes. (No specimens were sent to me.)

Teeth of a species of Shark, *Lamna*: Pl. XXVIII. fig. 1.

Belemnite? Fragments of a solid, subcylindrical, calcareous body, with a fibro-radiating structure, closely resembling that of the guard of the Belemnite: it is very like a fossil from the cretaceous beds of Pondicherry in India, described by Prof. E. Forbes as *Belemnites? fibula* *.

*Terebratula.* Fragments of a large smooth species.

—— *Gualteri*, nov. spec.: Pl. XXVIII. figs. 2, 3. "Shell somewhat trigonal, smooth, both valves nearly equal and rather depressed; lateral margins sinuous; rostral valve with an acute and slightly recurved beak, the perforation below it. The anterior margin with a broad sinus, producing a corresponding arched elevation in the smaller valve.

"This shell bears a remarkable resemblance to the *Terebratula subplicata* (of Dr. Mantell, Fossils of the South Downs, pl. 26. fig. 5), but may be readily distinguished by a careful comparison of the two species: in this shell there are no plicæ. I have named it *Gualteri* in honour of the discoverer, Walter Mantell, Esq."—*Mr. Morris.*

*Pollicipes.* Resembling a cretaceous species.

*Cidaris.* Fragments of plates and numerous spines.

*Eschara.* Pl. XXVIII. fig. 8. Investing *Cereoporæ.*

*Cereopora Ototara*, nov. spec.: Pl. XXVIII. figs. 4–7. This coral more closely resembles the *C. disticha* of Goldfuss, than any other known species. The cells, however, are more distinct and less regular. I propose to distinguish it by the name of the locality in which it was first noticed.

* Transactions of the Geological Society, 2nd Series, vol. vii. p. 119. pl. 9. fig. 3.

*Cereopora*: Pl. XXVIII. figs. 9–11. This species is nearly allied to *C. diadema* of Goldfuss.
*Manon*: Pl. XXVIII. figs. 12–14. A small claviform species.

Foraminifera.—With the exception of spicula of *Alcyonia* or *Gorgoniæ*, all the microscopic organisms belong to a few genera of Foraminifera. These have been carefully examined and compared by Mr. Rupert Jones.
*Rosalina lævigata*, Ehrenberg. Found in the chalk of Sicily.
—— *Beccarii*, Linn. sp. A common recent form.
——. Somewhat resembling *Cristellaria propinqua*, Reuss, from the tertiary formations.
*Textularia*: Pl. XXIX. fig. 1. "Nearly related to an undescribed gault species, and to a species from the magnesian limestone, *T. cuneiformis*, Jones."—*Mr. R. Jones.*
*Textularia elongata*, nov. spec.: Pl. XXIX. fig. 2. This is a remarkable species, and is so like a common but undescribed form in the Charing chalk-detritus, first discovered by Mr. Harris, that Mr. R. Jones thinks it is identical *.
—— *globosa*, Ehrenb. Common in the chalk.
—— *aciculata*, Ehrenb.: Pl. XXIX. fig. 3. Common in the chalk.
In addition to the above, Mr. R. Jones has detected the following:
*Globigerina.*
*Nodosaria limbata*, D'Orbigny. Cretaceous.
*Cristellaria rotulata*, Lamarck, sp. Cretaceous.
*Dentalina.*
*Polymorphina.*
*Bulimina.* Two or three species.
*Rosalina Lorneiana*, D'Orbigny. Cretaceous.

Entomostraca.—*Bairdia subdeltoidea*, Münster, sp. Recent, tertiary, and cretaceous.
*Cythereis interrupta*, Bosquet, sp. Cretaceous.
—— *gibba*, Rœmer, sp. Tertiary.
—— *galtina*, Jones. Cretaceous.

*Pleistocene or newer Tertiary Blue Clay of Onekakara.*

The argillaceous strata extending from near Kakaunui to Matakaca, abound in shells of species that still inhabit the neighbouring sea, and must therefore be considered as a comparatively modern tertiary or pleistocene formation.

The microscopic organisms are but few; they consist of circular discs with regularly perforated hexagonal apertures (*Coscinodiscus*), resembling a form common in the slate of Jutland; and others with a hyaline centre surrounded by a richly sculptured margin (*Actino-*

* I am doubtful whether this fossil does not terminate apically in a discoidal involution; thus resembling, in external form, the Spirolinites and Lituolites, but differing from the latter in the alternate arrangement of the cells. Specimens in flint, having this form and structure, have been transmitted to me by Mr. Samuel Smith, of Wisbeach.

*cyclus*). There are many sponge spicula traversed by a central tube, and other spines, apparently of *Alcyonia* or *Gorgoniæ*. The clay contains also fragments of a delicate branched body, having linear rows of regularly disposed openings. I have not observed any traces of *Foraminifera*, though my son mentions having found *Spirolinites*.

*Bone of Bird*: in a septarium (*ante*, p. 325).

Corals.—*Eschara*: Pl. XXVIII. fig. 8.

*Pustulopora Zealandica*, nov. spec.: Pl. XXVIII. figs. 20, 21. It is a beautiful species, allied to *Cereopora madreporacea* of Goldfuss.

*Turbinolia*: Pl. XXVIII. figs. 18, 19. There are two lamelliferous corals, apparently of this genus. One is of an inverted conical shape, fig. 19 *a*, the other has a broad, nearly flat, callous base, as shown in fig. 18.

Mollusca.—The shells are for the most part in a beautiful state of preservation, differing but little from dead recent specimens, except in being destitute of colour. With the assistance of Mr. J. E. Gray, Mr. Lovell Reeve, and Mr. Morris, the following genera and species have been determined:—

*Turritella rosea*, Quoy: Pl. XXVIII. figs. 16, 17.

*Struthiolaria straminea*, Sowerby. This genus is peculiar to New Zealand.

*Triton Spengleri*, Lamarck.

*Fusus australis*, Quoy. "Near to *F. sulcatus*."—*Mr. L. Reeve.*

—— *nodosus*, Martyn, sp.

*Pyrula. Natica.*

*Ancillaria australis*, Sowerby. "This fine species is very like one described by Mr. Hinds in the 'Mollusca of the Voyage of the Sulphur.' Among fossil shells it comes nearest to *A. glandiformis*, from Bordeaux, but is certainly distinct from it. Being found in the same semi-fossil state with *Struthiolaria* and *Triton Spengleri*, it probably exists on the neighbouring coasts*."—*Mr. Lovell Reeve.*

*Calyptræa.*

*Dentalium*; an undescribed, finely striated species: Pl. XXVIII. fig. 15.

*Cardium. Nucula. Limopsis. Pectunculus*, resembling the common Bognor species.

*Arca. Pecten. Ostrea.*

*Mytilus*. A beautiful striated recent species.

*Vegetable remains*.—Fossil wood of the Araucarian type, in which the internal structure is exquisitely preserved, and a fragment of a silicified monocotyledonous stem, are the only examples transmitted to me from these deposits.

* In a note on the Fossil Shells of New Zealand in Dr. Dieffenbach's work, vol. ii. p. 296, Mr. J. E. Gray mentions "an Ancillaria with a very callous apex," which is probably the same species.

*Blue Clay of Wanganui, in the North Island.*

In my former Memoir on the Fossil Birds of New Zealand, a bed of clay abounding in marine shells was described as underlying the bone-deposit *. A few specimens from this locality were sent in the present collection; they are in the same condition as the shells of Onekakara, and the stratum whence they were obtained is evidently of the same age; they are all of species existing in the South Pacific Ocean:

*Fusus nodosus*, Quoy.
*Murex Zealandicus*, Quoy.
*Venus mesodesma*, Gray.
*Venericardia Quoyii*, Lamarck.
*Pecten asperrimus*, Lamarck.

*Infusorial Earth of Taranaki.*

Along the shores of the North Island, and especially within a short distance of New Plymouth, there are extensive low mounds or hills of a siliceo-calcareous sand, of a light fawn colour, and which in some places is aggregated into concretionary friable masses. This deposit is in a great measure composed of the siliceous shields or frustules of *Diatomaceæ*, those vegetable structures which Ehrenberg considered of animal origin, and described as Infusoria. From the many forms similar to those so universally present in marine and brackish water deposits, I have selected a few which are delineated in Pl. XXIX., to convey an idea of the organic composition of this earth.

*Stauroneis Zealandica*, nov. spec.: Pl. XXIX. figs. 4, 5. This beautiful organism is very like a species from the "Little Falls," State of New York, but differs in the form of the shield, which is subangular in the middle, and in the central bar or cross; I have therefore given it a specific name.

*Surirella*: Pl. XXIX. figs. 6, 7. "Resembles *S. bifrons*, Ehrenb." —*Mr. R. Jones.*

*Navicula librile*, Ehrenb.

*Pinnularia*: Pl. XXIX. fig. 8. Mr. Topping informs me that the same form occurs in the Thames at Tilbury Fort.

*Cocconema*. "Resembling *C. cymbiforme*, Ehrenb."—*Mr. R. Jones.*

*Actinocyclus*: Pl. XXIX. figs. 9, 10.

*Bacillaria*. *Polycystina*: Pl. XXIX. fig. 11.

*Eunotia ocellata*, Ehrenb.

*Pyxidicula* or *Posodira*: Pl. XXIX. fig. 10.

*Coscinodiscus.*

Mr. Williamson of Manchester informs me, that in addition to the bodies I have detected, he has obtained from the earth I transmitted to him, *Polycystineæ* apparently identical with species that are abundant in the well-known infusorial earth of Barbadoes; and disks of *Meloseira*†.

* See Quarterly Journ. Geol. Soc. 1848, vol. iv. p. 239.

† For the most beautiful preparations of these infusorial earths, and especially for a selection of the most delicate organisms mounted separately, I am indebted to Mr. C. Poulton, of Southern Hill, Reading, whose skill in this department of

*Infusorial earth from Lake Waihora.*—I will close this account of the microscopic organisms by stating, that some white earth resembling magnesia in appearance, collected from the bed of the vast lake on the south-east of Banks' Peninsula, is made up of the usual lacustrine species and genera of *Diatomaceæ*; viz. *Gallionella, Bacillaria, Gomphonema, Micrasterias, Synhedra*; "*Meloseira,* resembling *M. varians, Cosmarium margaritaceum,* and *Rimularia viridis.*"—*Mr. Williamson.*

Mr. Henry Deane, of Clapham Common, informs me, that a few years since, a white earth was exported from New Zealand as native carbonate of magnesia; it was nothing more than the usual lacustrine organic deposits formed by the accumulation of innumerable minute frustules of *Diatomaceæ.*

### *Fossil Remains of Birds.*

I now enter upon the examination of those remarkable relics which have invested the Palæontology of the Islands of New Zealand with the highest interest,—the remains of the Moa or Dinornis, Palapteryx, and other genera of birds of which no living species are known to naturalists. The collection of bones of the Class Aves, transmitted by my son in 1847, amounted to between 700 and 800 specimens: the present one comprises about 500, and 25 or 30 belonging to dogs and seals. The birds' bones are of various kinds of Dinornis and related genera, and of contemporaneous birds identical with, or closely resembling existing species of Albatros (*Diomedea chlororhynchus*), Penguin (*Aptenodytes*), Water Hen (*Brachypteryx*), Rail (*Notornis*), the nocturnal Parrot of New Zealand (*Nestor*), and the *Apteryx.*

In the catalogue accompanying the specimens the following are enumerated: viz. skulls and mandibles 8, tympanic bones 8, vertebræ 90, pelves 11, femora 17, tibiæ 17, fibulæ 10, tarso-metatarsals 23, phalangeals 90, ungueals 40; detached ribs, pubis, ischium, sacrum, and portions of sterna. A few bones of the anterior extremities or wings occur of Penguin, Albatros, and some unknown species; but not even a fragment that can be referred to the large Struthious forms.

About 200 bones are from the same locality in the North Island as those I had the honour of placing before the Society in 1848. The remainder are from the Middle Island, and chiefly from Waikouaiti, already mentioned.

On the former occasion the nature and position of the menaccanite sand-beds in which the bones from Te Rangatapu, in the North Island, were imbedded, were described as fully as the materials transmitted to me would allow. I have nothing to add to that description, as my son has not been able to revisit the spot and confirm or correct my previous statements; but in his last letter (dated Port Levi, Banks' Peninsula, September 1849), he mentions the discovery in the North Island of several extensive caverns lined with stalactites, about 175 miles inland from the Waingongoro bone-bed, and that bones of Dinornis and other animals had been found in their stalagmitic and

microscopic manipulation is well known. Mr. Rupert Jones also had the kindness to prepare many slides to assist my examination of the various earths sent by my son.

sandy floors. On his return from his present mission he intends to explore these caves and collect any relics they may contain. On the present series from Waingongoro I will therefore only remark, that it contains some very perfect tarso-metatarsals of that remarkable type, named *Aptornis* by Professor Owen*; a cranium and several upper mandibles of *Palapteryx*; crania of *Notornis*; and bones of genera and species undetermined. A circumstance is worthy of remark as indicative of the high antiquity of some of the bone deposits, namely, that Moa bones were obtained from a bed of sandy marl abounding in pipes of ironstone and masses of iron pyrites.

*Moa Deposit at Waikouaiti.*

The bones from the Middle Island are almost entirely from the locality in which Dr. Mackellar and Mr. Percy Earl collected the specimens described in Zool. Trans. vol. iii. p. 313–319. The ossiferous deposit at Waikouaiti is very dissimilar from that of Waingongoro. Instead of a fine dry incoherent volcanic sand, which has preserved the bones in a state of integrity, and but slightly altered in composition and colour, the bone-bed in the Middle Island is an ancient swamp or morass, in which the New Zealand flax (*Phormium tenax*) once grew luxuriantly; it is now covered by a layer of sand, and is submerged at high water, being visible only when the tide has receded. Its inland boundary is obscured by vegetation, but from the notes of my son, and the verbal account with which I have been favoured by Mr. Alfred Wills, who has recently arrived in this country from New Zealand, and who is well acquainted with the locality, the deposit appears to be of very limited extent.

Fig. 8.—*Sketch of the Coast at Island Point.*

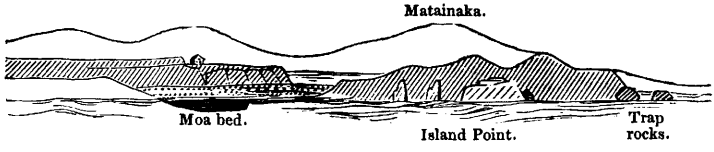
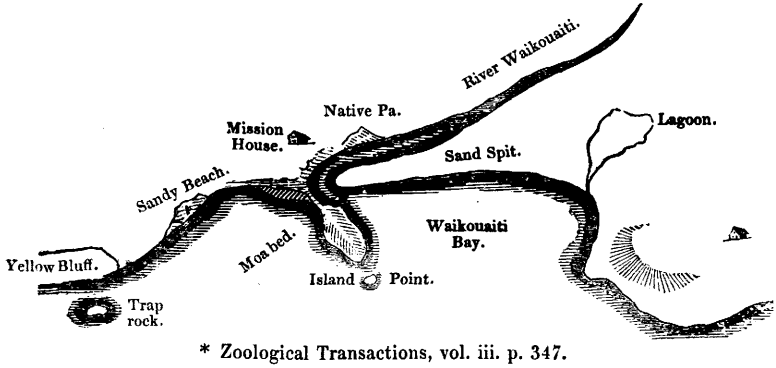



Fig. 9.—*Ground Plan of Waikouaiti and Island Point.*




* Zoological Transactions, vol. iii. p. 347.

The location of this bed is in a little bay, on the side of the bar of sand that unites the headland called Island Point with the mainland, at the entrance of the river Waikouaiti; this headland is about three-quarters of a mile in length, and 150 feet high.

The above sketch of the coast, and the annexed ground-plan will serve to illustrate the position of this remarkable accumulation of the extinct colossal bipeds of New Zealand.

This peat or rather flax-swamp, though soft and extremely fetid when fresh, dries into a dark brown friable inodorous mass*.

A microscopical examination shows that by far the largest portion consists of fibres of *Phormium tenax*; my son mentions that he sought diligently on the spot for vestiges of feathers and egg-shells, but unsuccessfully. The appearance and condition of the bones, as exemplified by the specimens, are similar to those presented by the mammalian remains exhumed from our peat bogs and morasses. Most of them have acquired a rich umber colour, and their texture is rendered tough and firm; even the periosteum is in many instances preserved†.

* My friend Dr. Gladstone, of University College, has obliged me with the following chemical examination of some of this deposit:—

"This substance is of a very heterogeneous character: it contains—

"1st. A brown marly earth, consisting mainly of alumina which gives off ammonia when heated, becoming at the same time black from the presence of carbonaceous matter.

"2nd. An earth considerably lighter in colour than the preceding, which contains lime. It is also impregnated with organic matter.

"3rd. Black decomposed woody matter.

"4th. Fragments of quartz.

"5th. Bones. There was a small vertebra of a grayish colour. Below it lay some small bones, or fragments entirely covered up by the earth. These are coloured of a reddish brown, and appear under the microscope to be enclosed in a sort of integument. Upon dissolving out the carbonate and phosphate of lime by means of acid, I found a soft mass remaining which blackened on exposure to heat. It was evidently the animal matter of the bone, and perhaps also some other portion of the animal which had dried upon it. Similar brown fragments were scattered throughout the mass of peat.

"Since flesh and feathers contain as much as 15 or 16 per cent. of nitrogen, I thought it possible that the peat-bog earth itself might indicate a considerable percentage of that element, if the soft parts of the birds were entombed along with their bones. A portion therefore was dried, the fragments of bone and quartz picked out, and the nitrogen was determined in the usual manner. It yielded however only 0·58 per cent. Now, as ordinary peat contains 2 per cent. or more of nitrogen, nothing favourable to such a view can be drawn from this experiment; but when we consider the large amount of earthy substances mixed up with the carbonaceous matter, it does not, I conceive, militate against the supposition."

† The shaft of one femur is in a remarkable state of preservation, the internal structure being as distinct as in a recent bone. Mr. Tomes, whose eminent skill in the microscopic investigations of osseous and dentinal organization is well known, obligingly made several sections of this specimen, and also favoured me with the following remarks:—

"The fragments of bone from the specimens of Dinornis remains, which you have recently received from New Zealand, show with unusual distinctness the characters of birds' bone.

"The microscope reveals that each Haversian canal is surrounded with from seven to twenty-five well-marked laminæ, which have slightly irregular or granu-

Although bones of various species of Moa, especially of the most gigantic kind, have been collected in considerable numbers and in great perfection from this locality, yet as the bed is rapidly diminishing from the encroachments of the sea, there is reason to fear that it will be entirely washed away, without yielding to the palæontologist all the desired information respecting the extinct animals whose relics it enshrines; for the Maoris or natives, and whalers, are well-aware of the interest attached to the bones by the Europeans, and they seize indiscriminately on any specimen that the receding tide may render visible; and if the bone cannot be readily extracted, what is exposed is broken off, and perhaps a most valuable relic destroyed, or mutilated and deprived of its most important characters. Their cupidity and avarice have too been so much excited by the large rewards given by casual visitors, that the cost of specimens has increased to an unreasonable amount. A residence near the spot, and diligent daily search, are required to ensure the acquisition of any connected portions of the skeleton of the same individual. An earnest of the treasures that might be obtained is afforded by the entire suite of bones composing the legs and feet of the same bird, which are now before us. "This pair of perfect feet," my son observes, "were discovered standing erect and about a yard apart, with the proximal epiphyses of the two tarso-metatarsals just visible above the soil.

Fig. 10.—*Position of the Moa's Feet in the Morass at Waikouaiti.*

"Upon the retiring of the tide, they were, fortunately, espied by 'Tommy Chaseland,' the best whaler in the island, who carefully dug them up. I examined the holes whence they were extracted,

lated edges, and that each layer has a thickness of from the 5000th to the 6000th of an inch; they may be seen equally well both in a longitudinal and transverse section of a large bone. In the latter section, the Haversian systems are very distinctly and strongly marked, and the outer laminæ may be readily distinguished from the inter-systemic layers of bone by the well-defined and uniform laminæ of the former, and the irregular laminæ of the latter, together with the irregular character of the inter-systemic lacunæ. The lacunæ of the Haversian systems lie sometimes in and sometimes between the laminæ, and have a length of about the 1000th, and a breadth of from about the 5000th to the 6000th of an inch; dimensions nearly similar to those stated by Mr. Bowerbank as characterizing bird-bone (Quarterly Journal of the Geological Society, vol. iv. page 9). Great numbers of canaliculi radiate from the lacunæ, but the majority of these proceed from the side nearest the Haversian canal and advance through the laminæ towards that part. The lacunæ of the inter-systemic layer of osseous substance give off relatively fewer and larger canaliculi, which proceed in equal numbers from each part of the circumference, in addition to which, the lacunæ are very irregular both in size and form. The canaliculi both of the systemic and inter-systemic lacunæ anastomose very freely, and through the medium of the latter the canaliculi of neighbouring Haversian systems are connected. I am not aware that these bones could by their structural characters be distinguished from those of other birds."

and have numbered every bone seriatim, to enable you to articulate them. This unlucky Moa, happily for science, must have been mired in the swamp, and, being unable to extricate himself, have perished on the spot. These splendid and unique fossils were presented to me by Mr. Jones. From the soil near them I dug out part of the lower jaw of a Sea-lion (*Phoca leonina*), which is enclosed."

No other locality in the Middle Island is specified by my son as containing birds' bones; but he incidentally mentions having seen fragments here and there in the subsoil of the plains. Mr. Alfred Wills, who has great local knowledge of New Zealand, and especially of the Middle Island, informs me that in the sand-spit near the mouth of the Molyneux river (now called the Cleuther), fifty miles south of Otago and north-east of the Kaihiku range, relics of Dinornis have been found; and also that fifteen miles inland from the mouth of the same river there is a hill about 100 feet high, called "*Moa Hill*," in consequence of bones having been observed in the superficial soil near its summit. The same intelligent traveller assures me that it is not uncommon to find small heaps of quartz pebbles wherever the bones are met with in any considerable number, and that these stones are supposed to have been swallowed by the birds. There is a native tradition that the Moa formerly inhabited the mountainous district of the Kaihiku range, which runs inland a few miles south of the Molyneux river.

I will now cursorily notice some of the most interesting osteological specimens in the collection; but I shall in a great measure avoid minute descriptions; for anatomical details, though of the highest importance in a physiological point of view, come more legitimately under the consideration of the zoologist than of the geologist; and I reserve for another Society the figures and descriptions of the new and most interesting specimens.

*Dinornis, Palapteryx, &c.*—The osteological characters of the extinct struthious birds of New Zealand have been so accurately and clearly determined by Professor Owen, in his memoirs on the Dinornis in the Zoological Transactions (vol. iii.), that I found no difficulty in assigning the principal bones in the collection to the several species of Dinornis, Palapteryx, and Aptornis, established by that eminent anatomist. The specimens from the Waingongoro deposit in the North Island, chiefly belong to the smaller species, namely *Dinornis didiformis, D. curtus, Aptornis otidiformis,* with *Dinornis casuarinus,* and a few of *D. giganteus.* The bones from Waikouaiti in the Middle Island are principally of the most gigantic birds, viz. *Dinornis giganteus, Palapteryx ingens,* associated with *D. struthioides, D. dromioides, D. casuarinus,* and *D. crassus.*

From both localities there are specimens which apparently belong to some undescribed species and genera of birds; and bones of a Dog, and of two species of Seal.

Some of the bones from Waikouaiti are of colossal size. The head of one tibia is 21 inches in circumference; femora, 16 inches long, and $8\frac{1}{4}$ inches in circumference at the middle of the shaft; vertebræ and portions of pelves of proportionate magnitude; a tarso-metatarsal

18 inches long. Several femora of the young of this gigantic species were collected; in these the epiphyses are wanting, and the walls of the shaft are in an immature state, the entire bone being very light and porous.

There are no portions of the skull sufficiently large for the *D. giganteus*; but there is one very large *os tympanicum* or *quadratum*—the bone articulating the lower jaw with the skull—which, according to the proportions of this element in the ostrich, indicates a cranium from 14 to 16 inches in length. From the activity of research my son has excited, there is reason to hope his efforts to obtain a perfect skull of the most colossal Moa will at no distant period be successful.

*Feet of Dinornis robustus.*—As the structure of the feet of the largest species of Dinornis is for the first time demonstrated by the pair of tarso-metatarsals, with the entire series of the bones of the corresponding toes in natural apposition, now before the Society, and which were dug up at Waikouaiti, as previously mentioned, the principal dimensions of the several parts are subjoined, that a record may remain for reference.

*Tarso-metatarsal*:—

| | inches. | lines. |
|---|---|---|
| Length | 17 | 0 |
| Proximal end, circumference of | 11 | 9 |
| ——, transverse diameter | 4 | 6 |
| ——, antero-posterior | 2 | 6 |
| Circumference of the middle of the shaft | 6 | 3 |
| Antero-posterior diameter of ditto | 1 | 8 |
| Transverse diameter of shaft | 2 | 6 |
| —— of distal extremity | 6 | 3 |
| Circumference of ditto | 15 | 6 |
| Antero-posterior diameter of the middle trochlea | 2 | 9 |

| *Phalangeal bones of*— | *Outer toe.* | | *Middle toe.* | | *Inner toe.* | |
|---|---|---|---|---|---|---|
| | inches. | lines. | inches. | lines. | inches. | lines. |
| First or proximal phalangeal: length | 3 | 2 | 4 | 3 | 4 | 9 |
| Circumference of proximal end | 5 | 9 | 6 | 9 | 6 | 6 |
| Second phalangeal: length | 1 | 9 | 2 | 6 | 1 | 9 |
| Circumference of proximal end | 4 | 9 | 5 | 3 | 3 | 0 |
| Third phalangeal: length | 1 | 0 | 1 | 9 | ungueal 3 | 0 |
| Circumference of proximal end | 4 | 6 | 4 | 6 | ungueal 4 | 0 |
| Fourth phalangeal: length | 0 | 11 | ungueal 3 | 0 | | |
| Circumference of proximal end | 4 | 0 | ungueal 4 | 2 | | |
| Ungueal: length | 2 | 6 | | | | |
| Circumference of proximal end | 3 | 9 | | | | |
| Total length | 9 | 4 | 11 | 6 | 9 | 6 |

The length of the toes when the bones are in close contiguity is about one inch less than the above measurements.

The transverse diameter of the expanse of the foot from the distal end of the outer toe to that of the inner one is $15\frac{1}{2}$ inches. From the back of the trochlear extremity of the tarso-metatarsal to the extremity of the middle toe, 13 inches.

If to the actual measurements of the bones be added the proportional thickness of the cartilaginous coverings of the joints, and the callous integuments, the length of the foot of the living bird may be

estimated at 16 inches, and the width of its imprint at 17 or 18 inches.

According to the scale of proportions given by Professor Owen in the Zoological Transactions, the corresponding tibia of the tarso-metatarsal above described would be about 2 feet 9 inches, and the femur 14½ inches in length; the total height of the living bird about 10 feet. The larger tibiæ and metatarsals must have belonged to a bird yet more gigantic; and there is reason to conclude that some individuals attained a height of 11 or 12 feet, or one-third higher than the tallest Ostrich. I may add, that the height of some of the other species has been estimated by Professor Owen as follow:—

*Palapteryx ingens*, 9 feet.
*Dinornis struthioides*, 7 feet; the height of an Ostrich of moderate size.
—— *dromioides*, 5 feet, or that of the Emu.
—— *didiformis*, 4 feet, or intermediate between the Cassowary and the Dodo.

The largest Ornithichnite or fossil footmark in the sandstone of Connecticut, would be surpassed in size by the imprint of the foot of the most colossal Dinornis.

*Phalangeal bones.*—Among the numerous phalangeal bones belonging to birds of various species and ages, there are a few which do not present the characters of the Dinornis, but evidently belong to other genera. Among these are several which are relatively flatter and shorter, and somewhat resemble those of the Emu; and there are a few middle proximals in which the trochlear articulation is as unequally divided as in the Ostrich, suggesting the idea that didactyle or two-toed struthious birds may have inhabited New Zealand, contemporaneously with the colossal tridactyle Moa, and tetradactyle Apteryx and Palapteryx.

*Egg-shells.*—Of the egg-shell of the Moa, a few small portions, and one fragment 4 inches long and 2 wide, from Waingongoro, are the only additional examples. The sculpturings on the outer surface of the shells are of three distinct types, and unlike any recent eggs with which I have been able to compare them; they approach nearest to those of the Emu. Some burnt fragments of egg-shells, evidently charred when recent, were found in the ancient fire-heaps mentioned in my former paper, intermingled with roasted bones of dogs, Moas, and men. This fact tends to confirm the opinion that the Dinornis existed when cannibalism was practised by the aborigines of New Zealand.

The present collection has also established the interesting fact, that the *Apteryx australis*, the only known existing type of the Struthionidæ of these islands, was coeval with the more gigantic species of Dinornis and Palapteryx; the bones in my possession leave no doubt on that point. We have likewise evidence that the yellow-billed Albatros, and some species of Penguin, Water-rail, Teal, and Nestor, were comprised in that ancient ornithic fauna. The only terrestrial qua-

druped of which there are vestiges in the bone-deposits is a Dog; whether an extinct or living species is not determined.

---

*Summary.*—From the facts described, it appears that in the Middle Island of New Zealand, as in the North Island, the fundamental rocks are metamorphic schists and clay-slate, with dikes of greenstone and compact and amygdaloidal basalt, and intruded masses of obsidian, vesicular and trachytic lavas, and other igneous products. Hornblende and porphyritic rocks, gneiss and serpentine occur, but granite has not been observed.

The lofty mountain ranges of schistose metamorphic rocks that extend through the country, from near Cloudy Bay on the north-east to near the south-western extremity of the island, a distance of between 300 and 400 miles, and whose crests everywhere attain an elevation above the line of perpetual snow—hence they were called by Captain Cook "The Southern Alps"—are flanked by volcanic grits, and covered at their base by alluvial deposits, which have evidently originated from the decay of trachytes and earthy lavas, and the detritus of the harder materials which entered into their composition. No active volcanos are known in the Middle Island, nor have any extinct craters been discovered; but as the physical structure of the interior of the country, and especially of the Alpine districts, has been but partially explored, no conclusive inferences can be drawn from this negative evidence. Strata of limestone, composed of organisms similar to those which prevail in certain cretaceous beds of Europe, crop out in a few localities on the eastern coast, from near Morakura to Kakaunui; but their relation to the adjacent igneous and metamorphic rocks has not been ascertained.

A pleistocene or newer tertiary formation—the clay of Onekakara—abounding in shells of species existing in the neighbouring sea, overlies the limestone, and is in many places covered by the alluvial deposits of gravel, sand, conglomerate, and loam, which form the superficial soil of the vast plains that are spread over the eastern side of the central mountain chain.

On the western shore of the North Island, argillaceous strata with similar fossil shells appear at Wanganui, Waingongoro, &c.; in both islands these beds are from a few feet to 20 or 30 feet above the sea-level. A subsidence of the land to the depth of 40 feet would unite these outliers of a deposit, evidently once continuous; we may therefore conclude that an elevation to that extent has taken place since the deposition of the uppermost beds of the blue clay of Onekakara. This phenomenon accords with the horizontal sediments containing drift wood that occur along the coast, and with the terraces of boulders of trap, 50 feet high, and the lines of ancient sea-margins now far above the highest tides; and these mutations in the relative level of the sea and land must have taken place long since the Pacific was inhabited by the existing species of mollusca.

The infusorial earths show that deposits wholly composed of the

durable remains of the most minute structures have been in as rapid progress of formation at the Antipodes, as in Europe and America; and that among many familiar types there are, even in this "invisible world of being," unknown forms of animal and vegetable existence.

Lastly, the position of the Moa-bed at Waikouaiti has been correctly determined; like that of Waingongoro in the North Island, it is superimposed on the tertiary clay. Both these ossiferous deposits, though but of yesterday in geological history, are of immense antiquity in relation to the human inhabitants of the country. I believe that ages ere the advent of the Maoris, New Zealand was densely peopled by the stupendous bipeds whose fossil remains are the sole indications of their former existence.

The extreme freshness of the bones in no respect militates against this supposition, for many of the skeletons of the most ancient extinct mammalia in Europe and America have undergone as little change as the specimens before us. Thus Mr. Darwin remarks on the fossil mammalia of the Pampas: "As far as I am aware, not one of these animals perished, as was formerly supposed, in the marshes or muddy river-beds of the present land; their bones have simply been exposed by the streams intersecting the subaqueous deposit in which they were originally imbedded. The bones of the head (of the Toxodon) are so fresh, that they contain a large per-centage of animal matter, and when placed in a spirit-lamp burn with a bright flame*." And Sir Charles Lyell, in commenting on the discovery of the skeleton of the *Mastodon giganteus* dug up at Newburgh, observes, "Nothing is more remarkable than the large proportion of animal matter in the tusks, teeth, and bones of many of these extinct mammalia, amounting in some cases to 27 per cent.; so that when all the earthy ingredients are removed by acids, the form remains as perfect as in a recent bone subjected to the same process. It would be rash to infer from such data that these quadrupeds were mired at periods more modern than the fossil elephants found imbedded in similar clayey deposits in Europe†."

From the great numbers of the largest species of Dinornis that must formerly have existed, and the remarkable form and strength of their thighs, legs, and feet, constituting powerful locomotive limbs, well-adapted for traversing extensive plains, it seems probable that these stupendous terrestrial birds were not anciently confined within the narrow limits of modern New Zealand, but ranged over a vast continent, that is now submerged, and of which the Isles of the Pacific are the culminating points.

That the last of the species was exterminated by human agency, like the Dodo and Solitaire of the Mauritius, and the gigantic Elk of Ireland, there can be but little doubt; but ere Man began the work of destruction, it is not unphilosophical to assume that physical revolutions, inducing great changes in the relative distribution of the land and water in the South Pacific Ocean, may have so circumscribed

* Journal of a Naturalist, Edit. 1845, p. 155.

† Sir C. Lyell's Travels in the United States, vol. ii. p. 265.

the geographical limits of the Dinornis and Palapteryx, as to produce conditions that tended to diminish their numbers, preparatory to their final annihilation.

Of the law which determines the extinction of races of highly organized beings, and whose effects through countless ages Palæontology has in part revealed, we are as utterly ignorant as of that which governs the first appearance of the minutest living animalcule which the most powerful microscope enables us to descry:—both are veiled in inscrutable mystery,—the results only are within the scope of our finite comprehension.

---

I have thus endeavoured to present a general idea of the facts and inferences suggested by the collection of minerals and fossils, and the notes and sketches, communicated by my eldest son, in the hope that his attempts to illustrate the Palæontology of his adopted country, will be received by the Geological Society as an earnest of his anxious desire to advance, in however humble a degree, our knowledge of the ancient physical history of the earth and its inhabitants.

---

## EXPLANATION OF THE PLATES.

### PLATE XXVIII.

Fig. 1. Tooth of *Lamna*, nat. size.....
Figs. 2, 3. *Terebratula Gualteri*, n. sp., nat. size.....
Fig. 4. *Cereopora Ototara*, n. sp., magn.....
Fig. 5. *Cereopora Ototara*, magn. 2 diam. .....
Fig. 6. *Cereopora Ototara*, transverse section of the stem, nat. size
Fig. 7. *Cereopora Ototara*, transverse section of the stem, magn. ..
Fig. 8. Portion of *Eschara*, incrusting the upper part of fig. 4, magn.
Figs. 9–11. *Cereopora*, nat. size .....
Figs. 12, 13. *Manon*, nat. size .....
Fig. 14. *Manon*, magn. .....
} From the Ototara limestone.

Fig. 15. *Dentalium*, nat. size.....
Figs. 16, 17. *Turritella rosea*, nat. size .....
Figs. 18, 19. *Turbinoliæ*? nat. size .....
Fig. 20. *Pustulopora Zealandica*, n. sp., nat. size .....
Fig. 21. *Pustulopora Zealandica*, magn. 3 diam. .....
} From the blue clay of Onekakara.

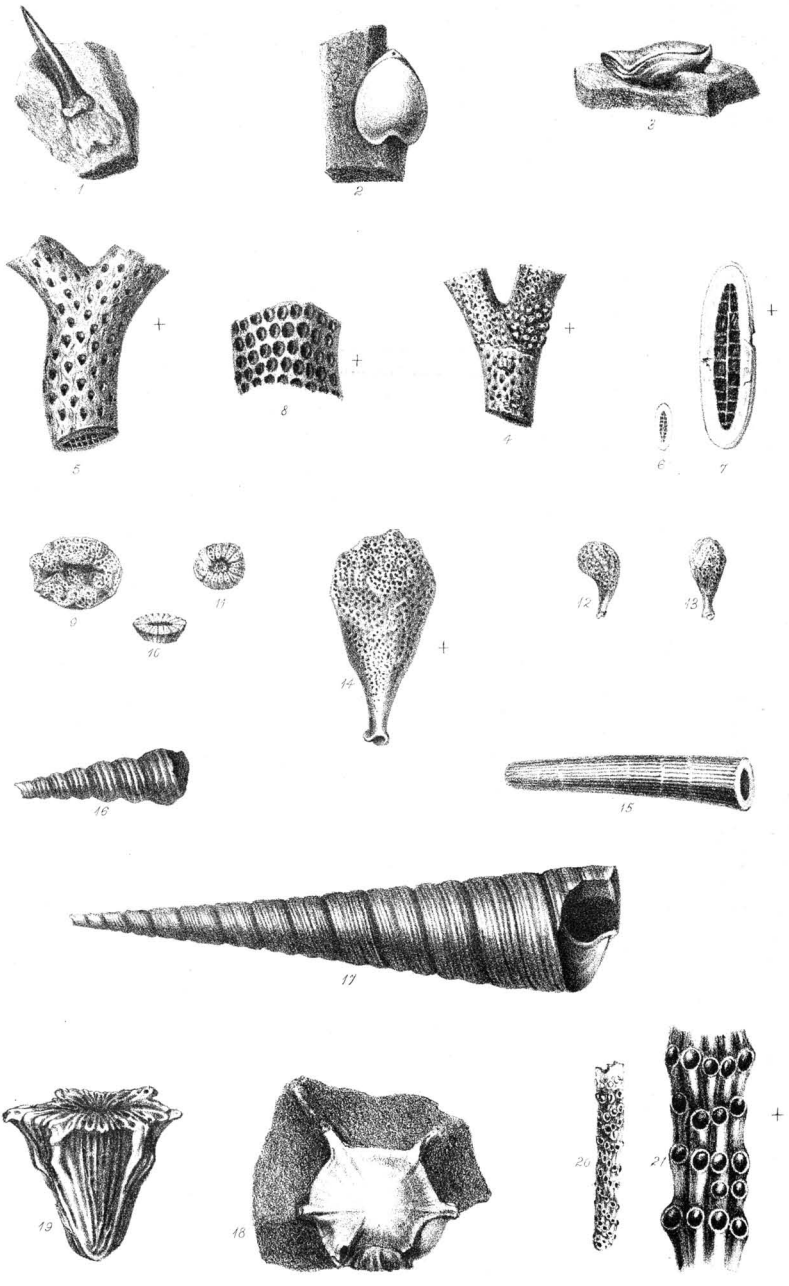
### PLATE XXIX.

[In this plate the objects are figured as seen by transmitted light, under magnifying powers of from 200 to 300 diameters.]

Fig. 1. *Textularia* .....
Fig 2. *T. elongata*, n. sp. .....
Fig. 3. *T. aciculata* .....
} From the Ototara limestone.

Figs. 4, 5. *Stauroneis Zealandica*, n. sp. .....
Fig. 5. *Stauroneis Zealandica*, the central bar, detached from the shield .....
Figs. 6, 7. *Surirella* .....
Fig. 8. *Pinnularia* .....
Fig. 9. *Actinocyclus* .....
Fig. 10. *Pyxidicula* .....
Fig. 11. *Polycystina* .....
} From the infusorial marl of New Plymouth.

Fig. 12. Spicule of *Gorgonia* .....From the Ototara limestone.

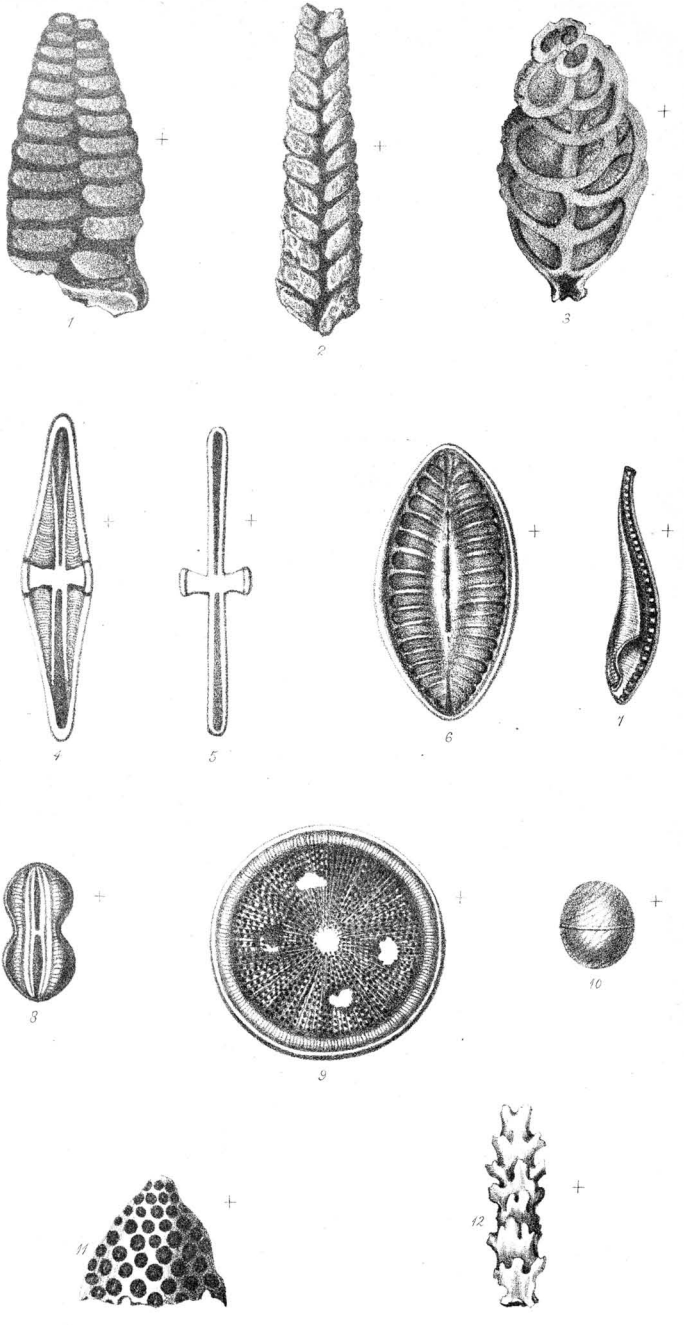


FOSSILS FROM NEW ZEALAND COLLECTED BY WALTER MANTELL, ESQ. 1848.

Ja.s Mounsey, del.

Ford & George, Lithographers, 54. Hatton Garden.

Dinkel. lith.




FOSSILS FROM NEW ZEALAND COLLECTED BY WALTER MANTELL, ESQ. 1848.

Jas Morrisey, del. Ford & George, Lithographers, 54, Hatton Garden. Dinkel, lith.