

## IV.—GEOLOGY.

### ART. XLIV.—*The Fossils of the Waitemata and Papakura Series.*

By E. CLARKE.

[Read before the Auckland Institute, 29th February, 1904.]

Plate XXXII.

#### I. INTRODUCTORY.

THE typical Waitemata beds consist of alternating soft sandstones and friable clays, both almost entirely unfossiliferous. Interbedded with these are several beds of volcanic and slate grits, a full description of which may be seen in the papers by Messrs. Mulgan and Fox (Appendix 27, 28).

The Papakura series is characterized by the occurrence of beds of limestone, and has yielded fairly numerous fossils. It seems doubtful whether those who have written about the Papakura series are quite agreed as to what and where that series is. Mr. Cox speaks of a "Papakura limestone forming high cliffs at Papakura" (App. 11, p. 13). I have not seen these cliffs of limestone. By "Papakura series" Hochstetter (its originator) meant the succession of clays and limestones seen in "Cooper and Smith's limestone quarries on the Hunua Mountains" (App. 4, p. 42).

Although a considerable amount of valuable stratigraphical work has been done, much remains to be done on palæontological lines. The age of the beds has not been determined by palæontological evidence since Hochstetter's time; and since then not only have the Waitemata and Papakura series yielded additional fossils, but also the number of described New Zealand Tertiary invertebrates has been increased, and the relative ages of the Tertiary strata have been more accurately determined.

The following list contains, so far as could be ascertained, all the specifically determined invertebrates, excepting *Bryozoa* and *Foraminifera*, found in the Waitematas near to and south of Auckland, and in the Pakakura series.

Considerable difficulty is experienced in trying to identify the Orakei Bay fossils. Owing to their abnormal smallness it is difficult to compare them with specimens from elsewhere.

The localities mentioned may all be found in the county maps, except Slippery Creek, which is kept in this paper since other geologists have used it. Hay's Creek is the name

appearing on the county map. If a fossil is found also in the northern extension of the Waitematas the fact is mentioned.

The following abbreviations are used: C.T.M.—“Catalogue of Tertiary Mollusca and Echinodermata of New Zealand,” by Professor Hutton (Geological Survey publication); 1873. Harris—“Catalogue of Tertiary Mollusca: Part i., Australasia,” by G. F. Harris (British Museum Catalogues); 1897. M.M.—“Manual of the New Zealand Mollusca,” by Professor Hutton (Geol. Surv. publication); 1880. M.M.V.—“Macleay Memorial Volume: Part ii., The Pliocene Mollusca of New Zealand,” by Professor Hutton (publication of Linnæan Soc. of N.S.W.); 1893. P.L.S.—“Proceedings of Linnæan Society of N.S.W.: Vol. i., Series ii., Mollusca of the Pareora and Oamaru Systems,” by Professor Hutton. Ten.W.—“Palæontology of New Zealand: Part iv., Corals and Bryozoa of the Neozoic Period in New Zealand,” by the Rev. J. E. Tenison-Woods (Geol. Surv. publication); 1880. Zittel and Eastman—“Zittel’s Text-book of Palæontology, translated by Dr. Eastman.”

After each locality is placed the name of the person who found the fossil there. The number refers to the number of his work in the appendix. Papakura and Slippery Creek I take to be synonymous.

A good many fossils were found by myself in the beds exposed in Slippery Creek which belong to the Papakura series. The most characteristic bed is the Papakura limestone, and as the other fossiliferous beds have not yet been described they have not been specified in naming the localities. They are, however, at no great vertical distance above or below the limestone.

Any value which this paper possesses is due to the criticism and advice of Professor Thomas. Although in no way responsible for the conclusions arrived at, he has generously sacrificed time for which he had many and better uses in directing and encouraging my work.

## II. INVERTEBRATE FAUNA OF WAITEMATA AND PAKAPAKURA SERIES.

### Sub-kingdom I. PROTOZOA.

For an account of the *Foraminifera* of Orakei Bay, see App. 5.

### Sub-kingdom II. COELENTERATA.

#### Class ANTHOZOA.

*Flabellum laticostatum*, Ten. W., p. 14.

Agrees fairly well with a specimen in Auckland University College museum (from fan-coral beds at junction of Thomas

and Porter Rivers), but there are differences—in the angle enclosed by the base, which is less than in the South Island specimen; in the marginal thickening of the septa, which is more pronounced; and in the external markings, which are fainter and more regular, with no concentric ones.

*Locality*.—Slippery Creek, *E. C.*

*Range*.—Oamaru.

**Flabellum papakurense**, sp. nov. Figs. 1 and 2.

More or less conical, but in some specimens (fig. 1) the sharp-pointed somewhat recurved apex stands in the middle of an almost flat area, from whose periphery the calice-walls rise as a cylinder. Aperture nearly circular; diameters 19 mm. and 16–18 mm. Thick outer layer of theca easily separable from inner. Near base are 6 to 8 rootlets. Septa in 3 cycles apparently, but in some specimens (fig. 1) their arrangement is irregular. In this variety the septa are thin, with granulated surface, the granules being more or less arranged in lines; towards the centre the septa diverge from the radial direction, seeming to lie over on their sides and anastomosing to form a false columella. In the one more strictly conical form obtained (fig. 2) the septa are stouter and more regular. No granules were observed. The first variety seems to have been worn so as to show the septa at a lower level, and this no doubt accounts for some of the differences noticed. Pali are absent.

There does not seem to be any grave objection to placing these specimens under *Flabellum*, unless it be the absence of compression. The septa anastomose irregularly in *F. rubrum* found in New Zealand waters.

*Locality*.—Slippery Creek, *E. C.*

Class ECHINOIDEA.

**Schizaster rotundatus**, C.T.M., p. 43.

*Locality*.—Papakura, *Hochstetter*, 3, p. 43.

*Range*.—Lower Oamaru.

Sub-kingdom V. MOLLUSCOIDEA.

Class BRYOZOA.

See App. 7. Mr. Fox (28) also identified a number of *Bryozoa*.

Class BRACHIOPODA.

**Rhynchonella nigricans**, M.M., p. 178.

*Localities*.—Little Omaha, *Cox*, 13, p. 31; Rodney, *Zittel*, 4, p. 61; Waikopua, *Park*, 19, p. 152, and *E. C.*; Papakura, *Park*, 19, p. 153, and *E. C.*; Motutapu, *Park*, 22, p. 226, and *E. C.*; Papakura and Cheltenham, *Fox*, 28, p. 468.

*Range*.—Oamaru to Recent.

**Terebratella dorsata**, C.T.M., p. 36.

*Localities*.—Little Omaha, *Cox*, 13, p. 31; Rodney, *Hochstetter*, 4, p. 61; Waikopua, *Park*, 19, p. 152; Papakura, *Park*, 10, p. 153, *Fox*, 28, p. 468, and *E. C.*; Cheltenham, *Park*, 22, p. 226, and *Fox*, 28, p. 468; Motutapu, *Park*, 22, p. 226.

*Range*.—Lower Pareora.

**Terebratella cruenta**, C.T.M., p. 36.

*Locality*.—Papakura, *Fox*, 28, p. 468.

*Range*.—Wanganui to Recent.

**Magellania (Waldheimia) grvida**, C.T.M., p. 36.

*Localities*.—Papakura, *Hutton*, 10, p. 246, *Hochstetter*, 4, p. 56, *Park*, 19, p. 164, *Fox*, 28, p. 468; Cheltenham, *Fox*, 28, p. 468.

*Range*.—Oamaru.

## Sub-kingdom VI. MOLLUSCA.

### Class PELECYPODA.

**Leda fastidiosa**, Hutton, P.L.S., p. 230. Fig. 3.

Through the kindness of Professor Thomas I am enabled to describe two specimens in Auckland University College museum from the Orakei Bay beds.

Subtrigonal, shell somewhat ventricose, anterior end slightly produced, rounded, posterior beaked and keeled, somewhat more produced than anterior, angular, acuminate. Shell regularly concentrically striated. Length—(a) 6.5 mm., (b) 2.5 mm.; height—(a) 4 mm., (b) 1.5 mm.

This seems to agree with *L. fastidiosa*, but I have not had access to any figures of the species.

*Range*.—Pareora and Wanganui.

**Limopsis aurita**, Harris, p. 346.

*Locality*.—Slippery Creek, *E. C.*

*Range*.—Oamaru and Pareora.

**Glycimeris (Pectunculus) globosus**, Harris, p. 343.

Agrees well with specimens in Auckland University College museum from Trelissic basin; also with the description, except that the measurements both of the Papakura and Trelissic specimens are just half those given by Harris and Hutton

*Locality*.—Slippery Creek, *E. C.*

*Range*.—Oamaru (?) and Pareora.

**Ostrea nelsoniana**, Harris, p. 301.

*Localities*.—Little Omaha, *Cox*, 13, p. 31; Papakura, *Park*, 19, p. 164, and *Fox*, 28, p. 468.

*Range*.—Oamaru and Pareora.

*Ostrea wullerstorfi*, Harris, p. 301.

*Localities*.—Motutapu, *Park*, 22, p. 226; Papakura, *Fox*, 28, p. 468; Rodney, *Hutton*, P.L.S., p. 237.

*Range*.—Oamaru to Pareora.

*Anodonta elliptica*, Hochstetter MSS. (*Hutton*, 8, p. 246).

*Locality*.—Papakura.

*Range*.—

*Pecten aucklandicus*, Zittel, 4, p. 53.

I have never found undoubted specimens of this species. The specimens of small smooth pectens seemed referable to damaged shells of *P. fischeri* or *Amussium zittelli*.

*Localities*.—Orakei, *Hochstetter*, 4, p. 53; Maungaroa, *Park*, 19, p. 163.

*Range*.—Only found in Waitemata beds.

*Pecten beethami*, Harris, p. 319.

*Localities*.—Motutapu and Arapaoa, *Park*, 22, p. 226, and 19, p. 167.

*Range*.—Oamaru and Pareora.

*Pecten burnetti*, C.T.M., p. 32.

*Localities*.—Motutapu and Cheltenham, *Park*, 22, p. 226; Papakura and Cheltenham, *Fox*, 28, p. 468; Orakei, *E. C.*

One specimen (height, 8 mm.; length, 7 mm.) is almost perfect, and seems nearer to this species than to *P. polymorphoides*.

*Range*.—Oamaru and Pareora

*Pecten convexus* (= *P. vellicatus*), C.T.M., p. 32; M.M., p. 171.

*Localities*.—Cheltenham, *Park*, 19, p. 154; Orakei, *Fox*, 28, p. 468.

*Range*.—Lower Pareora to Recent.

*Pecten fischeri*, C.T.M., p. 30.

In connection with the fact that "Dr. Zittel has expressed doubts as to the specific identity of the Orakei pectens (*i.e.*, *fischeri* and *zittelli*) with those from Papakura" (*Hutton*, 10, p. 249), I obtained specimens of both from Papakura, which seemed identical with those from Orakei Bay.

*Localities*.—Komiti, *Cox*, 13, p. 17; Orakei, *Cox*, 13, p. 25, and *E. C.*; Papakura, *Hochstetter*, 5, p. 53, and *E. C.*; Arapaoa, *Cox*, 13, p. 33; Maungaroa and Orakei, *Park*, 19, p. 63; George's Bay, *Park*, 24, p. 399; Papakura, Cheltenham, and Orakei, *Fox*, 28, p. 468.

*Range*.—Oamaru and Pareora.

*Pecten polymorphoides*, Harris, p. 316.

*Localities*.—Little Omaha, *Cox*, 13, p. 31; Maungaroa and Orakei, *Park*, 19, p. 163; Cheltenham, *Park*, 22, p. 226;

Judge's Bay, *Park*, 24, p. 398; Cheltenham and Orakei, *Fox*, 28, p. 468; Orakei(?) and Papakura, *E. C.*

*Range*.—Oamaru and Pareora.

*Pseudamussium hochstetteri*, Harris, p. 323.

*Localities*.—Papakura, *Park*, 19, p. 153; *Fox*, 28, p. 468, *E. C.*; Motutapu, *Park*, 22, p. 226.

*Range*.—Oamaru and Pareora.

*Amussium zittelli*, Harris, p. 324.

*Localities*.—Komiti, *Cox*, 13, p. 17; Orakei, *Cox*, 13, p. 25, and *E. C.*; Arapaoa, *Cox*, 13, p. 33; Papakura, *Hochstetter*, 4, p. 53, and *E. C.*; Maungaroa and Orakei, *Park*, 19, p. 163; Cheltenham and Orakei, *Fox*, 28, p. 468.

*Range*.—Oamaru to Pareora.

*Amussium papakurense*, sp. nov. Fig 4.

Shell quite inequilateral, very thin, shows externally a fine radial striation, internally the ribs (apparently 8, though only 7 are seen in my best specimen) characteristic of the genus. The ears are small, and, so far as could be seen, smooth. An apparently identical form was collected by Mr. E. K. Mulgan on the Waiwera-Warkworth Road, a few hundred yards beyond the Puhoi Bridge. Height, 24 mm.; length, about 21 mm.

*Localities*.—Reid's quarry, on the Papakura-Wairoa South Road, and Symonds Stream, near Slippery Creek, *E. C.*

*Lima bullata*, Harris, p. 311.

*Localities*.—Papakura and Orakei, *E. C.*; Arapaoa, *Cox*, 13, p. 33.

*Range*.—Lower Oamaru to Recent.

*Crassatellites amplius*, Harris, p. 365.

*Localities*.—Rodney, *Hochstetter*, 4, p. 46; Motutapu, *Park*, 22, p. 226.

*Range*.—Pareora.

*Cardita awamoensis*, Harris, p. 360.

Probably Professor Hutton's *C. patagonica* (P.L.S., p. 229) is the same, in which case it must have precedence over Harris's *C. awamoensis*.

*Localities*.—Papakura, *E. C.*; Arapaoa, *Park*, 19, p. 167 (?). (*Venericardia intermedia*).

*Range*.—Oamaru to Wanganui.

#### CLASS SCAPHOPODA.

*Dentalium subgiganteum*, d'Orbigny, 1852 (new name for *D. giganteum*, Sowerby).

*Localities*.—Papakura, *E. C.*; Arapaoa, *Park*, 19, p. 167.

*Range*.—Oamaru to Pareora.

Class GASTROPODA.

*Calyptræa calyptræformis*, Harris, p. 252.

*Localities.*—Orakei and Papakura, *E. C.*

*Range.*—Upper Oamaru to Recent.

*Natica ovata*, Harris, p. 259.

In general outline and the shape of the umbilical opening the specimens differ slightly, but only slightly, from those in Auckland University College museum from the Miocene of Trelissic basin.

*Locality.*—Papakura, *E. C.*

*Range.*—Oamaru to Wanganui.

*Turritella cavershamensis*, Harris, p. 242.

*Localities.*—Papakura, *E. C.*; Arapaoa, *Cox*, 13, p. 33.

*Range.*—Oamaru and Pareora.

*Vaginella aucklandica*, sp. nov. Fig. 5.

The shell is much more slender than *V. depressa* (Zittel and Eastman, p. 489, fig. 1021). A groove running right round the shell is usually the line along which breakage takes place, and thus no specimen has been found with the mouth uninjured. The one figured, however, shows something of this important part. Length of shell, 14 mm.; greatest breadth, 2 mm.

Through the kindness of Professor Thomas I have seen a copy of Tate's figure of *V. eligmostoma* in *Trans. Roy. Soc. S. Aust.*, vol. ix., pl. xx., which differs considerably from any specimen obtained from the Waitematas.

*Locality.*—Orakei Bay, *E. C.* A *Vaginella* has been reported by Hochstetter and many others from Orakei. Hochstetter also found one at Papakura.

Sub-kingdom VII. ARTHROPODA.

Class CRUSTACEA.

*Pollicipes aucklandicus*, Benham, *Geol. Mag.*, March, 1903, p. 110.

*Locality.*—Motutapu Island.

*Range.*—This species is, so far, peculiar to Waitemata beds. Has hitherto been called a *Scalpellum*. Mr. Cheesman kindly called my attention to Professor Benham's paper, which I had missed.

III. SUMMARY.

Up to the present the palæontological evidence as to the age of the Papakura and Waitemata series is as follows:—

(a.) Of the twenty-four species found in the Papakura series, three are found elsewhere only in rocks of Oamaru

age, *one* in Pareora, *eleven* both in Oamaru and Pareora, *two* range from Oamaru to Wanganui, *three* from Oamaru to Recent, *one* from Wanganui to Recent, and *three* have not yet been reported from other districts.

(b.) Of the eighteen species reported from the Orakei Bay and other beds near Auckland, *one* is found only in Oamaru rocks, *two* are found only in Pareora, *eight* both in Oamaru and Pareora, *one* both in Pareora and Wanganui, *three* range from Oamaru to Recent, and *three* have not yet been reported from other districts.

(c.) Of the eleven species common to the Waitemata and Papakura series, *one* is found only in Oamaru rocks, and *one* only in Pareora, *six* belong to both Oamaru and Pareora, and *three* range from Oamaru to Recent.

#### APPENDIX—LITERATURE.

1. 1860. Rupert-Jones, Quart. Journ. Geol. Soc., xvi.
2. 1863, Zittel, Quart. Journ. Geol. Soc., xix., Miscellaneous, p. 20.
3. 1865? Hochstetter, Reise der "Novara," Geology, i.; also "Geology of New Zealand," published in Auckland.
4. 1865? Zittel, Reise der "Novara," Geology, ii.
5. 1865? Karrer, Reise der "Novara," Geology, ii.
6. 1865? Stache, Reise der "Novara," Geology, ii.
7. 1865? Stoliczka, Reise der "Novara," Geology, ii.
8. 1867. Hutton, Reports of Geological Survey of New Zealand.
9. 1870. Duncan, Quart. Journ. Geol. Soc., xxvi., p. 316
10. 1870. Hutton, Trans. N.Z. Inst., iii., p. 244.
11. 1874-6. Cox, Geol. Surv. Reports.
12. 1876-7. Cox, Geol. Surv. Reports.
13. 1879-80. Cox, Geol. Surv. Reports.
14. 1879-80. Hector, Geol. Surv. Reports, Progress Report.
15. 1881. Cox, Geol. Surv. Reports.
16. 1883-4. McKay, Geol. Surv. Reports.
17. 1883-4. Hector, Geol. Surv. Reports, Progress Report.
18. 1884. Hutton, Trans. N.Z. Inst., xvii., p. 307.
19. 1885. Park, Geol. Surv. Reports.
20. 1885. Hector, Geol. Surv. Reports, Progress Report.
21. 1885. Hutton, Quart. Journ. Geol. Soc., xli., p. 209.
22. 1886-7. Park, Geol. Surv. Reports.
23. 1887-8. McKay, Geol. Surv. Reports.
24. 1889. Park, Trans. N.Z. Inst., xxii., p. 391.
25. 1897. Park, "Geology and Veins of the Hauraki Gold-fields," published by N.Z. Inst. of Mining Engineers.



26. 1899. Hutton, Trans. N.Z. Inst., xxxii., p. 171.  
 27. 1901. Mulgan, Trans. N.Z. Inst., xxxiv., p. 414.  
 28. 1901. Fox, Trans. N.Z. Inst., xxxiv., p. 452.

## EXPLANATION OF PLATE XXXII.

- Figs. 1 and 2. *Flabellum papakurense*, sp. nov.: a, side view; b, view of base: both natural size. 1c, calice from above; 2c, part of calice: both  $\times 2$ .  
 Fig. 3. *Leda fastidiosa* (specimen b): a, natural size; b, magnified (drawn with camera lucida).  
 Fig. 4. *Amussium papakurense*, sp. nov.: Chiefly a cast, the internal ribs being preserved; part of the shell showing the external ribbing is adherent (natural size).  
 Fig. 5. *Vaginella aucklandica*, sp. nov.: a, natural size; b and c, views from opposite sides: both  $\times 2$ .

## ART. XLV.—Notes on the East Coast Earthquake of 9th August, 1904.

By GEORGE HOGBEN, M.A.

[Read before the Wellington Philosophical Society, November, 1904.]

THIS earthquake was felt nearly all over the colony, from Auckland to Queenstown. Its effects were most marked in the Hawke's Bay and Wellington Districts, especially on and near the coast from Porangahau to Castlepoint, where rock-falls occurred from cliffs, and fissures were formed in the surface-crust, indicating an intensity of IX. (or nearly so) on the Rossi-Forel scale. In the area affected and in its intensity it closely resembled the earthquake of the 17th February, 1863, which proceeded from the same region of disturbance.

Memoranda or notices of the shock were received from the following places, the Roman numbers denoting the degree of intensity (in some cases only approximately):—

IX.: Castlepoint, Motuotaraia, Porangahau.

VIII.—IX.: Napier; Hastings, Te Aute, Kopua, Dannevirke, Pahiatua, Wellington.

VIII.: Woodville, Masterton, Featherston, Carterton.

VII.—VIII.: Wairoa, Palmerston North.

VII.: Gisborne, Feilding.

VI.: Opunake, Aramoho, Marton, Nelson, Blenheim, Taupo.

V.—VI.: New Plymouth, Hawera, Kaikoura, Motueka, Collingwood, Wakapuaka.