NEW ZEALAND.

Department of Mines.

NEW ZEALAND GEOLOGICAL SURVEY.

(P. G. MORGAN, Director.)

PALÆONTOLOGICAL BULLETIN No. 1.

MATERIALS

FOR THE

PALÆONTOLOGY OF NEW ZEALAND.

BY

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LETTER OF TRANSMITTAL.

Geological Survey Office,
Sir,— Wellington, 31st July, 1913.

I have the honour to submit herewith Palæontological Bulletin No. 1, entitled "Materials for the Palæontology of New Zealand," and written by Dr. J. Allan Thomson, Palæontologist.

The work now being done in connection with the palæontology of New Zealand, of which the present publication is the firstfruits, marks a most important step in advance. The results of this work will be not merely of high scientific interest, but of great economic value in connection with the Dominion's coal, oil, and other mineral resources.

The present bulletin contains 104 pages of letterpress, and is illustrated by a map and six plates, these latter including a series of figures of Mesozoic *Brachiopoda* prepared many years ago under the direction of Sir James Hector, but hitherto unpublished.

I have the honour to be,
Sir,
Your obedient servant,

P. G. MORGAN,
Director, New Zealand Geological Survey.

The Hon. William Fraser, Minister of Mines, Wellington.

INTRODUCTION.

The aims of this bulletin are threefold. In the first place, it is prepared for the use of officers of the New Zealand Geological Survey, to afford a ready means of reference to the literature and localities of New Zealand fossils. In the second place, it is designed to encourage and facilitate palæontological work amongst New Zealand geologists. For this purpose the rules of Linnean nomenclature, which are not readily accessible in the local libraries, have been included. Emphasis has been laid on the due preservation and classification of type specimens, and on the importance of forming collections of topotypes in all the principal museums of the Dominion. In the third place, it attempts to give to palæontologists abroad who are interested in the geology of the Dominion an account of the present position of New Zealand palæontology and of the material that is available for subsequent work. It will be many years before New Zealand can hope to possess a number of specialists adequate to cope with the gigantic task that lies before them. As the need arises in connection with the unravelling of the stratigraphy of given districts, the Geological Survey will no doubt obtain the services of foreign specialists in the manner employed by the Indian Geological Survey, but in the meantime, if the peculiar interest attaching to the palæontology of the country attracts volunteers abroad, the material in New Zealand will be freely made open to them.

To those ladies and gentlemen in New Zealand, Australia, and England who have already volunteered to examine collections of fossils the Geological Survey is under a deep debt of gratitude, which it is desired here to acknowledge publicly.

TABLE OF CONTENTS.

ABBREVIATIONS USED IN THIS BULLETIN.

BESIDES the usual abbreviations for references to scientific journals (a list of which is issued by the Geological Society of London in their Annual List of Literature added to the Library of the Society), the following abbreviations are used in this bulletin:—

Ann. Rep. Col. Mus. Lab.	Annual Report on the Colonial Museum and Laboratory. Wellington. (The year refers to the date of publication.)
App. Off. Cat. S.E. ..	Appendix to Official Catalogue, New Zealand Court, International Exhibition, Sydney, 1879. Wellington, 1880.
B.M.	British Museum (Natural History), South Kensington, London.
C.M.	Canterbury Museum, Christchurch, N.Z.
Cat. Col. Mus.	Catalogue of the Colonial Museum, Wellington, New Zealand. Wellington, 1870.
Cat. Ind. Col. Exh. ..	Detailed Catalogue and Guide to the Geological Department's Exhibits at the Indian and Colonial Exhibition, and Outline of the Geology of New Zealand. Wellington, 1886.
Cat. Tert. Moll. Ech. ..	Catalogue of the Tertiary *Mollusca* and *Echinodermata* of New Zealand in the Collection of the Colonial Museum. Wellington, 1873.
Cor. Bry. N.Z. ..	Corals and *Bryozoa* of the Neozoic Period in New Zealand. Pt. IV: Palæontology of New Zealand. Wellington, 1880.
D.M.	Dominion Museum, Wellington, N.Z. (Formerly Colonial Museum. The fossils stored temporarily in this Museum are the property of the Mines Department.)
N.Z. Journ. Sci. ..	New Zealand Journal of Science. Dunedin.
Nov. Pal.	Paläontologie von Neu-Seeland. Reise der "Novara." Geol. Theil., bd. i, abth. ii. Vienna, 1864.
O.M.	Otago Museum.
Parl. Pap.	The Annual Reports of the Geological Survey since 1894 and various other papers before that date have been published as parliamentary papers, and are usually bound in "Papers and Reports relating to Minerals and Mining."
Prog. Rep.	Reports of the Geological Survey of New Zealand. Progress Report. (Forms the first part of Reports of Geological Explorations, *q.v.* for numbers of volumes)

R.G.E .. .. Colonial Museum and Geological Survey of New Zealand. Sir James Hector, K.C.M.G., M.D., F.R.S., Director. Reports of Geological Explorations during 1886–1893, with maps and sections. Wellington. Roy. 8vo.

In accordance with a suggestion made by Mr. A. Hamilton, the earlier unnumbered reports are numbered to correspond with the numbers printed on the later reports, as follows:—

No.	During Years.	Date of Issue.
I	1866	1866
II	1867	1867
III	1867	1867
IV	1866–67	1868
V	1868–69	1869
VI	1870–71	1871
VII	1871–72	1872
VIII	1873–74	1877
IX	1874–76	1877
X	1876–77	1877
XI	1877–78	1878
XII	1878–79	1879
XIII	1879–80	1881
XIV	1881	1882
XV	1882	1883
XVI	1883–84	1884
XVII	1885	1886
XVIII	1886–87	1887
XIX	1887–88	1888
XX	1888–89	1890
XXI	1890–91	1892
XXII	1892–93	1894

T.N.Z.I. .. .. .. Transactions of the New Zealand Institute. Wellington. (The date following the reference refers to the date of publication.)

V.M. .. .. .. (Vienna Museum.) Kaiserliches-königliches naturhistorisches Hofmuseum in Wien.

MATERIALS

FOR THE

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CHAPTER I.

HISTORY OF PALÆONTOLOGICAL RESEARCH ON NEW ZEALAND MATERIAL.*

THE outstanding events in the history of New Zealand geology and palæontology were the visit of Hochstetter in 1858–59 and the publication of the geological memoirs of the "Novara" Expedition in 1864. Before his visit all that was known of New Zealand geology was due to the short visits of scientific missions and the notes of well-informed travellers. A few collections had been sent to England and briefly described. After Hochstetter's visit the Provincial and Colonial Surveys were instituted, and the work of exploring every part of the country was vigorously prosecuted by trained geologists.

Although such celebrated geologists as Darwin and Dana had touched at New Zealand, they had added little to a knowledge of the rock formations and the fossils occurring there. Dieffenbach, who travelled through parts of the North Island and the Chatham Islands, was the first to collect and send Home fossils, which were noticed by J. E. Gray in 1843. No doubt the discovery of the moa, and the interest thereby aroused amongst naturalists, diverted attention from the less exciting invertebrate fossils, but, nevertheless, W. Mantell, who was one of the most enthusiastic collectors of moa relics, found time to remark the occurrence of invertebrate fossils in the Wanganui district in 1848, and to send Home collections from Ototara (Totara, near Oamaru) and Onekakara (Hampden), in Otago, in 1850. The latter were described by his father, G. A. Mantell, assisted by Gray, Reeve, Morris, and Rupert Jones. In the same paper E. Forbes published a short note on fossils from Banks River and Blind Bay, collected by F. Manse. In 1855 Charles Forbes, assistant surgeon to H.M.S. "Acheron," communicated a paper to the Geological Society on the geology of coast-lines of New Zealand, in which the New Zealand coal-measures were scientifically described for the first time. Numerous genera of fossils were mentioned as occurring at West Wanganui, Cape Campbell, and the River Kohai (Mount Grey). In 1858 J. T. Thomson, the observant surveyor by whom the first explorations in the interior of Otago were made, recorded the occurrence of coal and fossil ferns at Mataura Falls, and *Terebratula* and *Pecten* in the limestone gorge of the Waiau. In the following year a further paper on the material collected by Mantell appeared from the pen of T. H. Huxley, who described bones of a fossil penguin from Kakanui and a fossil cetacean from Awamoa.† In 1860 Rupert Jones

* Excluding the *Dinornithidæ*.

† "Parimoa," the locality quoted by Huxley, and later by Harris for Tertiary *Mollusca*, cannot be otherwise than that usually known as "Awamoa" by New Zealand geologists. Parimoa is stated to be about five miles north of Kakanui.

determined a few species of *Foraminifera* sent to England to illustrate an account of the geology of Auckland by C. Heaphy, who had already contributed geological papers on unfossiliferous districts. The last pre-"Novara" contribution to New Zealand palæontology was the description of saurians from the Waipara River by Owen, based on collections made by Cockburn Hood. Owen supposed the beds from which they came to be of Jurassic age, but they have since been shown to overlie a Cretaceous fauna.

Towards the end of 1858 the Austrian frigate "Novara" touched at Auckland, and, sailing a fortnight after, left behind Ferdinand von Hochstetter, Assistant Geologist of the Geological Survey of Austria and Director of the Section Bohemia, and already one of the foremost geologists of Central Europe. Hochstetter's residence in New Zealand was due to a fortunate accident. While the "Novara" was in Sydney the New Zealand Government had requested Sir William Denison, Governor-General of Australia, to lend a geologist to examine a newly discovered coalfield near Auckland. He in turn had asked the Commodore of the "Novara" to permit his geologist to carry out this examination, and owing to the friendly relations existing between the expedition and the Australian and New Zealand Governments this permission had been granted. The report, completed in nine days, led to further negotiations, with the result that Hochstetter, while still nominally a member of the expedition, remained for nine months in the colony carrying out geological explorations, first in Auckland and then in Nelson.

Hochstetter's work was valuable in two ways. Not only did he lay the foundations of New Zealand stratigraphy, and collect the materials that in the hands of his Austrian colleagues have given rise to the most important memoirs on New Zealand palæontology, but he also inspired the various Provincial Governments to institute geological surveys, with the result that in a very few years Haast in Canterbury, Hector in Otago, and Crawford in Wellington were officially engaged in exploratory work.

Hochstetter's most important discoveries were the fossiliferous *Pseudomonotis* (Triassic) beds of Richmond, near Nelson, the belemnite and fern beds of Waikato Heads, and the belemnite and ammonite beds of Kawhia; but he was able also to subdivide and to some extent to correlate the Tertiary rocks of various localities. Although subsequent workers have differed from him on minor points, the general body of his work has stood the test of time in a manner that proclaims him the first master of New Zealand geology.

The fossils collected by Hochstetter and transferred to Vienna were described and figured by Unger, Zittel, Suess, Hauer, Karrer, Stoliczka, Stache, and Jæger—names that of themselves convey the certainty of careful and valuable work. A few changes in nomenclature have since been found necessary, but the "Novara" palæontology still remains the prime source of information on the fossils of New Zealand. The wonder is that, with this example before them, New Zealand geologists have been satisfied with such a meagre standard of palæontology.

Dr. Julius Haast (later Sir Julius von Haast) had landed in Auckland the very day before the arrival of the "Novara." He had come to report on the suitability of the colony for German immigrants, and immediately attached himself to Hochstetter, and accompanied him in his journeys in Auckland and Nelson. In 1860 he made further explorations for the Provincial Government in Nelson, and in 1861 was appointed Provincial Geologist of Canterbury. Haast's name is particularly associated with the exploration of the Southern Alps, during the progress of which he discovered the fossiliferous localities of Mount Potts and the Clent Hills; but he also made important investigations in the Malvern Hills and in the Cretaceous and Tertiary beds of North Canterbury and Amuri Bluff. Haast did not attempt direct palæontological work, but he was fully alive to the importance of fossil collections, and published many determinations furnished in manuscript by McCoy. To him also was due the foundation of the Canterbury Museum, and the high standard it subsequently attained.

Dr. James Hector (later Sir James Hector) was, on Sir Roderick Murchison's recommendation, appointed Provincial Geologist of Otago in 1861, and at once commenced the study of the coal-measures of that province. In 1865 he was appointed Director of the Geological Survey of New Zealand and of the Colonial Museum. In 1867 he was also appointed Manager of the New Zealand Institute. The growth and progress of these three institutions under his management has been admirably told by A. Hamilton in the first bulletin of the Colonial Museum, 1906.

In estimating Hector's contribution to New Zealand palæontology it is always necessary to remember that he held three arduous appointments, and that he devoted much time to zoology, meteorology, and other branches of science, and was repeatedly engaged in making up collections for exhibitions. Had he been able to devote his undoubtedly high talents to geology and palæontology alone, it is safe to assert that New Zealand stratigraphy would be in a much more advanced state. As it was, Hector's geological work was very largely done by deputy. He soon gathered a staff of assistants, among whom the names of Hutton, McKay, Cox, and Park are most prominent. Until 1893, when the survey was practically suspended, these officers visited every part of the colony, and brought back large collections of rocks and fossils. The annual reports of the Survey contain accounts of these visits, with a running commentary by Hector as an introduction. Hector, Haast, and Hutton soon began to differ on many points of interpretation, and New Zealand geological literature became involved in polemics which must be very confusing to foreign readers, since they can only with difficulty be followed by residents in the country.

Hector insisted at a very early date on the importance of the Colonial Museum as an adjunct to the Geological Survey,* and devoted a large part of its space to the disposal and exhibition of the geological collections. In 1870 he published a catalogue of the Museum, in which lists of fossils from a great number of localities form a prominent part. Hutton wrote descriptive catalogues of the Recent shells, and of the Tertiary *Mollusca*, *Brachiopoda*, and *Echinodermata*, which were published without plates in 1873. Drawings were made for plates by Buchanan, the draughtsman of the Survey, and are still in the possession of the Survey; but the plates were never issued. Hector always had in view the publication of descriptive palæontological memoirs of the fossils collected, but, owing to the pressure of other work, these were never published. The following extracts speak for themselves:—

8th Ann. Rep. Col. Mus. Lab. (1873), p. 5.—"Very important and extensive additions have been made to the collection of fossils, both of New Zealand and foreign countries. Chief among the former is a large series of Upper Mesozoic remains found associated with the reptilian remains at the Amuri Bluff. It is proposed to place these in the hands of an experienced palæontologist in England for publication." Pp. 6–7.—"All the fossil plants found in New Zealand have been accurately drawn and printed by photo-lithography, fifty plates being now ready to illustrate a work on the fossil flora that is in progress. In addition, most of the other fossils, and especially those which are to be sent to England for description, have been figured, so that they may not be altogether lost in case of accident."

13th Ann. Rep. Col. Mus. Lab. (1878), p. 6.—"Publications: The volume of Geological Reports for the past year is now in the press, and will contain the progress reports of the Survey, and, in addition, descriptions and figures of the most important of the Lower Mesozoic fossils."

14th Ann. Rep. Col. Mus. Lab. (1879), p. 8.—"A large amount of the material, both letterpress and plates, is in readiness for the first of a series of publications illustrative of the palæontology of New Zealand. The earliest-issued parts of this work will comprise the fossil flora and the *Brachiopoda* of the Lower Mesozoic formations."

15th Ann. Rep. Col. Mus. Lab. (1880), p. 11.—The following works have been partly prepared for publication: 4. Contributions to New Zealand Palæontology—(1) "*Belemnitidæ*" and (2) "*Brachiopoda*," by Dr. Hector; (3) "Fossil Flora," by Dr. Hector; (4) "Fossil Corals," by the Rev. J. E. Tenison-Woods.

Of these proposed publications, only the last was issued, as "Palæontology of New Zealand, Part IV." Papers by Hector on the "Fossil *Brachiopoda*" and the "Fossil Flora" appeared in abstract, without plates, in the Transactions of the New Zealand

* *Cf.* 3rd Ann. Rep. Col. Mus. Lab., p. 3 (1868); 21st Ann. Rep. Col. Mus. Lab., pp. 3–4 (1886).

Institute (1879). A paper on the *Belemnitidæ*, accompanied by plates, had already appeared in 1878. Plates for the Memoir on the Flora were printed, but not issued, and are still in the possession of the Survey. Drawings for several plates of *Brachiopoda* were made, but only four plates were printed, and these also are stored away. An extra supply of the plates illustrating the paper in the Transactions on the *Belemnitidæ* were printed, and are now in stock. In 1886 a number of figures were included in the "Catalogue of the Indian and Colonial Exhibition." For the most part they are very poor, but on comparison it becomes evident that they were prepared from the plates and drawings mentioned above, including Buchanan's drawings of the Tertiary *Mollusca*.

Hector contributed other papers to the Transactions: "On the Fossil *Reptilia*," "On a New Trilolite," and "On the Recent and Fossil *Cetacea*." He also published numerous identifications of foreign species occurring in New Zealand in the Progress Reports of the Geological Survey, most often without author's name and reference; and he is responsible for many manuscript names. His positive contributions to New Zealand palæontology are most valuable, but in the work he left half-done he has but increased the difficulties of subsequent workers.

Captain Frederick Wollaston Hutton joined the Geological Survey in 1871, and left in 1873 to become Provincial Geologist of Otago and Curator of the Otago Museum. He subsequently held the positions of Professor of Natural Science in the University of Otago and Professor of Biology in Canterbury College, and, on Haast's death, Curator of the Canterbury Museum. Like Hector, he also spread his energies over a variety of subjects, but he returned again and again to the palæontology of the Tertiary invertebrates, and made himself easily the chief authority on this subject. His task was rendered difficult by the poverty in colonial libraries of the early post-Linnean works, in which so many of the Recent *Mollusca* were first described, and hence very many of his early names have had to be revised. His work was marred chiefly by his extreme brevity and terseness of description and reference, and by the poverty of illustrations accompanying his papers; but it is only in the groups in which he specialized that our knowledge of New Zealand palæontology has any approach to completeness. Hutton was not always very definite about the localities from which his fossils were derived, but he was very conscientious in his care of type specimens, and has left behind him a striking monument in the exhibit of Tertiary fossils at the Canterbury Museum.

Alexander McKay joined the Provincial Survey of Canterbury under Haast in 1871 as field assistant, and at once distinguished himself as a fossil-collector by the splendid suite of saurian remains he obtained from the Waipara River.* Towards the end of 1872 he was transferred to the Colonial Survey, under Hector, and until 1893 was the officer most closely associated with the collection of fossils and the description of the localities from which they came. Hector's classification of the formations occurring in New Zealand was based very largely on McKay's investigations, and on most points they stand so closely together that it is difficult to assign the authorship of any particular point of view to one or the other. After 1893 McKay acted first as Mining Geologist and subsequently as Government Geologist to the Mines Department until his retirement in 1908. The collections of the Survey have been his particular care in recent years, and it is due to his great enthusiasm and keen memory that they are now so well labelled.†

* Now in the Canterbury Museum.

† The writer has frequently had occasion to put to the test Mr. McKay's memory of the localities from which given specimens were collected, and with most satisfactory results. It could hardly be expected that over 100,000 specimens would be labelled without some mistakes, and already a few have been detected in cases where differences of matrix led to suspicions as to the correctness of the labels; but the percentage of errors is wonderfully small, and should not give rise to any serious confusion.

With the exception of Hector and Hutton, New Zealand geologists have made very small contributions to palæontology. Short papers on Tertiary fossils have been contributed by Kirk, Murdoch, Suter, Benham, Clarke, Park, and Thomson, while descriptions or figures of fossils have accompanied papers by Maclaren, Andrew, and Boult. Marshall has written a very terse paper on Secondary *Cephalopoda*, which has been amplified by Bœhm and Diener. The study of the Recent *Mollusca*, however, with which the Tertiary palæontology is so intimately bound, has made great advances in the hands of Hedley, Suter, and Murdoch, and it has been found that many of the species first described as fossil are still living in the deeper waters off the New Zealand coast. Suter's forthcoming "Mollusca of New Zealand" (now in the press) will be a great boon to students of the Tertiary fauna, and may be confidently expected to exercise a great influence on the future development of our knowledge of this group.

In 1904, at the Dunedin meeting of the Australasian Association for the Advancement of Science, the state of New Zealand palæontology was thoroughly discussed by Section C, and it was resolved to urge the New Zealand Government to take steps to have the fossil collections of the Survey described. The recommendation adopted by the Association, and communicated by the President, Professor David, to the Minister of Mines and the Colonial Secretary, was as follows:—

"*New Zealand Fossils*.—On the recommendation of Section C, it was agreed, That the following resolution be forwarded to the New Zealand Government: That whereas this Association considers that the description of the large collection of fossils now at the Wellington Museum is one of the most important services which the New Zealand Government could at the present time render to science, and that it is one which would be for the advancement of science throughout the world; that whereas the work would be of economic as well as of scientific interest, as it is only by its means that the coalfields of New Zealand can be properly correlated, and the broad relations and modes of origin of its metalliferous deposits understood; that, whereas, according to the annual reports, there are more than thirty thousand fossil-specimens in the exhibition-cases at Wellington Museum, by far the larger part of which are unnamed and undescribed, and besides about five hundred boxes of fossils still unpacked in the same Museum; and that whereas these collections, made at considerable expense to New Zealand, are obviously useless in their present state—this Council recommends: (1.) That the description of these fossils should be commenced immediately, and that if this recommendation is adopted by the New Zealand Government the undermentioned groups of fossils be sent for description to the following workers at once: The graptolites to T. S. Hall, M.A.; the *Foraminifera* and ostracods to F. W. Chapman; the echinoids to Professor Gregory; Palæozoic fossils, other than those in the above groups, to R. Etheridge, jun. (Curator, Australian Museum, Sydney) and W. S. Dun (Palæontologist, Geological Survey, New South Wales). (2.) That, with regard to the large and important collections of Mesozoic and Cainozoic fossils (other than echinoids, *Foraminifera*, and ostracods) in the Wellington Museum, the Council recommends that advice as to their description be delegated, so far as this Association is concerned, to a committee consisting of the following: Captain F. W. Hutton (retiring President), Professor Baldwin Spencer (President-elect), and A. Hamilton, Esq. (Director of the Colonial Museum, Wellington)."

At the request of the Colonial Secretary, Mr. A. Hamilton made further recommendations,* with the result that the repacking of the collections into boxes of similar size in such a way as to bring all fossils from one locality together was commenced by Mr. A. McKay and an assistant. This repacking was an essential preliminary to the sorting-out of special collections for description.

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* See T.N.Z.I., vol. 42, pp. 52–54 (1909).

The reorganized Geological Survey, under the Directorship of Dr. J. M. Bell (1905–11), made no attempt to inaugurate the description of the old collections, but dealt briefly, in various bulletins, with the new fossils discovered in the areas under survey. Only one new species was described, but a number of identifications were made by Morgan, Clarke, Thomas, and Marshall, and the age of the beds was discussed. On the resignation of Dr. Bell and the appointment of Mr. P. G. Morgan as Director the writer was appointed Palæontologist (June, 1911), his first duties being defined as "the description of the fossils now stored in Wellington." On the recommendation of various scientific gentlemen throughout the Dominion, the services of Mr. H. Suter were obtained for six months to work at the Tertiary *Mollusca*.

Meanwhile the various collections of New Zealand fossils that found their way abroad received some attention from specialists. H. Woodward, described a fossil crab, and P. M. Duncan some Tertiary corals, in 1875. E. T. Newton contributed a paper on two Cretaceous fish in 1876. Von Ettingshausen obtained collections of plants from Professors Parker, of Dunedin, and Haast, of Christchurch, and published a series of papers in Vienna, which were subsequently translated into English (1884–87). So far at least as the Tertiary and Cretaceous leaf fossils are concerned, Ettingshausen's generic identifications and general conclusions have been looked at askance by New Zealand botanists. J. W. Davis described a large collection of Cretaceous and Tertiary fish-teeth lent by Hutton, Enys, Parker, Haast, and Hector, and also investigated the specimens in the British Museum (1886–88). A. W. Waters, in 1887, described a large series of *Bryozoa* lent by Miss Jelly and by Hutton and Hamilton, and added greatly to the list of new species, although the absence of identifications of species established by Stoliczka and Tenison-Woods suggests that the synonymy may require revision. Hinde and Holmes, in 1891–92, described and figured a large number of sponge-spicules from the diatomaceous earth of Oamaru. Tate, in 1894, supplied critical notes on the Tertiary *Echinodermata* based on an examination of some of Hutton's type specimens and other "authentic specimens." G. Bœhm, who visited New Zealand in 1900, described Tertiary *Brachiopoda* of his own collecting in 1904, and has since revised the Triassic and Jurassic *Cephalopoda* after a re-examination of Hochstetter's and Marshall's material, coupled with a suite of specimens collected for him by Suter. F. A. Bather, in 1905, established a new genus of annelid, and a new species of *Dentalium* on material collected by Ferrar. Kidston and Gwynne-Vaughan described fossil ferns collected by Dunlop and Gibb near Gore (1907). Dr. Ethel M. R. Shakespear, in 1908, examined a collection of graptolites brought to England by Isaacson, and showed the probability of the occurrence of two zones at Collingwood.

The most important foreign contributions, however, since the "Novara" palæontology have been the British Museum catalogues of fossil *Reptilia* and *Amphibia* by R. Lydekker (Part 2, 1889), and of Tertiary Australasian *Mollusca* by G. F. Harris (1897). In each of these a large number of New Zealand fossils have been described and figured, and compared with those of other countries.

Principal Results obtained.

There is not as yet any general accord amongst New Zealand geologists as to the number of formations represented amongst the rocks, nor as to the relationship and absolute age of the formations that are well recognized (*pace* Park). This is due to the absence of fossils over large extents of country, the lack of critical study of the fossil faunas known to exist, and the lack of detailed stratigraphical studies in critical localities, and, as pointed out by Marshall, to the prevailing philosophical creed of the earlier geologists that all the formations recognizable in Europe should be found represented in New Zealand. McKay, Park, and Marshall hold opinions to-day as much at variance as those formerly held by Haast, Hector, and Hutton. It is possible, however, to distinguish three groups of formations on structural grounds about which there can be little dispute. These groups correspond in a broad way to the Caledonian, Armorican, and post-Armorican elements in Great Britain.

The oldest group of formations, characterized by graptolite and trilobite faunas, is found only in the South Island, and on the western side of the main axis of the Island. The rocks strike to the west of north in Nelson, and, according to Morgan, are overthrust farther south by the rocks of the next group along their line of junction.* Graptolites of Ordovician age are found at Collingwood, and others of undetermined age at Preservation Inlet (Otago). Brachiopods and trilobites, referred by Hector to the Upper Silurian, are fairly abundant on the slopes of Mount Arthur, in the Baton River Valley. An apparently younger fauna, containing in addition a large number of corals, occurs at Reefton, and is placed by Hector in the Lower Devonian. Hector and Hutton have each described a trilobite from the last locality.

The middle group of formations constitutes the rocks of the Southern Alps, the central mountains of Otago, the Hokanui and Kaihiku Ranges, the Kaikoura Ranges, and the high ground between Nelson and the Wairau Valley. It also forms the axis of the North Island, and occurs as well at Kawhia and Waikato Heads, on the west coast of that Island, and in various parts of Auckland Peninsula. Over the greater part of the country these rocks are unfossiliferous, but there are several localities with a fairly rich marine fauna, and others with an abundance of plant-impressions. The most important localities are Waikato Heads, Kawhia, the Wairoa Gorge, Eighty-eight and Aniseed Valleys at Nelson, the Malvern Hills (plants), the Clent Hills (plants), Mount Potts ("*Spirifer*" and plant beds), Mount St. Mary, Nugget Point, Owaka (plants), Waikawa (plants), Mataura Falls (plants), Kaihiku, and the Hokanui Hills.

The highly metamorphic unfossiliferous mica-schists of Otago have been referred to various ages from Archæan to Triassic, but we are not concerned with them here. The *Brachiopoda* of Mount Potts were claimed by Haast as Devonian or Carboniferous on the authority of McCoy. Hutton, however, pointed out that a saurian was found at Mount Potts, and Hector stated that the *Brachiopoda* were similar to those of the Kaihiku beds (Permian). With the exception of some fossils determined as Carboniferous in the Maitai Series near the Wairoa Gorge, and various beds elsewhere referred to the Carboniferous on the occurrence of an annelid, Hector and McKay referred the other fossiliferous rocks of the group to various horizons between Permian and Middle Oolite. Park has oscillated between a Jurassic and Carboniferous age for the Maitai Series of Nelson, but agrees with Hector and McKay in referring the other fossiliferous beds to various horizons between Permian and Jurassic. Marshall classes all the rocks of the group, including the Otago mica-schists and the Maitai Series of Nelson, as Trias-Jura.

Exact knowledge is, however, practically confined to two horizons—viz., the *Pseudomonotis* beds, first discovered by Hochstetter at Richmond, and ascribed to the Trias, and the ammonite beds of Kawhia, also discovered by Hochstetter, and referred both by him and Bœhm to the uppermost Jurassic. The *Cephalopoda* described by Marshall, Bœhm, and Diener, from the Hokanui Hills have not been collected with sufficient exactness of detail to throw much light on the age of the different series established by Cox and McKay in that locality.† It seems certain, however, that a lower fossiliferous horizon than the *Pseudomonotis* beds occurs in the Hokanui Hills, and it is possible, from McKay's description, that a higher fauna than that of the ammonite beds of Kawhia

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* Morgan, P. G.: "A Note on the Structure of the Southern Alps." T.N.Z.I., vol. 43, pp. 275–78 (1911).

† Professor Marshall has informed me since the above was written that the *Cephalopoda* in question were all derived from "a single bed 10 ft. thick just on the Otapiri side of Cox's 1877–78 junction of the Otapiri and Wairoa Series, two miles from Boundary Creek, in the bed of the Otamita River." This makes it clear that the base at least of Hector's Otapiri Series is Upper Trias.

occurs near the mouth of the Catlin's River. The localities where the clearest superposition of faunas is to be found are the Hokanui Hills, Wairoa Gorge, Kawhia, and Nugget Point. The correlation of the plant-beds with marine horizons may be worked out at Mataura Falls, Catlin's River, Mount Potts, and Waikato Heads.

The marine fossils of most of the localities consist preponderatingly of *Brachiopoda*, which in the lower groups have, according to Hector, strikingly Palæozoic affinities. Ammonites are found chiefly at Nugget Point, the Hokanui Hills, and Kawhia, but are seldom well preserved except in the last locality. Belemnites are also found in the above-mentioned localities and at Waikato Heads and Catlin's River. Other *Mollusca* are moderately represented. Saurian remains are reported from Nugget Point, Mount Potts, Kawhia, and Mount St. Mary.

The third group of formations may be described as marginal. It is found on each side of the main axis both in the North and the South Islands, and is usually very little folded. The succession of beds varies greatly in different localities, and correlation is difficult, although it has been attempted by all the leading geologists. The presence or absence of unconformities has given rise to much discussion, and there is still no agreement as to how many formations should be established, and where the dividing-lines should be drawn.* Hector divided the rocks into Lower Greensand, Cretaceo-Tertiary, Upper Eocene, Lower Miocene, Upper Miocene, and Pliocene formations; Hutton distinguished the Waipara (Cretaceous), Oamaru (Oligocene), Pareora (Miocene), and Wanganui (Pliocene) systems. McKay still upholds Hector's divisions; Park has a classification similar to that of Hutton; while Marshall, Speight, and Cotton prefer to consider the whole group as one "rock-series." There are, however, at least three distinct faunas represented. Saurians of Cretaceous or even Jurassic facies are found at Amuri Bluff, the Waipara Gorge, and the Malvern Hills; and in the underlying beds at Amuri Bluff there is a rich fauna of pelecypods and gasteropods, with numerous belemnites and rare ammonites, the whole having a distinctly Cretaceous aspect. In the overlying beds as developed in North Canterbury there is a scarcity of fossils until a series of rubbly limestones and calcareous sandstones is reached, with a rich fauna of *Brachiopoda*, *Bryozoa*, corals, *Echinodermata*, and *Mollusca*, all belonging to Recent genera, with a fair percentage of Recent species. Finally, in the North Island, at Wanganui and Napier, there is a still younger fauna, which contains so many Recent species that no one has placed it earlier than Pliocene. It is quite possible that by careful work it will be possible to subdivide these three faunas, or to discover intermediate faunas elsewhere. The first essential is to work them out in North Canterbury, where the succession (but not the question of unconformities) is undoubted.

The saurians are now well known, through the researches of Owen, Hector, Haast, Hutton, and Lydekker. Fish remains have been studied by Newton and Davis. The basal fauna at Amuri Bluff is, however, almost untouched. The two highest faunas are now fairly well known, thanks to Zittel, Hutton, Harris, and others, but there is much work still to be done in all groups.

Policy of the Present Geological Survey.

Undoubtedly the most satisfactory and the quickest method of placing New Zealand palæontology on a firm footing would be to adopt the policy of the Geological Survey of India—viz., to secure for adequate remuneration the services of the most eminent specialists in each group of organisms, and to send carefully selected collections to them. In the case at least of the *Cephalopoda* there is no other possible method,

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* *Cf.* Marshall, P.; Speight, R.; and Cotton, C. A.: "The Younger Rock-series of New Zealand." T.N.Z.I., vol. 43, pp. 378–407 (1911).

but the present vote for "special services" at the disposal of the Geological Survey will not permit of the general adoption of such a policy.

The most pressing economic problems in New Zealand geology are associated with the age and correlations of the coal-measures, which all belong to the marginal group of formations. After consultation with the Director, the writer has commenced the study of these. As marine fossils are not plentiful in the actual coalfields, the succession in North Canterbury and East Marlborough has been selected in the first place. Further work on the fossils of the Trelissic Basin, South Canterbury, and the Oamaru – Shag Point district, may be necessary to establish thoroughly the succession of marine faunas in the marginal group. Meanwhile the services of Mr. Henry Suter have been secured to revise the descriptions of the type specimens of Tertiary *Mollusca* and to examine the undescribed Pliocene collections. Other collections from "Cretaceo-Tertiary" or Tertiary localities will be placed at the disposal of private workers who are willing to examine them.*

Once the marine succession is established it will become possible to assign to their correct horizon various plant-beds at Amuri Bluff, the Malvern Hills, the Clarence Valley, and Shag Point. The plant fossils consist very largely of leaf-impressions, and in order to determine these satisfactorily Mr. G. M. Thomson has commenced the formation of a series of nature prints of the leaves of the older elements of the New Zealand flora. When the plant fossils of the above localities have been described it will be possible to correlate the plant-fossil beds of the main coalfields.†

To place our knowledge of the fossils of the central group of formations on a proper footing, the first essential will be to have the *Cephalopoda* (particularly the ammonites) described by an expert of standing in Great Britain or Europe. No one in New Zealand is competent to undertake this work. After this has been done a selected collection of *Brachiopoda* (including the genotypes of *Rastelligera*, *Psioidea*, and *Clavigera* referred to in Chapter VI) should also be described by an expert abroad. It will then be possible for New Zealand geologists to attempt stratigraphical investigations with some hope of doing valuable work, and the correlation of the plant-fossil beds may be then undertaken.‡

In accordance with the recommendation of the Australasian Association, Mr. W. S. Dun, of Sydney, has offered to undertake the description of the fossils of the western group of formations from the Baton River and Reefton, and is now engaged on the examination of the former. Dr. E. M. R. Shakespear, of Birmingham, has undertaken to examine the graptolites of Slaty Creek, Collingwood, and a collection is now on its way to her. The fossils of the oldest group are thus all in the hands of experts.

Literature referring to the History of New Zealand Geology.

1863. Hochstetter, F. von: "Neu-Seeland." Stuttgart, 1863. (English translation by E. Sauter, 1867, pp. 46-51.)

1879. Haast, J. von: "Geology of the Provinces of Canterbury and Westland, New Zealand." Christchurch, 1879. Part 1.

1884. B[ickerton], A. W.: "Biographical Notice: Julius von Haast, Ph.D., F.R.S., C.M.G., &c." N.Z. Journ. Sci., vol. 2, pp. 112–16 (with photo).

* Mr. C. A. Cotton, Lecturer in Geology at Victoria College, Wellington, has commenced the examination of the fossils of the Curiosity Shop, remarkable for the abundance and variety of *Terebratulacea*. Mr. E. de C. Clarke, Demonstrator in Geology at Auckland College, and Mr. G. Uttley, Waitaki Boys' High School have undertaken to describe collections from Auckland and Oamaru respectively.

† Professor Marshall, of Otago University, has intimated his willingness to commence the study of the leaf fossils.

‡ Mr. E. A. Newell Arber, University Demonstrator in Palæobotany, Cambridge, has kindly volunteered to undertake an examination of the plant fossils from Mount Potts and other localities, and the collections both from the Geological Survey and from the Canterbury Museum have been sent to him.

1885. Haast, J.: "In Memoriam: Ferdinand Ritter von Hochstetter." N.Z. Journ. Sci., vol. 2, pp. 202–20 (with photos).

1885. T[homson], G. M.: "Biographical Notice: Frederick Wollaston Hutton." N.Z. Journ. Sci., vol. 2, pp. 301–6 (with photo).

1887. W[oodward], H.: "Obituary: Sir J. F. Julius von Haast." Geol. Mag., Dec. 3, vol. 4, p. 432.

1888. Judd, J. W.: Obituary Notice of Sir Julius von Haast in the Anniversary Address of the President. Q.J.G.S., vol. 44, Proc., pp. xlv–xlvii.

1905. Anon.: "Obituary: Capt. Frederick Wollaston Hutton, F.R.S., F.G.S." Geol. Mag., Dec. 5, vol. 2, pp. 575–76.

1905. Woodward, H. B.: Captain F. W. Hutton, F.R.S. (Obit. Notice). Nature, vol. 73, pp. 32, 33.

1906. H[erries], S. H.: Obituary Notice of Frederick Wollaston Hutton in Anniversary Address of the President. Q.J.G.S., vol. 42, Proc., pp. lxii–lxiii.

1906. Hamilton, A.: "Colonial Museum Bulletin No. 1," pp. 1–14.

1907. Bell, J. M.: First Ann. Rep. (n.s.) N.Z. Geol. Surv. Dept., Parl. Paper C.–9, pp. 1–3.

1907. Anon.: "Obituary: Sir James Hector, K.C.M.G., M.D., F.R.S., F.L.S., F.G.S." Geol. Mag., Dec. 5, vol. 4, p. 576.

1908. Geikie, A.: Obituary Notice of Sir James Hector in Anniversary Address of the President. Q.J.G.S., vol. 44, Proc., pp. lxi–lxii.

1910. Hamilton, A.: "The Present Position of New Zealand Palæontology," &c. T.N.Z.I., vol. 42, pp. 46–63.

1910. Park, J.: "The Geology of New Zealand," pp. 1–3. Dunedin, 1910.

CHAPTER II.

COLLECTIONS OF NEW ZEALAND FOSSILS.

I. Collections of the New Zealand Geological Survey.*

The largest but hitherto the least accessible and least known collection of New Zealand fossils is that in the possession of the Geological Survey, accumulated by Hector and his assistants, particularly by A. McKay. It includes older collections received from the Provincial Surveys and from private individuals, amongst whom the names of Travers, Traill, Enys, Westbrooke, and Esdaile deserve special mention. There are also a few boxes of fossils collected by the officers of the Geological Survey under the Directorship of Dr. Bell.†

In the early days of the Geological Survey the Colonial Museum was used for exhibiting the fossils, and they were separated into various series according to age, geographical distribution, zoological relationships, &c. The "Catalogue of the Colonial Museum," published in 1870, mentions 950 invertebrates from seventy-five localities, plant fossils from twenty-three localities, as well as a special collection of vertebrates. This, however, did not compose the whole collection in the possession of the Survey, for 3,542 specimens were mentioned in the annual report of the Museum for 1866–67. The Cretaceous and Tertiary *Mollusca*, *Brachiopoda*, and *Echinodermata* were studied by Hutton in 1872, and his "Catalogue" of the Tertiary species was issued in 1873. The collections grew rapidly year by year till 1893, and many determinations were made and published by Hector, but little systematic work was attempted. Hector's papers on the fossil *Reptilia*, *Belemnites*, and *Brachiopoda*, a paper by Kirk on Pliocene *Mollusca*, Tenison-Woods's monograph of the Tertiary corals and *Bryozoa*, Tate's criticism of Hutton's "Catalogue of the *Echinodermata*," and Davis's work on fossil fish practically exhaust the references in systematic literature to the collection. For many years it has been mostly packed away in cases, and has been inaccessible to New Zealand students.

After the retirement of Sir James Hector, in 1903, the association of the Geological Survey and the Colonial Museum came to an end, and the fossil collections remained in the possession of the Geological Survey.‡ They were still stored for convenience, however, in the Colonial Museum, but it became necessary to repack parts of the collection still on exhibition in the Museum. When the writer joined the Geological Survey (in June, 1911) the type collections of *Reptilia*, *Cetacea*, Tertiary *Mollusca*, *Brachiopoda*, and *Echinodermata*, and teeth of fishes were still on exhibition in show-cases in the Museum, as was also a collection of *Cephalopoda* and *Brachiopoda* zoologically arranged. The rest of the collection was stored away in boxes, into which it had recently been repacked in such a way as to bring specimens from each locality together as far as possible.

The type collections are at present in an unsatisfactory condition. The *Reptilia* are partly unlabelled, the fish-teeth are lying loose in card trays, while the Tertiary corals and *Bryozoa* were found packed away in boxes, though mounted on cards. With the exception of a few *Reptilia*, none of the types of Hector's species were

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* *Cf.* Hamilton, A.: "The Present Position of New Zealand Palæontology." T.N.Z.I., vol. 42, pp. 46–63 (1910).

† The cost of making the collections has been estimated by Mr. A. Hamilton at £50,000.

‡ See Hamilton, *loc. cit.*, and Col. Mus. Bull. No. 1 (1905).

to be found labelled, although a few have since been identified by comparison with figures, and others have been found packed away with the general collection in the boxes, but with labels attached. Until the whole collections have been unpacked and examined it will be impossible to state what types are lost. It is urgently desirable that suitable and permanent accommodation should be found for the existing type collections, as well as for others that will doubtless be constituted as the collection is worked out. The specimens packed away in the boxes, with few exceptions, bear locality numbers referring to the list of fossil localities published in R.G.E., vol. 21, pp. 120–78 (localities 1–764). No collections are extant from sixty-two of these. There are, in addition, eighty-four additional localities with numbers in the manuscript register, of which five are unrepresented by collections.*

There are in all 778 numbered localities from which collections are extant, and a few other localities not numbered, but represented by labelled fossils (67) in the old collection. The total number of fossils packed away is 112,698, making the average from one locality 145. The largest number from a single locality is 16,568, from Awamoa Beach and Creek. The collection from Amuri Bluff (under several numbers) is next in size, with over 4,000 specimens. If the grouping of formations used in the preceding section be adopted, the collection may be divided as follows:—

	Localities.	Specimens.
Western (oldest) group	13	5,282
Central group—		
Animals	126	14,487
Plants	24	1,076
Marginal group—		
Animals	595	91,238
Plants	20	615

These figures represent in some measure the abundance of fossils in the rocks of the different groups. The oldest group is perhaps over-represented by specimens, while the localities for plant fossils are certainly under-represented; but the proportions between the figures for the central and marginal groups correspond sufficiently nearly to the relative abundance of fossils in the rocks of the country.

The locality labels have been all carefully checked by Mr. A. McKay, to whom is due great credit for the present state of the collections. Although further collecting will be necessary to establish more closely the horizons of some of the specimens, the collection in its present state forms the most important material yet collected for working out the palæontology of New Zealand. It is possible, however, that many of the best specimens of the early period of collecting have been exchanged with other museums.† A record of the collections sent away (extracted from annual reports of the Colonial Museum and Laboratory) may prove of service to palæontologists abroad who are interested in New Zealand fossils:—

1867. "160 rocks and fossils to the National Museum in Melbourne."

1868. "Collections of birds, shells, Recent and fossil moa-bones, coals and associated rocks and fossils have been sent to the Adelaide Museum, in exchange for most liberal gifts from that institution. Collections of Tertiary fossils have also been sent to the Melbourne Museum, and to the Christchurch Museum in Canterbury."

1869. "Collections of . . . fossil shells, per Dr. Haast, for transmission to Norway."

"A collection of Recent and Tertiary fossil shells sent to the Geological Society, London."

"The collections of Recent and fossil shells which have been sent to England for the purpose of receiving correct names, and being compared with the collections from South America and Australia at the Geological Society's Museum, have not yet been reported on."

"Sixty specimens of Wanganui fossils to Mr. C. Traill, as exchange."

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* For list of localities, see Chapter VIII.

† *E.g.*, Mr. McKay informs the writer that the best specimens from Reefton and the Baton River were exchanged with the British Museum Trustees in the hope that they would be described by experts in England.

1871. "115 species of fossils to the Canterbury Museum."
"Collection . . . of New Zealand fossils . . . to the Museum at Florence, per the Consul-General of Italy."
"Collections . . . of fossils . . . to the Auckland Museum."
1873. "105 specimens of Amuri fossils and thirty-one Waikato fern-impressions to the Christchurch Museum."
" A large collection . . . of New Zealand fossils to the Vienna Exhibition, most of which have been handed over to a colonial museum in London."
1874. "Collections of fossils . . . to Professor Wyville Thomson, H.M.S. 'Challenger.'"
1875. "Large collections from the various localities at present represented in the Museum have been sent Home for identification by competent authorities, with a view of establishing a distinct basis for the classification of the formations appearing in this country."
1878. "250 specimens fossil *Reptilia* of New Zealand
"1,688 ,, *Mollusca* ,,
"68 ,, plants ,, } Exchanged with Trustees, British Museum."
"Collection of New Zealand saurians to Professor Cope, Philadelphia."
"Collection of Tertiary fossils of New Zealand to Professor Tate, Adelaide."
"Collection of New Zealand *Belemnites* to the Otago Museum."
1880. "Collection of diatomaceous earths to Dr. Ralph, Melbourne."
1882. "Collection of fossils to the Hon. W. B. D. Mantell, Wellington."
"Collection of fossils to Professor Tate, Adelaide."
1883. "Collection of diatomaceous earths to Herr R. Jordan, Bohemia."
"100 specimens of fossils and rocks to the Oamaru Museum."
1885. "A very large collection of rocks, minerals, and fossils, comprising 511 specimens, illustrative of the geology of New Zealand, has been presented to Mr. S. H. Cox, of Sydney, formerly of this Department."
1889. "Large collection of fossil teeth (250 specimens) sent to J. W. Davis, F.R.S., England." (Since returned.)

II. Other Collections in New Zealand.

The collection in the Canterbury Museum, acquired under the Curatorships of Haast and Hutton, ranks next in importance.* Although small compared to the Wellington collection, it is much more select, and is well cared for and well exhibited. The special feature is the exhibit of Tertiary *Mollusca* and *Brachiopoda*, which has been labelled by Hutton, and contains a very large number of type specimens. The older fossiliferous localities of Canterbury—Mount Potts, the Clent Hills, the Malvern Hills—as well as the saurian localities of Amuri Bluff, the Waipara River, and the Malvern Hills, are also well represented by specimens.

The collection in the Otago Museum has also considerable historical importance, in that the Tertiary *Mollusca* and *Brachiopoda* were labelled by Hutton, but there are few primary types. Tertiary *Cetacea* from Otago localities are well represented, and there are large collections of plant fossils from Shag Point, Mataura Falls, and Waikawa. There is also in Dunedin a small collection in the Otago School of Mines, which includes the types of *Cephalopoda* described by Marshall and re-examined by Bœhm, and the fossils described in "The Subantarctic Islands of New Zealand."

The collections in the Auckland Museums are relatively small, and contain only a few types of Tertiary species established by Benham and Clarke. Of the museums in the smaller towns, many of which contain interesting fossils, that of Wanganui perhaps contains the most important collections.

Two private collections deserve special mention. Professor J. Park, of Dunedin, has a very complete collection of Tertiary fossils, which were named in association with Hutton, and therefore have some value as type specimens.† Mr. A. Hamilton, of Wellington, has also a select collection of Tertiary fossils, many of which are paratypes of Hutton's species, while others are new.

* *Cf.* Haast, Geol. Cant. Westland, 1879, chap. iii.
† Now in the Otago School of Mines.

III. Collections outside New Zealand.

The two most important collections outside New Zealand are those of the British Museum and of the Imperial Museum of Natural History, Vienna. To the former have been transferred the old collections formerly in the possession of the Museum of Practical Geology and the Museum of the Geological Society of London, which probably include the collections of Dieffenbach, Heaphy, and Mantell. The most important part, however, consists of the exchanges made with Hector. There are, in addition, smaller collections presented by various travellers or purchased. The Tertiary *Mollusca* and the Cretaceous *Reptilia* have been described in the Museum Catalogues by Harris and Lydekker respectively. A few other specimens have furnished the basis of separate papers—viz., a fossil crab (Tertiary) described by H. Woodward, two fish-mandibles (Cretaceous) described by Newton, an annelid and scaphopod (? Trias - Jura) described by Bather, and a collection of graptolites determined by Shakespear. The rest of the collection remains unexamined, and is the most important undescribed material outside New Zealand.

The collections made by Hochstetter and described by Unger, Zittel, Hauer, Suess, Karrer, Stoliczka, Stache, and Jæger are deposited in the Imperial Museum of Natural History, Vienna. They include type specimens of Tertiary, Jurassic, and Triassic species. The Jurassic specimens from Kawhia have recently been re-examined by Bœhm.

The most important private collection in Europe is that made by Professor G. Bœhm, of Freiburg, during a visit to New Zealand, supplemented by specimens from Kawhia collected and bought for him by Suter. The Tertiary *Brachiopoda* of Kakanui and the collections from Kawhia have recently formed the basis of papers.

The most important collection in Australia is that in Adelaide, acquired by Tate. It not only includes specimens presented and exchanged by Hector and Hutton, but a certain number of type specimens which were lent to Professor Tate and not returned at his death. It is to be hoped that these specimens will soon be restored to New Zealand.*

* *Cf.* Hamilton, T.N.Z.I., vol. 42, p. 49 (1910).

CHAPTER III.

THE CLASSIFICATION OF TYPE SPECIMENS.

New Zealand palæontology has already suffered so much from the neglect of type material that too great stress cannot be laid on the importance of the preservation in museums of all material described in the future. Type specimens include not only the original material used in the description of new species, but also any material on which subsequent descriptions or figures are based, and also certain labelled specimens which are used for the comparison and identification of new material. There should be a record attached to each specimen stating by whom and at what date it has been named, and in the event of changes of name the earlier name should also be preserved. This record may be kept either on the back of the card or block to which the specimens are attached, or in a catalogue if the specimens are numbered.

The classification here adopted is that proposed by Buckman and Schuchert.* Type Specimens may be divided into two groups—Type Material, on which descriptions and figures have been based; Typical Specimens, which have not been used in literature.

Type Material is again divided into two groups—Primary Types, on which the first published descriptions or figures have been based; Supplementary Types, on which subsequent descriptions or figures have been based.

PRIMARY TYPES.—All the specimens examined at the time of description by the author of a species and considered by him to belong to it are Primary Types. If one specimen was specially selected and marked by the author to become the type, or if only one specimen was figured, or if only one specimen was available at the time of description, that specimen becomes the Holotype. If there were other specimens, they become Paratypes. If, however, no one specimen was specially selected by the author, either by marking or by being the only specimen figured, all the primary types become Syntypes. A subsequent author may select one of the syntypes to take the place of the holotype, and this specimen then becomes the Lectotype. The material on which a published manuscript name (Chironym) is based is termed a Chirotype until such time as it is adequately described. It is hardly necessary to point out how desirable it is for authors to found holotypes.

SUPPLEMENTARY TYPES.—If the primary types are lost, or are too imperfect for determination, a new specimen from the same locality and horizon may be selected as the Neotype. A specimen, not a primary type, that is selected by an author to illustrate his own species is termed an Heautotype. A similar specimen that is selected by one not the author is termed a Plesiotype.

TYPICAL SPECIMENS comprise specimens from the original locality, specimens identified by the author of a species, or specimens compared with the primary types. A specimen from the same locality and horizon as the primary type is termed a Topotype. A topotype named by the author of a species becomes a Metatype. A specimen from other than the original locality named by the author becomes an Ideotype. A specimen compared and identified with the primary types by a specialist is termed a Homœotype.

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* C. Schuchert and S. S. Buckman: "The Nomenclature of Types in Natural History," Ann. and Mag. Nat. Hist., vol. 91, pp. 102–4 (1905). C. Schuchert: "Classification of Type Specimens," Bull. U.S. Nat. Mus. No. 53, pt. 1, pp. 9–18 (1905).

The importance placed in this classification on specimens from the same locality and horizon as the primary types of any given species should be laid to heart by workers in New Zealand. Hutton, who has labelled the majority of the specimens in the Canterbury and Otago Museums, appeared to lay very little stress on the identification of localities, for in some of his stratigraphical lists of fossils he omits to mention the type locality from which the species was originally described. In figuring his species, too, he sometimes selected specimens from other than the type localities, although the primary types were unfigured. In his museum collections he appeared to be indifferent from what locality the specimen selected to illustrate his species came.* It is impossible for each museum to have complete collections of primary types, but it is quite possible and practicable for them to have nearly complete collections of topotypes or the other categories of typical specimens. Without such collections the task of identification is more difficult, and the identifications cannot possess the same weight.

* Due credit must be paid to Hutton for his care to preserve holotypes. Had Hector exhibited the same care the task of subsequent workers would be much easier.

CHAPTER IV.

PRIORITY, NOMENCLATURE, AND CITATION IN PALÆONTOLOGICAL WORK.

THE following information, derived principally from the International Rules for Zoological Nomenclature adopted by the International Zoological Congress of 1904,* may be found useful by New Zealand students approaching systematic work in palæontology and by geologists wishing to cite lists of fossils. For fuller information the publication in question should be consulted.

PRIORITY OF NOMENCLATURE.

Binary nomenclature in zoology commenced with the publication of the 10th edition of Linné's "Systema Naturæ" in 1758. Pre-Linnean authorities are not accepted. By the law of priority the oldest available name of a genus or species is retained, provided that it was published and accompanied by an indication, or a definition, or a description, and that the author has applied the principles of binary nomenclature. It is recommended, however, that a specific name accompanied by both description and figure should stand in preference to one accompanied only by a diagnosis or only by a figure.

Example: *Corbula dubia* Hutton (1873) was accompanied by a description only. It may therefore be replaced by *Mactra chrydœa* Suter (1911), which was accompanied by both description and figure.

Other things being equal, that name is to be preferred which stands first in the publication (page precedence).

Example: *Lima paleata* Hutton (1873) and *Lima multiradiata* Hutton (1873) are probably synonyms. If this proves to be the case, *Lima paleata*, standing first on the page (Cat. Tert. Moll. Ech., p. 33), will take priority.

A generic or specific name once established cannot be rejected even by its author because of inappropriateness.

Example: Hutton in 1873 described *Struthiolaria tuberculata* and var. B (Cat. Tert. Moll. Ech., p. 11). In 1886 he proposed to elevate the variety to a species under the name *tuberculata*, and to rename the original species *spinosa*. This is inadmissible.

The International Conference gave no ruling on manuscript names, except in so far as they are included above. In the case of most New Zealand manuscript names the only indication supplied is the locality and horizon of the fossil. From the spirit of the International Rules, it follows that a specific name accompanied by a description, or by a figure, stands in preference to a manuscript name accompanied only by an indication. It is, of course, valid for subsequent workers to accept both available manuscript names, and names accompanied only by a description, or only by a figure, and establish them by adequate description and illustration. Hutton followed this plan in the case of some of Hector's and McCoy's manuscript names, and it will simplify our future synonymy if this course is adopted by other workers.

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* *Cf.* "Journal of Conchology," vol. 11, pp. 179–185, 201–211 (1904–6).

A Homonym is one and the same name for two or more different things. Synonyms are different names for one and the same thing. A generic name is to be rejected as a homonym when it has previously been used for some other genus of animals. A specific name is to be rejected as a homonym when it has previously been used for some other species or subspecies of the same genus.

Example: *Natica solida* Sowerby, 1846, is rejected as a homonym of *Natica solida* Blainville, 1825. It has therefore been renamed *N. darwini* by Hutton.

Rejected homonyms can never again be used; this applies to specific homonyms even when the species is placed in another genus. Rejected synonyms can again be used in case of the restoration of erroneously suppressed groups.

Example: *Neothyris* has been rejected as a synonym of *Magellania*, but it may be again used if an author considers that *M. lenticularis*, the genotype of *Neothyris*, is not congeneric with *M. flavescens*, the genotype of *Magellania*.

Nomenclature.

The names that may be chosen to designate genera and species are limited by definite rules and recommendations. Of these only the more important can be given here.

A Generic Name must consist of a single word, simple or compound, written with a capital initial letter, and employed as a substantive in the nominative singular. With Greek names the rules of Latin transcription recommended by the Congress should be followed. Modern patronymics are modified according to definite rules (as, *e.g.*, in *Waldheimia*). Barbarous names (*i.e.*, words of non-classic origin) are admitted if they can be treated as Latin substantives, otherwise they are given a Latin termination (*e.g.*, *Torlessia*).

A Specific Name may be an adjective agreeing grammatically with the generic name (*e.g.*, *Waldheimia gravida*), a substantive in the nominative in apposition with the generic name (*e.g.*, *Turritella pagoda*), or a substantive in the genitive (*e.g.*, *Toredo heaphyi*). Specific substantive names derived from names of persons may be written with a capital initial letter (*e.g.*, *Terebratulina Suessi* or *T. suessi*). All other specific names are to be written with a small initial letter. If the name is derived from a modern patronymic, the genitive is always formed by adding to the exact and complete name an *i* if the person is a man, and an *æ* if the person is a woman (*e.g.*, *Zitteli*, not *Zittelli*). Geographical names are to be given as substantives in the genitive or are to be placed in an adjectival form (*e.g.*, *novæ-zealandiæ*, *neozelanica*). Barbarous words are to be latinized (*e.g.*, *kakanuiensis*, *oamarutica*). The original orthography of a name is to be preserved unless an error of transcription, a *lapsus calami*, or a typographical error is evident.

Care must be taken with the orthography of the following specific names, all of which have been applied to New Zealand *Mollusca*: *novæ-zealandiæ*, *novæ-zelandiæ*, *zealandiæ*, *zelandiæ*, *neozelanica*, *neozealanica*, *novoseelandica*, *novozealandica*, *zelandica*, *zealandica*, &c. Hutton's versions of these names are unreliable (*fide* Suter, T.N.Z.I., vol. 34, pp. 207–24).

Citing of Names.

For scientific names it is advisable to use some other type than that used in the text.

Example: *Conchothyra parasitica* occurs in the Malvern Hills.

When it is desired to cite the name of a subgenus, this name is to be placed in parentheses between the generic and the specific names—*e.g.*, *Lima* (*Limatula*) *bullata*.

If it is desired to cite the subspecific name, such name is written immediately following the specific name without the interposition of any mark of punctuation—*e.g.*, *Magellania lenticularis ovalis*.

If it is desired to cite the author's name, this should follow the scientific name without interposition of any mark of punctuation; if other citations are desirable (date, sp. nov., emend., *sensu stricto*, &c.), these follow after the author's name, but are separated from it by a comma or are placed in parentheses.*

Example: *Flabellum radians* Tenison-Woods (1886), or *Flabellum radians* Tenison-Woods, 1886. *Conchothyra parasitica* McCoy (MS.), or *Conchothyra parasitica* McCoy, MS.

When a species is transferred to another than the original genus, or the specific name is combined with any other generic name than that with which it was originally published, the name of the author of the specific name is retained in the notation, but placed in parentheses.

Example: *Waldheimia gravida* Suess, 1865, and *Terebratula gravida* (Suess, 1865).†

If it is desired to cite the author of the new combination, his name follows the parenthesis.

Example: *Terebratula gravida* (Suess, 1865) Hutton, 1905.

No ruling was given by the Congress for the citation of the author who establishes an earlier manuscript name, but the principles involved are similar to those in the last case.

Example: *Conchothyra parasitica* (McCoy, MS.) Hutton, 1894.

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* Many modern authors—*e.g.*, Buckman—insert a comma before the author's name.

† Many modern authors would write *Terebratula gravida*, Suess sp.

New Zealand systematists are urged, however, to follow the International Rules, if only for the sake of uniformity in Government publications.

CHAPTER V.

CENSUS OF THE PRE-CRETACEOUS FOSSIL SPECIES OF NEW ZEALAND.

WITH a view to facilitating reference to previous determinations of fossils, a census of all specific determinations hitherto recorded has been made. No opinions are here expressed as to the value of the determinations. Where the location of the specimens identified is known it is specified. Those parts only of the census dealing with the pre-Cretaceous species are published here, as the Cretaceous and Tertiary species would occupy so much space, and it is hoped that their synonymy will shortly undergo such a revision as would make a census published at the present time obsolete. It is hoped to conclude the publication of the census in future bulletins.

I. Graptolites from Slaty Creek, near Collingwood.

The specimens figured by Hector, and those identified and figured by Bell, Webb, and Clarke, are in the Dominion Museum. Those identified by Shakespear are in the British Museum.

References.

(*a*) = Hector, J.: Cat. Ind. Col. Mus., p. 82, f. 57; 1886.
(*b*) = Hutton, F. W.: "On the Foliated Rocks of Otago," T.N.Z.I., vol. 24, p. 362; 1892.
(*c*) = Bell, J. M.; Webb, E. J. H.; and Clarke, E. de C.: "Palæontology of the Aorere Series," Bull. No. 3 (n.s.), N.Z. Geol. Surv., pp. 34–37, pl. 8; 1907.
(*d*) = Shakespear, E. M. R.: "On Some New Zealand Graptolites," Geol. Mag., dec. 5, vol. 5, pp. 145–48; 1908.

Shakespear distinguished two bands from the hand-specimens, and suggested that probably two zones are present.

Bryograptus lapworthi Ruedemann. Horizon.
1908. *Bryograptus lapworthi.* Shakespear, (*d*) .. .. .. Bands 1 and 2.

Climacograptus sp. (See **Diplograptus,** *cf. inutilis.*)

Dichograptus octobrachiatus (Hall).
1908. *Dichograptus octobrachiatus.* Shakespear, (*d*) .. .. Band 1.

Didymograptus affinis Nicholson .. .. Band 2.
Didymograptus affinis (?) Shakespear, (*d*).

Didymograptus caduceus. (See **D. gibberulus.**)

Didymograptus extensus Hall.
1907. *Didymograptus extensus.* Bell, Webb, and Clarke, (*c*), f. 2–5.
1908. ,, Shakespear, (*d*) .. .. .. Band 1.

Didymograptus gibberulus Nicholson.
1886. *Graptolites* sp. Hector, (*a*), Nos. 6 and 13.
1907. *Didymograptus caduceus.* Bell, Webb, and Clarke, (*c*), f. 6–12.
1908. ,, *gibberulus* Shakespear, (*d*).. .. .. Band 1.

Didymograptus nanus Lapworth. Horizon.
1908. *Didymograptus nanus.* Shakespear, (*d*) .. .. .. Band 2.
Didymograptus nitidus Hall.
1908. *Didymograptus nitidus.* Shakespear, (*d*) .. .. .. Band 1.
Didymograptus octobrachiatus Hall.
1892. *Didymograptus octobrachiatus.* Hutton, (*b*).
Didymograptus quadribrachiatus Hall.
1892. *Didymograptus quadribrachiatus.* Hutton, (*b*).
Didymograptus similis Ruedemann.
1908. *Didymograptus similis.* (?) Shakespear, (*d*) .. .. Band 2.
Diplograptus sp. *cf. Dinutilis* Hall.
1907. *Climacograptus* sp. Bell, Webb, and Clarke, (*c*), f. 17.
1907. *Diplograptus* sp. Bell, Webb, and Clarke, (*c*), f. 18.
1908. „ sp. *cf. inutilis.* Shakespear, (*d*) .. .. Band 1.
Goniograptus geometricus Ruedemann.
1908. *Goniograptus geometricus.* Shakespear, (*d*) .. .. Band 2.
Goniograptus perflexilis Ruedemann.
1907. *Rastrites* sp. Bell, Webb, and Clarke, (*c*), f. 1.
1908. *Goniograptus perflexilis.* Shakespear, (*d*) .. .. .. Band 1.
Loganograptus logani Hall.
1908. *Loganograptus logani.* Shakespear, (*d*) .. .. .. Band 1.
Loganograptus octobrachiatus Hall.
1886. *Graptolites* sp. Hector, (*a*), No. 4.
1907. *Loganograptus octobrachiatus.* Bell, Webb, and Clarke, (*c*), f. 15 (probably = *L. logani, apud* Shakespear).
Phyllograptus angustifolius Hall.
1908. *Phyllograptus angustifolius.* Shakespear, (*d*).
Phyllograptus anna Hall.
1908. *Phyllograptus anna.* Shakespear, (*d*) .. .. .. Bands 1 and 2
Phyllograptus folium.
1892. *Phyllograptus folium.* Hutton, (*b*).
Phyllograptus ilicifolius Hall.
1908. *Phyllograptus ilicifolius.* Shakespear, (*d*) .. .. .. Band 1.
Phyllograptus typus Hall.
1907. *Phyllograptus typus.* Bell, Webb, and Clarke, (*c*), f. 19–20.
1908. „ Shakespear, (*d*) .. .. .. Band 2.
Rastrites sp. (See **Goniograptus perflexilis.**)
Strophograptus trichomanes Ruedemann.
1908. *Strophograptus trichomanes* (?) Shakespear, (*d*) .. .. Band 2.
Tetragraptus amii Elles and Wood.
Tetragraptus amii. Shakespear, (*d*) .. .. Band 1.
Tetragraptus bigsbyi (Hall).
1908. *Tetragraptus bigsbyi.* Shakespear, (*d*) .. .. .. Band 2.
Tetragraptus pendens Elles.
1908. *Tetragraptus cf. pendens.* Shakespear, (*d*) .. .. Band 2.
Tetragraptus quadribrachiatus (Hall).
1886. *Graptolites* sp. Hector, (*a*), No. 3.
1907. *Tetragraptus quadribrachiatus.* Bell, Webb, and Clarke, (*c*), f. 13.
1908. „ Shakespear, (*d*) .. .. Band 2.

II. Fossils of the Baton River Series, Baton River, Nelson (Upper Silurian of Hector).

No descriptions or figures of any fossils from the Baton River have been published, but a large number of identifications have been made. The letters (*a*), (*b*), &c., after the author's name indicate the following references:—

(*a*.) 1879. Hector, J.: Prog. Rep., vol. 12, p. 39; and McKay, A.: R.G.E., vol. 12, p. 126.
(*b*.) 1879. Hector, J.: 14th Ann. Rep. Col. Mus. Lab., p. 7.
(*c*.) 1880. Hector, J.: App. Off. Cat. S.E., pp. 2–3.
(*d*.) 1880. Hector, J.: Journ. Roy. Soc., N.S.W., vol. 13, p. 79.
(*e*.) 1880. Hector, J.: Handbook of N.Z., 2nd ed., p. 29, and 3rd ed. (1883).
(*f*.) 1883. Hector, J.: Prog. Rep., vol. 14, p. xxv.
(*g*.) 1886. Park, J.: R.G.E., vol. 17, pp. 179–80.
(*h*.) 1886. Hector, J.: Cat. Ind. Col. Exh., pp. 18–21, 81.

	Specimens so labelled in Dominion Museum.
Astrocerium venustum Hall, (*c*).	
Athyris longiformis, (*g*)	1
Atrypa reticularis Linn., (*a*), (*b*)	4
Avicula anisota Phillips, (*c*), (*h*)	1
,, *cancellata* Phillips, (*b*), (*c*), (*h*)	1
,, *echinus* (?), (*g*).	
,, *damnoniensis* J. de C. Sow., (*a*).	
,, *subplana* Hall, (*b*).	
Callopora elegantula Hall, (*c*).	
Calymene blumenbachii Brogniart, (*a*), (*b*), (*c*), (*d*), (*e*), (*g*), (*h*)	5
Chonetes striatella Dalman, (*a*).	
Homalonotus harrisoni, (*h*).	
,, *knightii* König, (*a*), (*b*), (*c*), (*d*), (*h*)	1
Leptæna planoconvexa Hall, (*f*)	2
,, *profunda* Hall, (*f*)	3
Modiolopsis modiolaris Conrad, (*a*), (*b*), (*c*), (*h*).	
Murchisonia terebralis Hall, (*a*), (*b*), (*c*), (*e*), (*h*)	2
,, *uniangulata abbreviata* Hall, (*c*), (*d*), (*h*).	
Nucleospira ventricosa Hall, (*g*)	8
Nucula levata, (*b*).	
Orthis basalis Dalman, (*c*), (*d*), (*g*), (*h*)	5
,, *canaliculata* Lindstrom, (*g*)	6
,, *circula* Hall, (*c*), (*g*), (*h*).	
,, *crassa* Lindström, (*c*), (*d*), (*g*), (*h*)	12
,, *fissicostata* Hall, (*b*), (*c*), (*g*), (*h*)	12
,, ,, var. A Hector (MS.), (*h*).	
,, *patera* Salter, (*c*), (*g*), (*h*)	4
,, *plicatella* Hall, (*g*).	
,, *protensa* J. de C. Sow., (*b*)	3
,, *reversa* Davidson, (*g*), (*h*)	4
,, *testudinaria* Dalman, (*g*).	
,, *unguis* J. de C. Sow., (*c*), (*d*), (*g*), (*h*)	6
Orthoceras junceum Hall, (*c*).	
Orthonota solenoides J. de C. Sow., (*b*).	
Pterinea spinosa Phillips, (*a*), (*e*), (*h*).	
Rhynconella (*atrypa*), (*g*).	

	Specimens so labelled in Dominion Museum.
Rhynconella nucula J. de C. Sow., (*g*)	5
„ *plena* Hall, (*g*)	6
„ *wilsoni* J. de C. Sow., (*a*), (*b*), (*c*), (*d*), (*g*), (*h*)	8
Spirifer radians, (*f*).	
„ *radiatus* J. de C. Sow., (*a*), (*b*), (*c*), (*d*), (*e*), (*f*), (*h*).	
„ *speciosus* Schlotheim, (*c*), (*g*)	8
„ *sulcatus* Hisinger, (*b*).	
Spiriferina grata Hector (MS.), (*g*)	3 chirotypes.
Streptelasma calicula Hall, (*c*).	
Stricklandia lirata J. de C. Sow., (*a*), (*c*), (*d*), (*e*), (*g*), (*h*)	1
Strophomena corrugata, (*h*).	
„ *corrugatella* Davidson, (*a*), (*b*), (*c*), (*h*)	1
„ „ var. A, (*h*).	
„ *orbignyi* Davidson, (*c*), (*h*)	1
„ *profunda* (*h*).	

III. Fossils of the Reefton Series. (Lower Devonian of Hector.)

Two species of trilobites (*Homalonotus*) have been described by Hector and Hutton respectively, and Hector has also figured one species each of *Avicula* and *Strophomena*. Besides these a few identifications have been made.

Avicula sp. ind. Hector, Cat. Ind. Col. Exh., p. 80, f. 52, No. 1; 1886.

Chonetes striatella Dalman.
1880. *Chonetes striatella*. Hector, Journ. Roy. Soc. N.S.W., vol. 13, p. 79.
1880. „ Hector, App. Off. Cat. S.E., p. 4.

Homalonotus expansus Hector.
1877. *Homalonotus expansus*. Hector, T.N.Z.I., vol. 9, p. 602, pl. 27, f. 2. (D.M., 4 syntypes, 3 figured.)
1880. „ *expansa*. Hector, Journ. Roy. Soc. N.S.W., vol. 13, p. 79.
1880. „ *expansus*. Hector, Handbook of N.Z. (2nd ed.), p. 29.
1886. „ „ Hector, Cat. Ind. Col. Exh., p. 19.

Homalonotus sp. ind. Hutton, Proc. Linn. Soc. N.S.W., ser. 2, vol. 12, p. 257; 1888.

Leptæna bipartita Salter.
1880. *Leptæna bipartita*. Hector, Journ. Roy. Soc. N.S.W., vol. 13, p. 79.
1886. „ Hector, Cat. Ind. Col. Exh., p. 20.

Orthis crassa Lindström.
1880. *Orthis crassa*. Hector, App. Off. Cat. S.E., p. 4.

Orthis grandis.
1877. *Orthis grandis*. McKay, R.G.E., vol. 8, p. 95.

Orthis interlineata J. de C. Sowerby.
1880. *Orthis interlineata*. Hector, App. Off. Cat. S.E., p. 4.
1880. „ Hector, Journ. Roy. Soc. N.S.W., vol. 13, p. 79.

Spirifer cultrijugatus Römer.
1880. *Spirifera cultrijugata*. Hector, App. Off. Cat. S.E., p. 3.
1880. „ Hector, Journ. Roy. Soc. N.S.W., vol. 13, p. 79.

Spirifer speciosus Schlotheim.
1880. *Spirifera speciosa*. Hector, App. Off. Cat. S.E., p. 4. (D.M., 3 specimens.)
1880. „ Hector, Journ. Roy. Soc. N.S.W., vol. 13, p. 79.
1886. „ Hector, Cat. Ind. Col. Exh., p. 19.

Spirifer vespertilio G. B. Sowerby.

1880. *Spirifera vespertilio.* Hector, Handbook of N.Z. (2nd ed.), p. 29.

1886. ,, Hector, Cat. Ind. Col. Exh., p. 80.

Stricklandia lirata J. de C. Sowerby.

1880. *Stricklandia lirata.* Hector, App. Off. Cat. S.E., p. 3.

Strophomena sp. ind. Hector, Cat. Ind. Col. Exh., p. 80, f. 52, No. 2; 1886. (D.M., 1 figured specimen.)

There are also in the Geological Survey collections six labelled specimens belonging to four species not included above.

IV. Fossils of the Maitai Series, Nelson District. (Carboniferous of Hector.)

Annelid.* Hector, Cat. Ind. Col. Exh., p. 78, f. 48, No. 1.

Cyathocrinus sp. ind.

1878. *Cyathocrinus* sp. ind. Hector, Prog. Rep., vol. 11, p. xii.

1879. ,, Hector, Handbook of N.Z., p. 26, and Prog. Rep., vol. 12, p. 12.

1880. ,, Hector, Handbook of N.Z. (2nd ed.), p. 28, and Jour. Roy. Soc. N.S.W., vol. 13, p. 78.

1886. ,, Hector, Prog. Rep., vol. 17, p. xx.

Cyathophyllum sp. ind.

1878. *Cyathophyllum* sp. ind. Hector, Prog. Rep., vol. 11, p. xii.

1879. ,, Hector, Handbook of N.Z., p. 26, and Prog. Rep., vol. 12, p. 12.

1880. ,, Hector, Handbook of N.Z. (2nd ed.), p. 28; Jour. Roy. Soc. N.S.W., vol. 13, p. 78; App. Off. Cat. S.E., p. 4.

1886. ,, Hector, Prog. Rep., vol. 17, p. xx.

Productus brachythærus G. Sowerby.

1878. *Productus branchythœrus.* Hector, Prog. Rep., vol. 11, p. xii.

1879. ,, Hector, Prog. Rep., vol. 12, p. 12, and Handbook of N.Z., p. 26.

1879. ,, McKay, R.G.E., vol. 12, p. 117.

1880. *Productus brachythœrus.* Hector, Handbook of N.Z. (2nd ed.), p. 28; Jour. Roy. Soc. N.S.W., vol. 13, p. 78; App. Off. Cat. S.E., p. 4.

1886. ,, Hector, Prog. Rep., vol. 17, p. xx.

Productus punctatus Martin.

1878. *Productus punctatus.* Hector, 13th Ann. Rep. Col. Mus. Lab., p. 6.

Spirifer bisulcatus J. de C. Sowerby.

1878. *Spirifer bisulcatus.* Hector, 13th Ann. Rep. Col. Mus. Lab., p. 6.

1879. *Spirifera bisulcata.* Hector, Prog. Rep., vol. 12, p. 12; Handbook of N.Z., p. 26; App. Off. Cat. S.E., p. 4.

1880. ,, Hector, Handbook of N.Z. (2nd ed.), p. 28, and Jour. Roy. Soc. N.S.W., vol. 13, p. 78.

1886. ,, Hector, Prog. Rep., vol. 17, p. xx, and Cat. Ind. Col. Exh., p. 78, f. 46, No. 2.

Spirifer glaber (Martin).

1880. *Spirifer glaber.* Hector, Handbook of N.Z. (2nd ed.), p. 28.

1886. ,, Hector, Prog. Rep., vol. 17, p. xx.

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* This fossil, known as the "Mount Torlesse Annelid" has been described by Bather, and named *Torlessia mackayi*, and under the latter name is also included in the list of Permo-Jurassic invertebrata, in deference to the views of Park and Marshall.

V. Permo-Jurassic Invertebrata.

—	Locality or Horizon.	Location of Specimens.
Ægoceras brownei. (See **Perisphinctes brownei.**)		
Ammonites debilis.		
1878. *Ammonites debilis.* Hector, Prog. Rep., vol. 11, p. xi	Oreti Series, Hokanui Hills	..
Ammonites discus d'Orbigny.		
1878. *Ammonites discus.* Hector, Prog. Rep., vol. 11, p. ix	Lower Flag Hill Series, Hokanui Hills	..
Ammonites of group **falciformi.** Hector, Prog. Rep., vol. 11, p. ix; 1878	Bastion Series, Hokanui Hills	..
Ammonites galeatus.		
1878. *Ammonites galeatus.* Hector, Prog. Rep., vol. 11, p. x	Otapiri Series, Hokanui Hills	..
Ammonites metternichii.		
1878. *Ammonites metternichii.* Hector, Prog. Rep., vol. 11, p. x	Otapiri Series, Hokanui Hills	..
Ammonites novoseelandicus. / **Ammonites novozelandicus.** (See **Hoplites novoseelandicus.**)		
Ammonites of group **planati.** Hector, Prog. Rep., vol. 11, p. ix; 1878	Bastion Series, Hokanui Hills	..
Ammonites sisyphi Hector.		
1886. *Ammonites sisyphi.* Hector, Cat. Ind. Col. Exh., p. 68, f. 33, No. 1	Jurassic	D.M.; chirotype.
1886. ,, Hector, 21st Ann. Rep. Col. Mus. Lab., p. 6	Putataka Series, Kawhia	
Ammonites sp. ind. Hector, Cat. Ind. Col. Exh., p. 68, f. 33, No. 2; 1886	Jurassic	..
Arca pulchra.		
1878. *Arca pulchra* var. Hector, Prog. Rep., vol. 11, p. vii	Putataka Series, Hokanui Hills	..
Arcestes hokanui Marshall.		
1909. *Arcestes hokanui.* Marshall, T.N.Z.I., vol. 41, p. 143 and text fig.	Mandeville, Hokanui Hills	Marshall coll.; holotype.
1910. *Proarcestes* sp. or *Arcestes* sp. Diener in Bœhm, Cb. f. Min., 1910, p. 634		
Astarte elegans Sowerby.		
1878. *Astarte elegans.* Hector, Prog. Rep., vol. 11, p. viii	Putataka Series, Hokanui Hills	..
1880. ,, Hector, App. Off. Cat. S.E., pp. 10, 11	Flag Hill and Putataka Series, Hokanui Hills	..
1886. ,, Hector, Cat. Ind. Col. Exh., p. 17	Flag Hill	..
Astarte fimbriata (Walton, MS.) Lycett.		
1878. *Astarte fimbriata.* Hector, Prog. Rep., vol. 11, p. ix	Lower Flag Hill Series, Hokanui Hills	..
Astarte minima (Phillips).		
1878. *Astarte minima.* Hector, Prog. Rep., vol. 11, p. ix	Bastion Series, Hokanui Hills	..
1880. ,, Hector, App. Off. Cat. S.E., p. 7	Wairoa Series, Nugget Point	..
1881. ,, McKay, R.G.E., vol. 13, p. 45	Bastion Series, Wyndham River	..
Astarte vallisneriana.		
1878. *Astarte vallisneriana.* Hector, Prog. Rep., vol. 11, p. x	Otapiri Series, Hokanui Hills	..
Astarte wollumbillaensis Moore.		
1872. *Astarte wollumbillaensis.* Hutton, Prog. Rep., vol. 8, p. 105	Otapiri	..
Atractites otapiriensis (Hector).		
1878. *Belemnites otapiriensis.* Hector, T.N.Z.I., vol. 10, pp. 485, 486, pl. xxii, f. 1	Otapiri to Wairoa Series	D.M.; 2 syntypes, Oreti railway-cutting, Dipton.
1878. ,, Hector, Prog. Rep., vol. 11, p. x	Otapiri Series, Hokanui Hills	..
1878. ,, McKay, R.G.E., vol. 11, pp. 72, 89,	Oreti railway-cutting	..
1879. ,, Hector, Prog. Rep., vol. 12, p. iv, and McKay, R.G.E., vol. 12, p. 120	Otapiri Series, Wairoa Gorge, and Eighty-eight Valley, Nelson	..
1880. ,, Hector, Journ. Roy. Soc., N.S.W., vol. 13, p. 75	Otapiri Series	..
1880. ,, Hector, App. Off. Cat. S.E., p. 8	Otapiri Series, Wairoa Gorge	..
1881. ,, McKay, R.G.E., vol. 13, pp. 44, 47	Otapiri Series, Mataura River, 1½ miles below Gore; Flag Hill Series, 1 mile below Mataura Falls	..
1885. *Belemnites* aut *Auloceras* sp. Denkschr. k. Akad. Wissensch. Wien, bd. 50, p. 120	..	..
1909. *Orthoceras otapiriensis.* Marshall, T.N.Z.I., vol. 41, p. 144	(?) Mandeville, Hokanui Hills	..
1910. *Atractites* (?) sp. Diener in Bœhm, Cb. f. Min., 1910, pp. 635, 636		

V. Permo-Jurassic Invertebrata—*continued.*

—	Locality or Horizon.	Location of Specimens.
Athyris sp. ind.		
1886. *Spirigera* sp. ind. Hector, Cat. Ind. Col. Exh., p. 73, f. 41, No. 4	Triassic	..
Athyris wreyi (Suess).		
1864. *Spirigera wreyi.* Suess, Nov. Pal., pp. 28, 29, taf. 8, f. 3, *a, b, c, d*	Wairoa Gorge and Aniseed Valley	V.M.; syntypes.
1886. ,, Hector, Cat. Ind. Col. Exh., p. 73, f. 41, No. 4	Triassic	..
(Numerous other references in New Zealand literature.)		
Aucella plicata Zittel.		
1864. *Aucella plicata.* Zittel, Nov. Pal., pp. 32, 33, taf. 8, f. 4, *a, b, c*	Waikato South Head	V.M.; syntypes.
1870. ,, Hector, Cat. Col. Mus., pp. 194, 195	Kawhia and Wairoa Valley	..
1886. ,, Hector, Cat. Ind. Col. Exh., p. 68, f. 33, No. 5	Waikato Heads	..
1911. ,, Bœhm, N.J. f. Min., 1911, bd. 1, pp. 7–14, taf. 2, f. 1, 2, *a, b, c*; 3, *a, b*; 4	Kawhia	Bœhm coll.; 9 plesiotypes.
(Also identified by Hector in Amuri Series, "Lower Greensand.")		
Aucella sp. ind. Hector, Cat. Ind. Col. Exh., p. 68, f. 33, No. 3; 1886	Kawhia	..
Avicula burumburiensis. (? **A. braamburiensis** Sow.)		
1878. *Avicula burumburiensis.* Hector, Prog. Rep., vol. 11, p. ix	Bastion Series, Hokanui Hills	..
Avicula costata Sowerby.		
1878. *Avicula costata.* Hector, Prog. Rep., vol. 11, pp. viii, ix	Putataka and Lower Flag Hill Series, Hokanui Hills	..
1880. ,, Hector, App. Off. Cat. S.E., p. 11	Putataka Series, Hokanui Hills	..
1886. ,, Hector. Cat. Ind. Col. Exh., p. 16	Hokanui Range	..
Avicula cygnipes.		
1878. *Avicula cygnipes.* Hector, Prog. Rep., vol. 11, p. ix	Bastion Series, Hokanui Hills	..
1884. ,, Hector, Prog. Rep., vol. 16, p. xxxviii	Flag Hill Series, Kawhia	..
1886. *Avicula cygnipes* var. Hector, Cat. Ind. Col. Exh., p. 69, f. 34, No. 2 ..	Jurassic	..
Avicula mima.		
1878. *Avicula mima.* Hector, Prog. Rep., vol. 11, p. ix	Lower Flag Hill Series, Hokanui Hills ..	..
Belemnites aucklandicus. (See **B. canaliculatus aucklandicus.**)		
Belemnites bessinus d'Orbigny.		
1878. *Belemnites bessinus.* Hector, Prog. Rep., vol. 11, p. ix	..	..
Belemnites canaliculatus aucklandicus (Blainville) Hauer.		
1859. *Canaliculati.* Hochstetter, N.Z. Govt. Gazette, Prov. of Auckland, vol. 8, July 8, 1859	Waikato South Head	V.M.; 9 specimens.
1859. ,, Hochstetter, Sitz. k. Akad. Wissensch. Wien, bd. 37, p. 124 ..	,, ...	..
1863. *Belemnites aucklandicus.* Hauer in Hochstetter, "Neu-Seeland," p. 129, and text fig.	Mouth of Waikato River	V.M.; 1 holotype, 2 paratypes.
1863. *Belemnites aucklandicus* var. Hauer in Hochstetter, "Neu-Seeland," p. 190, and text fig.	Kawhia	V.M.; 1 holotype, 5 paratypes.
1864. *Belemnites aucklandicus.* Hauer, Nov. Pal., pp. 29, 30, taf. 8, f. 2, *a–d* ..	Waikato South Head	..
1864. *Belemnites aucklandicus minor.* Hauer, Nov. Pal., pp. 29, 30, taf. 8, f. 3, *a–d*	Ahuahu Point, Kawhia	..
1878. *Belemnites aucklandicus.* Hector, Prog. Rep., vol. 11, p. viii, and Cox, R.G. ., vol. 11, pp. 37, 40	Putataka Series, Hokanui Hills	..
1878. ,, Hector, T.N.Z.I.. vol. 10, p. 486, pl. 22, f. 2, *a, b* ..	Putataka Series, Waikato Head and Hokanui Hills	..

1878. *Belemnites hochstetteri.* Hector, T.N.Z.I., vol. 10, pp. 486, 487, pl. 22, f. 4, *a*, *b*	Kawhia and East Cape District	..
1884. *Belemnites aucklandicus minor.* Hector, Prog. Rep., vol. 16, p. xxxvi ..	Old Wesleyan Mission Station, Kawhia ..	..
1884. *Belemnites minor.* Hector, Prog. Rep., vol. 16, p. xxxviii	Mataura Series, Kawhia	..
1886. *Belemnites aucklandicus.* Hector, Cat. Ind. Col. Exh., p. 68, f. 33, No. 4 ..	Kawhia	..
1909. *Orthoceras brownei.* Marshall, T.N.Z.I., vol. 41, p. 144	..	Marshall coll.
1911. *Belemnites canaliculatus aucklandicus.* Bœhm, N.J. f. Min., 1911, bd. 1, pp. 16, 17	..	Bœhm coll.; 20 plesiotypes.
Belemnites catlinensis Hector.		
1878. *Belemnites catlinensis.* Hector, T.N.Z.I., vol. 10, p. 486, pl. 22, f. 3, *a*, *b* ..	South of Catlin's River and Hokanui Hills ..	D.M.; holotype.
1878. ,, Hector, Prog. Rep., vol. 11, p. ix, and Cox, R.G.E., vol. 11, p. 40	East Face, Flag Hill	..
1880. ,, Hector, App. Off. Cat. S.E., p. 10	Flag Hill Series, Hokanui Hills	..
1881. ,, McKay, R.G.E., vol. xiii, p. 47	1 mile below Mataura Falls	..
1886. ,, Hector, Cat. Ind. Col. Exh., p. 70, f. 36, No. 3 ..	Jurassic	..
Belemnites hochstetteri. / **Belemnites minor.** } (See **B. canaliculatus aucklandicus.**)		
Belemnites otapiriensis. (See **Atractites otapiriensis.**)		
Belemnites sp. ind. Thomas, Bull. No. 4 (n.s.), N.Z. Geol. Surv., pp. 48–50, pl. 9; 1907	Manaia Hill, Coromandel	..
Brancoceras mandevillei. (See **Proclydonautilus mandevillei.**)		
Calamopora mackrothii Geinitz.		
1880. *Calamopora mackrothii.* Hector, App. Off. Cat. S.E., p. 5	Permian, Eighty-eight Valley	..
Cardium conicum.		
1878. *Cardium conicum* var. Hector, Prog. Rep., vol. 11, p. viii	Putataka Series, Hokanui Hills	..
Clavigera spp. ind. Hector, Cat. Ind. Col. Exh., p. 72, f. 4, Nos. 2, 3; 1886	Triassic	..
Clavigera tumida Hector (MS.).		
1881. *Clavigera tumida.* McKay, R.G.E., vol. 13, p. 44	Mataura River, 1½ miles below Gore ..	..
Clydonautilus goniatites (Hauer).		
1879. *Nautilus goniatites.* Hector, Handbook of N.Z., p. 24	Otapiri Series	..
1880. ,, Hector, Journ. Roy. Soc. N.S.W., vol. 13, p. 75 ..	,, ...	..
1886. ,, Hector, Cat. Ind. Col. Exh., p. 72	Triassic	..
1910. *Clydonautilus goniatites.* Bœhm, Cb. f. Min., 1910, p. 633	..	..
Conularia grata Hector.		
1878. *Conularia gratus.* McKay, R.G.E., vol. 11, p. 126	Cowan's Wash, Oreti River	..
1886. *Conularia grata.* Hector, Cat. Ind. Col. Exh., p. 74, f. 43, No. 2	Triassic, Kaihiku Ranges	..
Cypricardia cordata.		
1878. *Cypricardia cordata.* Hector, Prog. Rep., vol. 11, p. x	Otapiri Series, Hokanui Hills	..
Cucullæa sp. ind. Hector, Cat. Ind. Col. Exh., p. 68 f. 33, No. 6; 1886	Jurassic	..
Dentalium huttoni Bather.		
1905. *Dentalium huttoni.* Bather, Geol. Mag., dec. 5, vol. 2, pp. 532–41, f. 4–7 ..	Kowai River and Wilberforce River	B.M.; holotype and 1 paratype.
Discina kawhiana Bœhm.		
1911. *Discina kawhiana.* Bœhm, N.J. f. Min., 1911, bd. 1, pp. 6, 7, taf. 1, f. 1 ..	Puti Point, Kawhia	Bœhm coll.; holotype.
Edmondia mackayi Hector.		
1886. *Edmondia mackayi.* Hector, Cat. Ind. Col. Exh., p. 74, f. 43, No. 1	Triassic	..
Epithyris elongata Schlotheim.*		
1878. *Epithyris elongata.* Hector, Prog. Rep., vol. 11, p. xi	Kaihiku Series, Hokanui Hills	..
1880. ,, Hector, App. Off. Cat. S.E., p. 5	Hokanui Range	..
1886. ,, Hector, Cat. Ind. Col. Exh., pp. 20, 76, f. 45, No. 5 ..	,, (Permian)	..

* Hector in other places speaks of "*Terebratula* of the type of *Epithyris elongata*"—*e.g.*, in T.N.Z.I., vol. 9, p. 537; 1879.

V. Permo-Jurassic Invertebrata—*continued.*

—	Locality or Horizon.	Location of Specimens.
Estheria minuta Alberti.		
1904. *Estheria minuta.* Park, T.N.Z.I., vol. 36, p. 397	Trigonia beds ("most places")	..
Gervillia acuta Sowerby.		
1878. *Gervillia acuta.* Hector, Prog. Rep., vol. 11, p. ix	Lower Flag Hill Series, Hokanui Hills ..	..
Gryphæa erana.		
1878. *Gryphæa erana.* Hector, Prog. Rep., vol. 11, p. viii	Putataka Series, Hokanui Hills	..
Grypoceras mesodiscum (Hauer).		
1878. *Nautilus mesodiscus.* Hector, Prog. Rep., vol. 11, p. x	Otapiri Series, Hokanui Hills	..
1879. ,, Hector, Prog. Rep., vol. 12, p. 10	Otapiri Series	..
1879. ,, Hector, Handbook of N.Z., p. 24	,, ...	..
1880. ,, Hector, Journ. Roy. Soc. N.S.W., vol. 13, p. 75 ..	,, ...	..
1886. ,, Hector, Cat. Ind. Col. Exh., p. 72	Triassic	..
1910. *Grypoceras mesodiscum.* Diener in Bœhm, Cb. f. Min., 1910, p. 635 ..	Mandeville, Hokanui Hills	Marshall coll.; plesiotype.
Halobia hochstetteri Mojsisovics.		
1864. *Halobia lomelli.* Zittel, Nov. Pal., pp. 27, 28, taf. 6, f. 2, *a–c* (non Wissman)	Richmond	V.M.
1874. *Halobia hochstetteri.* Mojsisovics, Abhandl. d. k.-k. geol. Reichsanst., bd. vii. heft 2, p. 32	,, ...	,,
1908. *Halobia hochstetteri.* Arthaber, Lethæa geognostica, teil 2, 1, p. 241.		
1910. ,, Bœhm, Cb. f. Min., 1910, p. 633.		
Halobia lomelli. (See **Halobia hochstetteri.**)		
Hoplites novoseelandicus (Hochstetter).		
1863. *Ammonites Novoseelandicus.* Hochstetter, "Neu-Seeland," p. 190, and text fig.	Kawhia	V.M.; holotype and 1 paratype.
1863. *Ammonites Novo-Zelandicus.* Hauer, in Hochstetter, "Reise der Novara," Geol. Th., bd. 1, abth. 1, p. 33	,, ...	..
1864. *Ammonites Novo Zelandicus.* Hauer, Nov. Pal., p. 31, taf. 8, f. 1, *a–c* .	,, ...	..
1865. *Ammonites Novo-Zelandicus.* Oppel, Zeitschr. deutsch. geol. Gesellsch., vol. 17, p. 555	,, ...	..
1885. *Ammonites novozelandicus.* Neumayr, Denkr. k. Akad. Wien, bd. 50, p. 120	,, ...	..
1911. *Hoplites novoseelandicus.* Bœhm, N.J. f. Min., 1911, bd. 1, pp. 21, 22 ..	,, ...	..
(Numerous references in New Zealand literature, mostly quoting from Hochstetter and Hauer.)		
Inoceramus haasti Hochstetter.		
1863. *Inoceramus haasti.* Hochstetter, "Neu-Seeland," pp. 130, 190	..	..
1864. ,, Zittel, Nov. Pal., p. 33, taf. 7, f. 5, *a–c*	Takatahi, Kawhia	V.M.; 2 figured syntypes,
1907. ,, Thomas, Bull. No. 4 (n.s.), N.Z. Geol. Surv., pp. 48–50, pl. 12	Manaia Hill, Coromandel	..
1911. ,, Bœhm, N.J. f. Min., pp. 14, 15	Kawhia	..
(Numerous references in New Zealand literature; also determined by Hector in the Amuri Series, "Lower Greensand.")		
Inoceramus labiatus Schlotheim.		
1904. *Inoceramus labiatus.* Park, T.N.Z.I., vol. 36, p. 385	Tuck's Bay, Catlin's River	..

Inoceramus obliquus.		
1878. *Inoceramus obliquus.* Hector, Prog. Rep., vol. 11, p. ix	Bastion Series, Hokanui Hills	..
Inoceramus tumidus Hector (MS.).		
1870. *Inoceramus tumidus.* Hector, Cat. Col. Mus., p. 195	Wairoa Valley, Nelson	..
Lima cordiformis.		
1878. *Lima cordiformis.* Hector, Prog. Rep., vol. 11, p. ix	Lower Flag Hill Series, Hokanui Hills	..
Lima (Plagiostoma) gigantea Sowerby.		
1878. *Plagiostoma gigantea.* Hector, Prog. Rep., vol. 11, p. ix	Bastion Series, Hokanui Hills	..
1911. *Lima* aff. *gigantea.* Bœhm, N.J. f. Min., 1911, bd. 1, pp. 15, 16	Puti Point and Motutara, Kawhia	Bœhm coll.; 2 plesiotypes.
Lima (Plagiostoma) grandis.		
1886. *Plagiostoma grandis.* Hector, Cat. Ind. Col. Exh., p. 70, f. 36, No. 1	Liassic	..
Lima rigidula.		
1878. *Lima rigidula.* Hector, Prog. Rep., vol. 11, p. x	Otapiri Series, Hokanui Hills	..
Lima semicircularis Goldfuss.		
1878. *Lima semicircularis.* Hector, Prog. Rep., vol. 11, p. ix	Lower Flag Hill Series, Hokanui Hills	..
Monotis decipiens.		
1863. *Monotis decipiens.* Zittel, Q.J.G.S., vol. 19, pt. 2, p. 20	Richmond	..
Monotis dissimilis Hector (MS.).		
1878. *Monotis dissimilis.* Hector, Prog. Rep., vol. 11, p. x	Otapiri Series, Hokanui Hills	..
1878. ,, Cox, R.G.E., vol. 11, p. 45	Taylor's Crossing grit, Hokanui Hills	..
Monotis radialis Phillip.		
1880. *Monotis radialis.* Hector, App. Off. Cat. S.E., p. 6	Wairoa Gorge	..
Monotis salinaria. / **Monotis salinaria richmondiana.** } (See **Pseudomonotis richmondiana.**)		
Monotis sp. ind. Hector, Cat. Ind. Col. Exh., p. 73, f. 41, No. 6; 1886	Triassic	..
Monotis sepuncularia Munster.		
1880. *Monotis speluncaria.* Hector, App. Off. Cat. S.E., p. 10	Bastion Series, Hokanui Range	..
1886. *Monotis sepuncularia.* Hector, Cat. Ind. Col. Exh., p. 17 and Errata	Hokanui Range	..
Myacites recurvum Phillips.		
1878. *Myacites recurvum.* Hector, Prog. Rep., vol. 11, p. ix	Lower Flag Hill Series, Hokanui Hills	..
Mytilus binfeldi Morris and Lycett.		
1878. *Mytilus binfeldi.* Hector, Prog. Rep., vol. 11, p. ix	Lower Flag Hill Series, Hokanui Hills	..
Mytilus cuneatus Sowerby.		
1878. *Mytilus cuneata.* Hector, Prog. Rep., vol. 11, p. ix	Lower Flag Hill Series, Hokanui Hills	..
Mytilus problematicus Zittel.		
1864. *Mytilus problematicus.* Zittel, Nov. Pal., p. 28, taf. 8, f. *a*, *b*	Near Spring Grove, Wairoa Gorge	V.M.
1880. ,, Hector, App. Off. Cat. S.E., p. 7	Wairoa Series, Wairoa Gorge and Nugget Point	..
(Many other references in New Zealand literature, mostly quotations of Zittel.)		
Mytilus squamosus Sowerby.		
1880. *Mytilus squamosus.* Hector, App. Off. Cat. S.E., p. 6	Wairoa Series, Wairoa Gorge	..
Nautilus baberi Morris and Lycett.		
1878. *Nautilus baberi.* Hector, Prog. Rep., vol. 11, p. ix	Bastion Series, Hokanui Hills	..
Nautilus freieslebeni Geinitz.		
1878. *Nautilus frieslebendi.* Hector, Prog. Rep., vol. 11, p. ix	Otapiri Series, Hokanui Hills	..
1880. ,, (?) Hector, App. Off. Cat. S.E., p. 7	Wairoa Series, Nugget Point	..
Nautilus goniatites. (See **Clydonautilus goniatites.**)		
Nautilus mesodiscus. (See **Grypoceras mesodiscum.**)		

V. Permo-Jurassic Invertebrata—*continued.*

—	Locality or Horizon.	Location of Specimens.
Nautilus reticulatus Hauer.		
1878. *Nautilus reticulatus.* Hector, Prog. Rep., vol. 11, p. v	Mount Potts	..
1878. *Nautilus reticularis.* Hector, Prog. Rep., vol. 11, p. x	Otapiri Series, Hokanui Hills	..
1878. *Nautilus reticulatus.* Hector, Prog. Rep., vol. 11, pp. x, xi	Oreti and Wairoa Series, Hokanui Hills	..
1878. *Palæaturia* sp. McKay, R.G.E., vol. 11, pp. 89, 126	Wairoa Series, Hokanui Hills, and Shaw's Bay, Nugget Point	..
1879. *Nautilus reticularis.* Hector, Prog. Rep., vol. 12, p. 10	Otapiri Series, Wairoa Gorge and Nugget Point	..
1879. ,, Hector, Prog. Rep., vol. 12, p. 32	Oreti Series, Nelson	..
1879. ,, Hector, 14th Ann. Rep. Col. Mus. Lab., p. 7	Lowest beds, Middle Wairoa Series, Nelson	..
1880. ,, Hector, App. Off. Cat. S.E., pp. 6, 7	Wairoa Series, Wairoa Gorge and Nugget Point	..
Nautilus simplex.		
1879. *Nautilus simplex.* Hector, Prog. Rep., vol. 12, p. 32	Oreti Series, Nelson	..
Orthis spirigera McCoy.		
1877. *Orthis spinigera.** Haast, R.G.E., vol. 8, p. 6	Fossil Gully, Mount Potts	..
1879. ,, Haast, "Geology of the Provinces Canterbury and Westland," p. 272	,, ,,	..
Orthoceras alviolare.		
1878. *Orthoceras alviolare.* Hector, Prog. Rep., vol. 11, p. v	Mount Potts	..
Orthoceras brownei. (See **Belemnites canaliculatus aucklandicus.**)		
Orthoceras otapiriensis. (See **Atractites otapiriensis.**)		
Patella inornata Morris and Lycett.		
1878. *Patella inornata.* Hector, Prog. Rep., vol. 11, p. iv	Lower Flag Hill Series, Hokanui Hills	..
Patella sp. ind. Hector, Cat. Ind. Col. Exh., p. 69, f. 34, No. 1	Jurassic	..
Patella sp. ind. Hector, Cat. Ind. Col. Exh., p. 76, f. 45, No. 1	Permian	..
Pecten arcuatus Sowerby.		
1878. *Pecten arcuatus.* Hector, Prog. Rep., vol. 11, p. ix	Bastion Series, Hokanui Hills	..
Pecten griesbachi.		
1878. *Pecten griesbachi.* Hector, Prog. Rep., vol. 11, p. ix	Lower Flag Hill Series, Hokanui Hills	..
Pecten projectus.		
1878. *Pecten projectus.* Hector, Prog. Rep., vol. 11, p. ix	Lower Flag Hill Series, Hokanui Hills	..
Pecten valoniscus.		
1878. *Pecten valoniscus.* Hector, Prog. Rep., vol. 11, p. x	Otapiri Series, Hokanui Hills	..
Perisphinctes brownei (Marshall).		
1909. *Ægoceras brownei.* Marshall, T.N.Z.I., vol. 41, p. 144 and text fig.	Kawhia	Marshall coll. ; holotype.
1911. *Perisphinctes brownei.* Bœhm, N.J. f. Min., 1911, bd. 1, p. 19 and text fig., pl. 1, f. 2	,,	,, ,,
Perisphinctes sp. ind. Bœhm, N.J. f. Min., 1911, bd. 1, pp. 19–21, text figs. 3, *a*, *b*, taf. 1, f. 3	Motutara Bluff, Kawhia	Bœhm coll. ; 1 specimen.
Perna engossa.		
1878. *Perna engossa.* Hector, Prog. Rep., vol. 11, p. viii	Putataka Series, Hokanui Hills	..
Pholadomya sp. ind. Hector, Cat. Ind. Col. Exh., p. 69, f. 34, No. 4 ; 1886	Jurassic	..
Pholadomya tumida.		
1886. *Pholadomya tumida.* Hector, Cat. Ind. Col. Exh., p. 70, f. 34, No. 2	Jurassic	..

* In the Errata, *spinigera* is corrected to *spirigera*.

Phylloceras kawhiæ Marshall.		
1909. *Phylloceras kawhiæ.* Marshall, T.N.Z.I., vol. 41, p. 144 and text fig.	Kawhia	Marshall coll.; holotype.
1911. ,, Bœhm, N.J. f. Min., 1911, bd. 1, p. 17	Kohai Point and Totara Point, Kawhia	Bœhm coll.; 2 plesiotypes.
Placunopsis striatula Zittel.		
1864. *Placunopsis striatula.* Zittel, Nov. Pal., pp. 33, 34, taf. 8, f. 6	Waikato South Head	V.M.
1870. ,, Hector, Cat. Col. Mus., p. 194	Kawhia	
Plagiostoma sp. (See **Lima (Plagiostoma)** sp.)		
Pleurophorus angulatus.		
1878. *Pleurophorus angulatus.* Hector, Prog. Rep., vol. 11, p. x	Otapiri Series, Hokanui Hills	
Pleurophorus costatus Brown. (? King.)		
1878. *Pleurophorus costatus.* Hector, Prog. Rep., vol. 11, pp. x, xi	Wairoa and Oreti Series, Hokanui Hills	
1880. ,, Hector, App. Off. Cat. S.E., p. 8	Otapiri Series, Nugget Point	
1886. ,, Hector, Cat. Ind. Col. Exh., pp. 17, 76, f. 45, No. 7	Nugget Point	
Pleurotomaria linkiana.		
1878. *Pleurotomaria linkiana.* Hector, Prog. Rep., vol. 11, p. x	Otapiri Series, Hokanui Hills	
Pleurotomaria ornata.		
1878. *Pleurotomaria ornata.* Hector, Prog. Rep., vol. 11, p. x	Otapiri Series, Hokanui Hills	
1879. ,, Hector, Prog. Rep., vol. 12, p. 10	Otapiri Series	
1879. ,, Hector, Handbook of N.Z., p. 24	,,	
1880. ,, Hector, Journ. Roy. Soc. N.S.W., vol. 13, p. 75	Otapiri	
1886. ,, Hector, Cat. Ind. Col. Exh., p. 71	Triassic	
Pleurotomaria tunstallensis.		
1878. *Pleurotomaria tunstallensis.* Hector, Prog. Rep., vol. 11, p. xi	Oreti Series, Hokanui Hills	
Proclydonautilus mandevillei (Marshall).		
1909. *Broncoceras mandevillei.* Marshall, T.N.Z.I., vol. 41, pp. 143, 144, and text fig.	Mandeville, Hokanui Hills	Marshall coll.; holotype.
1910. *Proclydonautilus* sp. *cf. spirolobus.* Diener in Bœhm, Cb. f. Min., 1910, pp. 634, 635	,, ,,	,, ,,
Pseudomonotis sp. ind. Diener in Bœhm, Cb. f. Min., 1910, pp. 635, 636	Mandeville	,,
Pseudomonotis richmondiana (Zittel) Teller and Mojsisovics.		
1863. *Monotis richmondiana.* Zittel, Q.J.G.S., vol. 19, pt. 2, p. 20	Richmond, near Nelson	V.M.
1864. *Monotis salinaria richmondiana.* Zittel, Nov. Pal., pp. 26, 27, taf. 6, f. 1, *a–e*	,, ,,	,,
1886. *Pseudomonotis richmondiana.* Teller and Mojsisovics, Mém. Acad. Imp. Sci. St. Pétersb., sér. 7, tom. 33, pp. 107, 111, 113, 115, 123, 124, 151–53 (*fide* Bœhm)	,, ,,	
1908. ,, Frech, Lethæa geognostica, teil 2, 1, pp. 506–9, taf. 68, f. 4, *a*, *b* (*fide* Bœhm)	,, ,,	
1909. ,, Borissjak, Bull. Com. géol. Russie, vol. 28, p. 100 (*fide* Bœhm)		
1910. ,, Bœhm, Cb. f. Min., 1910, pp. 632, 633		
(Numerous other references in New Zealand literature.)		
Pseudomonotis richmondiana truncata (Zittel) Frech.		
1908. *Pseudomonotis richmondiana truncata.* Frech, "Lethæa geognostica," teil 2, 1, taf. 68, f. *c*, *d* (*fide* Bœhm)	Richmond, near Nelson	V.M.
1910. ,, Bœhm, Cb. f. Min., 1910, p. 633		
Psioidea sp. ind. Hector, Cat. Ind. Col. Exh., p. 73, f. 41, No. 1; 1886	Triassic	
Rastelligera sp. ind. Hector, Cat. Ind. Col. Exh., p. 72, f. 40, No. 1; 1886	Triassic	
Rastelligera taylori Hector (MS.).		
1881. *Rastelligera taylori.* McKay, R.G.E., vol. 13, p. 44	Otapiri Series, Mataura River, 1½ miles below Gore	

V. Permo-Jurassic Invertebrata—*continued.*

—	Locality or Horizon.	Location of Specimens.
Retzia sp. ind. Hector, Cat. Ind. Col. Exh., p. 73, f. 41, No. 8; 1886	Triassic	..
Rhynconella sp. *cf.* **tabulata.**		
1911. *Rhynconella* sp. *cf. tabulata.* Bœhm, N.J. f. Min., 1911, bd. 1, p. 7 ..	South of Totara Point, Kawhia	Boehm coll.; 3 specimens.
Schizodus obscurus Sowerby.		
1878. *Schizodus obscurus.* Hector, Prog. Rep., vol. 11, p. xi	Oreti Series, Hokanui Hills	..
Schizodus oblongus.		
1878. *Schizodus oblonga.* Hector, Prog. Rep., vol. 11, p. x	Otapiri Series, Hokanui Hills	..
Schizodus schlotheimi Geinitz.		
1880. *Schizodus schlotheimi.* Hector, App. Off. Cat. S.E., p. 6	Wairoa Series, Wairoa Gorge	..
Solarium bathonicum.		
1878. *Solarium bathonicum.* Hector, Prog. Rep., vol. 11, p. viii..	Putataka Series, Hokanui Hills	..
Solarium polygonium d'Archaic.		
1878. *Solarium polygonium.* Hector, Prog. Rep., vol. 11, p. ix	Lower Flag Hill Series, Hokanui Hills ..	..
Spirifer duodecimocostatus McCoy.		
1877. *Spirifera duodecimocostata.* Haast, R.G.E., vol. 8, p. 6	Fossil Gully, Mount Potts	..
1879. „ Haast, "Geology of the Provinces Canterbury and Westland," p. 272	„ „	..
Spirifer latus Brown.		
1877. *Spirifera lata.* Haast, R.G.E., vol. 8, p. 6	Fossil Gully, Mount Potts	..
1879. „ Haast, "Geology of the Provinces Canterbury and Westland," p. 272	„ „	..
Spirifer lineatus (Martin).		
1877. *Spirifera lineata.* Haast, R.G.E., vol. 8, p. 6	Fossil Gully, Mount Potts	..
1879. „ Haast, "Geology of the Provinces Canterbury and Westland," p. 272	„ „	..
Spirifer oviformis McCoy.		
1877. *Spirifera oviformis.* Haast, R.G.E., vol. 8, p. 6	..	..
1879. „ Haast, "Geology of the Provinces Canterbury and Westland," p. 272	Fossil Gully, Mount Potts	..
Spirifer subradiatus Sowerby.		
1904. *Spirifer subradiata.* Park, T.N.Z.I., vol. 26, p. 450	Mount St. Mary	..
Spirifer undulatus Sowerby.		
1878. *Spiriferina undulatus.* Hector, Prog. Rep., vol. 11, p. xi..	Kaihiku Series, Hokanui Hills	..
1880. *Trigonotreta undulata.* Hector, App. Off. Cat. S.E., pp. 4, 5	Mount Potts; Kaihiku Series, Hokanui Hills ..	..
1886. „ Hector, Cat. Ind. Col. Exh., p. 72, f. 45, No. 3 ..	Permian	..
Spirifer vespertilio G. Sowerby.		
1904. *Spirifer vespertilio.* Park, T.N.Z.I., vol. 26, p. 450	Mount St. Mary	..
Spiriferina conjuncta.		
1878. *Spiriferina conjuncta.* Hector, Prog. Rep., vol. 11, p. xi	Oreti Series, Hokanui Hills	..
Spiriferina cristata Schlotheim.		
1878. *Spiriferina cristatus.* Hector, Prog. Rep., vol. 11, p. xi	Kaihiku Series, Hokanui Hills	..
1886. *Spiriferina* (*cristata* ?). Hector, Cat. Ind. Col. Exh., p. 76, f. 45, No. 6 ..	Permian	..

Spiriferina radiata.		
1886. *Spiriferina radiata.* Hector, Cat. Ind. Col. Exh., p. 70, f. 30, No. 4 ..	Liassic	..
Spiriferina rostrata (Sowerby).*		
1878. *Spiriferina rostratus.* Hector, Prog. Rep., vol. 11, p. ix	Lower Flag Hill Series, Hokanui Hills ..	..
1879. ,, Hector, Handbook of N.Z., p. 23	Flag Hill Series	..
1880. ,, Hector, Journ. Roy. Soc. N.S.W., vol. 13, p. 74 ..	,, ...	..
1880. ,, Hector, Handbook of N.Z. (2nd ed.), p. 25	,, ...	..
1884. *Spiriferina rostrata.* Hector, Prog. Rep., vol. 16, p. xxxviii	Bastion Series, Kawhia	..
1884. ,, McKay, R.G.E., vol. 16, pp. 145, 146	Opposite Opunga, Kawhia County	..
1886. ,, Hector, Cat. Ind. Col. Exh., p. 68	Jurassic	..
Spiriferina spatulata Hector (MS.).		
1881. *Spiriferina spatulata.* McKay, R.G.E., vol. 13, p. 44	Otapiri Series, Mataura River, 1½ miles from Gore	..
1884. ,, Hector, Prog. Rep., vol. 16, p. xxxvii	Otapiri Series, Kawhia	..
Spiriferina undulata. (See **Spirifer undulatus.**)		
Spirigera sp. (See **Athyris** sp.)		
Streblites motutaranus Bœhm.		
1911. *Streblites motutaranus.* Bœhm, N.J. f. Min., 1911, bd. 1, pp. 17, 18, text fig. 1, taf. 2, f. 5, *a*, *b*	Motutara Bluff, Kawhia	Bœhm coll.; holotype.
Tancredia curtansata (Phillips).		
1878. *Tancredia curtanstata.* Hector, Prog. Rep., vol. 11, p. ix	Lower Flag Hill Series, Hokanui Hills ..	..
Tancredia mactraoides.		
1878. *Tancredia mactraoides.* Hector, Prog. Rep., vol. 11, p. viii	Putataka Series, Hokanui Hills	..
Tancredia similis.		
1878. *Tancredia similis.* Hector, Prog. Rep., vol. 11, p. viii	Putataka Series, Hokanui Hills	..
Tancredia truncata Lycett.		
1878. *Tancredia truncata.* Hector, Prog. Rep., vol. 11, pp. ix, x	Bastion and Otapiri Series, Hokanui Hills ..	..
1879. ,, Hector, Handbook of N.Z., p. 24	Otapiri Series	..
1879. ,, Hector, Prog. Rep., vol. 12, p. 10	,, ...	..
1880. ,, Hector, Journ. Roy. Soc. N.S.W., vol. 13, p. 75 ..	,, ...	..
1886. ,, Hector, Cat. Ind. Col. Exh., p. 71	Triassic	..
Torlessia mackayi Bather.†		
1905. *Torlessia mackayi.* Bather, Geol. Mag., dec. 5, vol. 2, pp. 532–41, f. 1–3 ..	Gorge of the Ashley; Mount Torlesse; Mueller Glacier	B.M.; holotype, 4 syntypes.
1906. ,, Bather, Geol. Mag., dec. 5, vol. 3, pp. 36, 37	..	..
Trigonia navis Lamarck.		
1886. *Trigonia navis* var. Hector, Cat. Ind. Col. Exh., p. 69, f. 34, No. 3 ..	Jurassic	..
Trigonia costata Sowerby.		
1878. *Trigonia costata.* Hector, Prog. Rep., vol. 11, p. ix	Lower Flag Hill Series, Hokanui Hills ..	..
1880. ,, Hector, App. Off. Cat. S.E., p. 11	Flag Hill Series, Hokanui Hills	..
1886. *Trigonia costata* var. Hector, Cat. Ind. Col. Exh., p. 68, f. 33, No. 8 ..	Jurassic	..
Trigonia vulgaris.		
1878. *Trigonia vulgaris.* Hector, Prog. Rep., vol. 11, p. x	Otapiri Series, Hokanui Hills	..
Trigonotreta undulata. (See **Spirifer undulatus.**)		
Trochus nudus.		
1878. *Trochus nudus.* Hector, Prog. Rep., vol. 11, p. x	Otapiri Series, Hokanui Hills	..

* Hector sometimes speaks of "*Spiriferina* of the *rostrata* group"—*e.g.*, 14th Ann. Rep. Col. Mus. Lab., p. 7.

† See p. 32.

VI. Permo-Jurassic Plant Fossils.

A few Cretaceo-Tertiary species are included in the list (in brackets) because they have also been found in the older rocks. To the reference to von Ettingshausen's species should be added in each case "Geol. Mag., dec. 3, vol. 4, p. 367 (1887)," and "T.N.Z.I., vol. 23, p. 242 (1891)," where his statements are repeated.*

Hector appears to have altered the genera of some of his manuscript names between 1870 and 1886, but there is no definite evidence in the literature to indicate the synonymy, and they have therefore been quoted as separate species. The majority of the plant fossils in the Geological Survey collections have been unpacked, and most of the types of the species figured by Hector in the "Catalogue of the Indian and Colonial Exhibition" have been found with labels attached. The chirotypes of his earlier manuscript species have not been found, and this strengthens the assumption that he subsequently assigned them to different genera. The chirotypes of von Ettingshausen's manuscript species are preserved in the Canterbury and Otago Museums.

—	Locality or Horizon.	Location of Specimens.
Alethopteris hochstetteri. (? *Polypodum hochstetteri* Unger.)		
1878. *Alethopteris hochstetteri.* Hector, Prog. Rep., vol. 11, p. viii	Waikato Heads and Mataura, and Flag Hill Series, Hokanui Hills	..
Alethopteris insignis Hector (MS.).		
1878. *Alethopteris insignis.* Hector, Prog. Rep., vol. 11, p. viii	Waikato Heads and Mataura, and Flag Hill Series, Hokanui Hills	..
Araucarioxylon australe Crié (MS.).		
1888. *Araucarioxylon australe.* Crié, C.R. Acad. Sci., Paris, vol. 107, p. 1014 ..	Clent Hills, Wairoa Gorge, Mataura	..
Asplenites cuneata Hector (MS.).		
1880. *Asplenites cuneata.* Hector, App. Off. Cat. S.E., p. 48	Jurassic	..
1886. ,, Hector, Cat. Ind. Col. Exh., p. 31	Clent Hills	..
Asplenites distans Hector (MS.).		
1880. *Asplenites distans.* Hector, App. Off. Cat. S.E., p. 48	Jurassic	..
Asplenites oblonga Hector (MS.).		
1880. *Asplenites oblonga.* Hector, App. Off. Cat. S.E., p. 48	Jurassic	..
Asplenites palæopteris. (See **Asplenium palæopteris.**)		
Asplenites rhomboides Hector.		
1880. *Asplenites thornboides.* Hector, App. Off. Cat. S.E., p. 48	Jurassic	..
1886. *Asplenites rhomboides.* Hector, Cat. Ind. Col. Exh., pp. 13, 65, f. 30, No. 1 ..	Clent Hills, Catlin's River	D.M.; holotype.
Asplenium hochstetteri. (See **Polypodium hochstetteri.**)		
Asplenium palæo-darea Ettingshausen (MS.).		
1887. *Asplenium palæo-darea.* Ett. in Haast, T.N.Z.I., vol. 19, p. 450	Clent Hills	..
1887. ,, Ett., Denkschr. d. math-wiss cl. d. k. Akad., vol. 53, p. 7	Malvern Hills	..
Asplenium palæopteris Unger.		
1864. *Asplenium palæopteris.* Unger, Nov. Pal., pp. 3–5, taf. 1, f. 4–8	Coast between Waikato mouth and Whaingaroa Harbour	V.M.; syntypes.
1878. *Asplenites palæopteris.* Hector, Prog. Rep., vol. 11, p. viii	Mataura Series and Waikato Head	..
1880. ,, Hector, App. Off. Cat. S.E., p. 48	Jurassic	..
1886. ,, Hector, Cat. Ind. Col. Exh., p. 66, f. 30A, No. 10 ..	Waikawa	D.M.; plesiotype, Waikawa.
1886. *Asplenium palæopteris.* Hector, Cat. Ind. Col. Exh., p. 32, f. 30A, No. 10 ..	Waikato Heads	C.M.; 1 specimen (? Ett.), Port Waikato.

* The abbreviation "Denkschr. d. math-wiss. cl. d. k. Akad." should be changed to "Denkschr. k. Akad. Wissensch. Wien" in all cases, in accordance with the list of the Geological Society (see page 7).

Asplenium ungeri Ettingshausen (MS.).		
1887. *Asplenium ungeri.* Ett. in Haast, T.N.Z.I., vol. 19, p. 451	Mataura and Waikawa	
Asterophylites clentii Hector (MS.).		
1880. *Asterophylites clentii.* Hector, App. Off. Cat. S.E., p. 47	Permian	
1886. ,, Hector, Cat. Ind. Col. Exh., p. 32	Clent Hills	
Baiera australis Ettingshausen (MS.).		
1887. *Baiera australis.* Ett., Denkschr. d. math-wiss. cl. d. k. Akad., vol. 53, p. 7	Clent Hills	
Camptopteris haasti Ettingshausen (MS.).		
1887. *Camptopteris haastii.* Ett., Denkschr. math-wiss. cl. d. k. Akad., vol. 53, p. 7	Clent Hills	C.M.; 4 chirotypes.
Camptopteris incisa Hector.		
1880. *Camptopteris incisa.* Hector, App. Off. Cat. S.E., p. 48	Jurassic	
1886. ,, Hector, Cat. Ind. Col. Exh., pp. 31, 66, f. 30A, No. 8	Clent Hills, Mataura	D.M.; holotype, Clent Hills.
Camptopteris novæ-zealandiæ Hector (MS.).		
1878. *Camptopteris novæ zealandiæ.* Hector, Prog. Rep., vol. xi, p. viii	Flag Hill Series, Hokanui Hills	
1879. *Camptopteris novæ-zealandiæ.* Hector, T.N.Z.I., vol. 11, p. 536	Flag Hill Series	
Camptoteris novæ-zealandiæ McCoy (MS.).		
1886. *Camptopteris novæ-zealandiæ.* McCoy in Hector, Prog. Rep., vol. 17, p. 21	Fern Gully, Mount Rowley, Upper Ashburton	
Cladophebis denticulata (Brogniart).		
1907. *Cladophebis denticulata.* Kidston and Gwynne-Vaughan, Trans. Roy. Soc. Edin., vol. 45, p. 759	Jurassic rocks, near Gore	Plesiotype, Edinburgh.
Cyperites wiwi Hector (MS.).		
1880. *Cyperites wiwi.* Hector, App. Off. Cat. S.E., p. 49	Jurassic	
Damnara fossilis Unger.		
1864. *Damnara fossilis.* Unger, Nov. Pal., pp. 12, 13	Richmond (Trias.)	V.M.; syntypes.
1880. *Damnarites fossilis.* Hector, App. Off. Cat. S.E., p. 48	Triassic	
Damnarites fossilis. (See **Damnara fossilis.**)		
Dictyophyllum huttonianum Crié (MS.).		
1888. *Dictyophyllum huttonianum.* Crié, C.R. Acad. Sci. Paris, vol. 107, p. 1014	Clent Hills, Wairoa Gorge, Mataura	
Equisetum microdon Ettingshausen (MS.).		
1887. *Equisetum microdon.* Ett., Denkschr. d. math-wiss. cl. d. k. Akad., vol. 53, p. 7	Mount Potts, Clent Hills	Chirotypes: C.M.—Mount Potts, 1; Clent Hills, 2; Malvern Hills, 2. O.M.—Waikawa, 1.
Gleichenia waitia Hector (MS.).		
1886. *Gleichenia waitia.* Hector, Cat. Ind. Col. Exh., p. 31	Eighty-eight Valley, Nelson	
Glossopteris angustifolia (McCoy).		
1878. *Glossopteris augustifolia.* Hector, Prog. Rep., vol. 11, p. iv	Mount Potts	
Glossopteris haastii Hector (MS.).		
1880. *Glossopteris haastii.* Hector, App. Off. Cat. S.E., p. 47	Triassic; Permian	
1886. ,, Hector, Cat. Ind. Col. Exh., p. 31	Mount Potts	
Hymenophyllites australis Ettingshausen (MS.).		
1887. *Hymenophyllites australis.* Ett., Denkschr. d. math-wiss. cl. d. k. Akad., vol. 53, p. 7	Mataura and Waikawa	
Lomarites pectinata Hector.		
1878. *Lomarites pectinata.* Hector, Prog. Rep., vol. 11, p. viii	Mataura Series, Hokanui Hills, and Waikato Head	
1880. ,, Hector, App. Off. Cat. S.E., p. 48	Jurassic	
1886. ,, Hector, Cat. Ind. Col. Exh., pp. 32, 66, f. 30A, No. 5	Mataura Falls, Clent Hills, Waikato Heads	D.M.; holotype, Mataura Falls.

VI. Permo-Jurassic Plant Fossils—*continued.*

—	Locality or Horizon.	Location of Specimens.
Lycopodites palæo-selaginella Ettingshausen (MS.).		
1887. *Lycopodites palæo-selaginella.* Ett., Denkschr. d. math-wiss. cl. d. k. Akad., vol. 53, p. 7	Mataura and Waikawa	
Macrotæniopteris affinis Ettingshausen (MS.).		
1887. *Macrotæniopteris affinis.* Ett., Denkschr. d. math-wiss. cl. d. k. Akad., vol. 53, p. 7	Mataura and Waikawa	Chirotypes: C.M. — Mataura, 3. O.M.—Mataura, 1; Waikawa, 1.
Macrotæniopteris lata Morris and Oldham.		
1878. *Macrotæniopteris lata.* Hector, Prog. Rep., vol. 11, p. viii	Waikawa, Mataura Falls, Flag Hill Series, Hokanui Hills	
1879. ,, Hector, Handbook of N.Z., p. 23	Flag Hill Series	
1879. ,, Hector, T.N.Z.I., vol. 11, p. 536	,,	
1880. ,, Hector, Journ. Roy. Soc. N.S.W., vol. 13, p. 74	(?) Putataka Series	
1880. ,, Hector, App. Off. Cat. S.E., p. 48	Jurassic	
1880. ,, Hector, Handbook of N.Z. (2nd ed.), p. 24	Mataura Series, Waikawa, and Mataura Falls	
1881. ,, Hector, Prog. Rep., vol. 13, p. xv	Mataura River	
1886. ,, Hector, Cat. Ind. Col. Exh., p. 66, f. 30A, No. 4	Mataura Falls	D.M.; plesiotype.
1887. ,, Park, R.G.E., vol. 18, pp. 150, 153	Waikawa	C.M.; 1 specimen, Mataura.
Macrotæniopteris zeelandica Crié (MS.).		
1888. *Macrotæniopteris zeelandica.* Crié, C.R. Acad. Sci. Paris, vol. 107, p. 1014	Clent Hills, Wairoa Gorge, Mataura	
Neuropteris stricta Hector (MS.).		
1878. *Neuropteris stricta.* Hector, Prog. Rep., vol. 11, p. viii	Flag Hill Series, Hokanui Hills	
1879. ,, Hector, T.N.Z.I., vol. 11, p. 536	Flag Hill Series	
1880. ,, Hector, App. Off. Cat. S.E., p. 48	Jurassic	
Nicolia zelandica Unger.		
1864. *Nicolia zelandica.* Unger, Nov. Pal., p. 13, taf. 5, f. 2, *a*, *b*	(Tertiary)	
1880. *Nicolia zealandica.* Hector, App. Off. Cat. S.E., p. 48	Jurassic	
Nillsonia zealandica Ettingshausen (MS.).		
1887. *Nillsonia zealandica.* Ett., Denkschr. d. math-wiss. cl. d. k. Akad., vol. 53, p. 7	Mataura and Waikawa	Chirotypes: O.M.—Mataura, 1.
Noeggerathia valida Hector (MS.).		
1886. *Noeggerathia valida.* Hector, Cat. Ind. Col. Exh., p. 31	Eighty-eight Valley, Nelson	
Oleandridum distans Hector (MS.).		
1880. *Oleandridum distans.* Hector, App. Off. Cat. S.E., p. 48	Jurassic	
Oleandridum huttoni Hector (MS.).		
1878. *Oleandridum huttoni.* Hector, Prog. Rep., vol. 11, p. viii	Mataura Series and Waikato Head	
1880. ,, Hector, App. Off. Cat. S.E., p. 48	Jurassic	
Oleandridum matauriense Hector (MS.).		
1880. *Oleandridum matauriense.* Hector, App. Off. Cat. S.E., p. 48	Jurassic	
Oleandridum obtusatum Hector (MS.).		
1880. *Oleandridum obtusatum.* Hector, App. Off. Cat. S.E., p. 48	Jurassic	
Oleandridum stipulatum Hector (MS.).		
1880. *Oleandridum stipulatum.* Hector, App. Off. Cat. S.E., p. 48	Jurassic	

Oleandridum tæniopteroide Hector (MS.).		
1880. *Oleandridum tæniopteroide.* Hector, App. Off. Cat. S.E., p. 48	Jurassic	..
Oleandridum tetranerve Hector (MS.).		
1880. *Oleandridum tetranerve.* Hector, App. Off. Cat. S.E., p. 48	Jurassic	..
Oleandridum vittatum.		
1878. *Oleandridum vittatum* var. Hector, Prog. Rep., vol. 11, p. viii	Flag Hill Series, Hokanui Hills, Mataura, Waikawa, and Clent Hills	..
1879. „ Hector, T.N.Z.I., vol. 11, p. 536	Flag Hill Series	..
Osmundites dunlopi Kidston and Gwynne-Vaughan.		
1907. *Osmundites dunlopi.* Kidston and Gwynne-Vaughan, Trans. Roy. Soc. Edin., vol. 45, pp. 759–63, 766–68, pls. 1–3, f. 1–16	Jurassic rocks, near Gore	Holotype, Edinburgh; paratype, B.M.
Osmundites gibbiana Kidston and Gwynne-Vaughan.		
1907. *Osmundites gibbiana.* Kidston and Gwynne-Vaughan, Trans. Roy. Soc. Edin., vol. 45, pp. 763–68, pl. 3, f. 17–19, and pl. 4, f. 20	Jurassic rocks, near Gore	Holotype, Edinburgh.
Palæozamia matauriensis Hector (MS.).		
1878. *Palæozamia matauriensis.* Hector, Prog. Rep., vol. 11, p. viii	Flag Hill Series, Hokanui Hills, Waikawa, Mataura, Clent Hills	..
1879. „ Hector, T.N.Z.I., vol. 11, p. 536	Flag Hill Series	..
1880. „ Hector, App. Off. Cat. S.E., p. 49	Jurassic	..
1886. „ Hector, Cat. Ind. Col. Exh., p. 32	Mataura	..
Palissya australis Crié (MS.).		
1888. *Palissya australis.* Crié, C.R. Acad. Sci. Paris, vol. 107, p. 1014	Clent Hills, Wairoa Gorge, Mataura	..
Palissya podocarpioides Ettingshausen (MS.).		
1887. *Palissya podocarpioides.* Ett., Denkschr. math-wiss. cl. d. k. Akad., vol. 53, p. 7	Mount Potts, Clent Hills	Chirotypes: C.M.—Mount Potts, 4; Clent Hills, 4; (?), 2.
Pecopteris acuta Hector.		
1880. *Pecopteris acuta.* Hector, App. Off. Cat. S.E., p. 48	Jurassic	..
1886. „ Hector, Cat. Ind. Col. Exh., p. 65, f. 30, No. 2	Clent Hills	D.M.; holotype.
Pecopteris distans Hector (MS.).		
1870. *Pecopteris distans.* Hector, Cat. Col. Mus., pp. 199, 200	Mataura Falls, Waikawa	..
Pecopteris gracilis Hector (MS.).		
1870. *Pecopteris gracilis.* Hector, Cat. Col. Mus., p. 200	Waikawa	..
1880. „ Hector, App. Off. Cat. S.E., p. 48	Jurassic	..
Pecopteris grandis Hector.		
1870. *Pecopteris grandis.* Hector, Cat. Col. Mus., p. 200	Waikawa	..
1880. „ Hector, App. Off. Cat. S.E., p. 48	Jurassic	..
1886. „ Hector, Cat. Ind. Col. Exh., pp. 31, 66, f. 30A, No. 3 ..	Waikawa, Waikato Heads, Mataura	D.M.; holotype, Waikawa; paratype, Waikato South Head.
1887. „ Park, R.G.E., vol. 18, pp. 143, 145, 150, 153	Coal Creek, McRae's, Lora, Hokanui Hills; Mataura River, 1½ miles below Gore; Waikawa	..
Pecopteris haastii Hector (MS.).		
1880. *Pecopteris haastii.* Hector, App. Off. Cat. S.E., p. 48	Jurassic	..
1886. „ Hector, Cat. Ind. Col. Exh., p. 31	Clent Hills, Mataura	..
Pecopteris hochstetteri. (See **Polypodum hochstetteri.**)		
Pecopteris linearis Hector.		
1878. *Pecopteris linearis.* Hector, Prog. Rep., vol. 11, p. viii	Flag Hill Series, Hokanui Hills	..
1880. „ Hector, App. Off. Cat. S.E., p. 48	Jurassic	..
1886. „ Hector, Cat. Ind. Col. Exh., pp. 31, 65, f. 30, No. 3 ..	Clent Hills, Waikawa	D.M.; holotype, Clent Hills.

VI. Permo-Jurassic Plant Fossils—*continued.*

	Locality or Horizon.	Location of Specimens.
Pecopteris lingulatus Hector (MS.).		
1870. *Pecopteris lingulatus.* Hector, Cat. Col. Mus., pp. 199, 200	Mataura, Waikawa	..
Pecopteris obliqua Hector (MS.).		
1880. *Pecopteris obliqua.* Hector, App. Off. Cat. S.E., p. 48	Jurassic	..
1886. ,, Hector, Cat. Ind. Col. Exh., p. 31	Waikato Heads	..
Pecopteris oblongis Hector (MS.).		
1880. *Pecopteris oblongis.* Hector, App. Off. Cat. S.E., p. 48	Jurassic	..
Pecopteris obtusata Hector.		
1886. *Pecopteris obtusata.* Hector, Cat. Ind. Col. Mus., p. 66, f. 30A, No. 1 ..	Clent Hills	D.M.; holotype.
1887. *Pecopteris* cf. *obtusata.* Park, R.G.E., vol. 18, p. 143	Coal Creek, Otapiri	..
Pecopteris ovata Hector.		
1878. *Pecopteris ovatus.* Hector, Prog. Rep., vol. 11, p. viii	Flag Hill Series, Hokanui Hills	..
1880. *Pecopteris ovata.* Hector, App. Off. Cat. S.E., p. 48	Jurassic	..
1886. ,, Hector, Cat. Ind. Col. Exh., pp. 31, 65, f. 30, No. 6 ..	Clent Hills, (Trelissic basin), Mataura, Waikato Heads	D.M.; holotype, Clent Hills, and paratype, Waikato South Head.
Pecopteris proxima Ettingshausen (MS.).		
1887. *Pecopteris proxima.* Ett., Denkschr. d. math-wiss. cl. d. k. Akad., vol. 53, p. 7	Clent Hills and Malvern Hills	..
Pecopteris serrata Hector (MS.).		
1870. *Pecopteris serratus.* Hector, Cat. Col. Mus., p. 199	Mataura	..
Pecopteris stricta Hector (MS.).		
1880. *Pecopteris stricta.* Hector, App. Off. Cat. S.E., p. 48	Jurassic	..
Pisoniaphyllites novæ-zealandiæ Hector (MS.).		
1880. *Pisoniaphyllites novæ zealandiæ.* Hector, App. Off. Cat. S.E., p. 49 ..	Cretaceo-Tertiary to Jurassic	..
Podozamites malvernicus Ettingshausen (MS.).		
1887. *Podozamites malvernicus.* Ett., Denkschr. d. math-wiss. cl. d. k. Akad., vol. 53, p. 7	Malvern Hills	C.M.; 3 chirotypes.
1888. *Podozamites malverianus.* Crié, C.R. Acad. Sci. Paris, vol. 107, p. 1014 ..	Mataura	..
Polypodum hochstetteri Unger.		
1864. *Polypodum hochstetteri.* Unger, Nov. Pal., pp. 5, 6, taf. 2, f. 1, 2	South of mouth of River Waikato	V.M.
1870. *Polypodum* (*Pecopteris*) *hochstetteri.* Hector, Cat. Col. Mus., pp. 199–201 ..	Mataura, Waikawa, (Pakawau), Waikato South Head, Malvern Hills	D.M.; 1 plesiotype, Waikato South Head.
1877. *Polypodum hochstetteri.* Hutton, R.G.E., vol. 8, p. 36	Cairn Range and Flagpole Hill, Malvern Hills ..	..
1880. *Pecopteris hochstetteri.* Hector, App. Off. Cat. S.E., p. 48	Lower Greensand, Jurassic	..
1886. ,, Hector, Cat. Ind. Col. Exh., p. 31	Waikawa, Mataura, Waikato Heads	..
1887. *Asplenium hochstetteri.* Ett., Denkschr. d. math-wiss. cl. d. k. Akad., vol. 53, p. 7	Mount Potts, Clent Hills, Malvern Hills, Mataura, Waikawa	Plesiotypes: C.M.—Clent Hills, 10; Malvern Hills, 4; Mataura, 2. O.M.—Waikawa, 30; Mataura, 5.
(*Cf.* also *Alethopteris hochstetteri.*)		
Protocladus lingua Ettingshausen (MS.).		
1887. *Protocladus lingua.* Ett., Denkschr. d. math-wiss. cl. d. k. Akad., vol. 53, p. 7	Malvern Hills	..
Psaronius mataurensis Crié (MS.).		
1888. *Psaronius mataurensis.* Crié, C.R. Acad. Sci. Paris, vol. 107, p. 1014 ..	Clent Hills, Wairoa Gorge, Mataura ..	..

Pterophyllum dieffenbachi Ettingshausen (MS.).		
1887. *Pterophyllum dieffenbachi.* Ett., Denkschr. d. math-wiss. cl. d. k. Akad., vol. 53, p. 7	Mataura, Waikawa	..
1888. ,, Crié, C.R. Acad. Sci. Paris, vol. 107, p. 1014 ..	Mataura	..
Pterophyllum grandis Hector (MS.).		
1886. *Pterophyllum grandis.* Hector, Cat. Ind. Col. Exh., p. 32..	Clent Hills	..
Pterophyllum matauriensis Hector.		
1886. *Pterophyllum matauriensis.* Hector, Cat. Ind. Col. Exh., p. 66, f. 30A, No. 7	Mataura Falls	D.M.; holotype and paratypes. C.M.; 1 specimen, Mataura (paratype of Hector).
Sphenopteris amissa Ettingshausen (MS.).		
1887. *Sphenopteris amissa.* Ett., Denkschr. d. math-wiss. cl. d. k. Akad., vol. 53, p. 7	Clent Hills	..
Sphenopteris asplenoides Hector.		
1880. *Sphenopteris asplenoides.* Hector, App. Off. Cat. S.E., p. 48	Jurassic	..
1886. ,, Hector, Cat. Ind. Col. Exh., pp. 32, 66, f. 30A, No. 9	Mataura Falls, Waikawa	C.M.; 2 specimens (? paratypes of Hector).
Sphenopteris clentiana Ettingshausen (MS.).		
1887. *Sphenopteris clentiana.* Ett., Denkschr. d. math-wiss. cl. d. k. Akad., vol. 53, p. 7	Clent Hills	..
Sphenopteris lomaroides Hector (MS.).		
1880. *Sphenopteris lomaroides.* Hector, App. Off. Cat. S.E., p. 48	Jurassic	..
Tæniopteris daintreei McCoy.		
1875. *Tæniopteris daintreei.* McCoy, Prodr. Palæ. Vict., dec. 2, pp. 15, 16, pl. 14, f. 1, 1*a*, 2	Cape Patterson, Victoria	..
1886. ,, McCoy in Hector, Prog. Rep., vol. 17, p. xxi ..	Fern Gully, Mount Rowley	..
Tæniopteris graminea Hector (MS.).		
1870. *Tæniopteris gramineus.* Hector, Cat. Col. Mus., pp. 199, 200	Mataura Falls, Waikawa	D.M.; chirotype, Waikato South Head.
1886. *Tæniopteris graminea.* Hector, Cat. Ind. Col. Exh., p. 31	Waikato Heads	..
Tæniopteris huttoni Hector (MS.).		
1886. *Tæniopteris huttoni.* Hector, Cat. Ind. Col. Exh., p. 31	Waikawa, Waikato Heads	D.M.; chirotype, Waikato South Head.
Tæniopteris linearis Hector (MS.).		
1870. *Tæniopteris linearis.* Hector, Cat. Col. Mus., pp. 199–201	Mataura, Waikawa, Waikato South Head ..	..
Tæniopteris lomariopsis Ettingshausen (MS.).		
1887. *Tæniopteris lomariopsis.* Ett., Denkschr. d. math-wiss. cl. d. k. Akad., vol. 53, p. 7	Malvern Hills, Mataura, Waikawa	Chirotypes: C.M.—Malvern Hills, 3; Mataura, 1; Clent Hills, 1. O.M.—Waikawa, 3.
Tæniopteris matauriensis Hector (MS.).		
1886. *Tæniopteris matauriensis.* Hector, Cat. Ind. Col. Exh., p. 31	Mataura	..
Tæniopteris obtusatus Hector (MS.).		
1870. *Tæniopteris obtusatus.* Hector, Cat. Col. Mus., p. 199	Mataura Falls	..
1886. ,, Hector, Cat. Ind. Col. Exh., p. 31	Mataura, Clent Hills, Waikato Heads ..	..
Tæniopteris pseudo-simplex Ettingshausen (MS.).		
1887. *Tæniopteris pseudo-simplex.* Ett., Denkschr. d. math-wiss. cl. d. k. Akad., vol. 53, p. 7	Clent Hills, Mataura, Waikawa	C.M.; chirotypes, Clent Hills, 4.
Tæniopteris pseudo-vittata Ettingshausen (MS.).		
1887. *Tæniopteris pseudo-vittata.* Ett., Denkschr. d. math-wiss. cl. d. k. Akad., vol. 53, p. 7	Mount Potts	Chirotypes: C.M.—Mount Potts, 2; Clent Hills, 5. O.M.—Waikawa, 1.

VI. Permo-Jurassic Plant Fossils—*continued.*

—	Locality or Horizon.	Location of Specimens.
Tæniopteris robustus Hector (MS.).		
1870. *Tæniopteris robustus.* Hector, Cat. Col. Mus., p. 199	Mataura Falls	..
Tæniopteris stipulata Hector.		
1886. *Tæniopteris stipulata.* Hector, Cat. Ind. Col. Exh., pp. 31, 61, f. 24A, No. 3	Waikawa, (Pakawau)	..
1887. „ Park, R.G.E., vol. 18, pp. 149, 150	Waikawa	..
Tæniopteris tetranervis Hector (MS.).		
1886. *Tæniopteris tetranervis.* Hector, Cat. Ind. Col. Exh., p. 31	Waikato Heads	..
Taxites kahikatea Hector.		
1880. *Taxites kahikatea.* Hector, App. Off. Cat. S.E., p. 48	Cretaceo-Tertiary to Jurassic	..
1886. „ Hector, Cat. Ind. Col. Exh., pp. 31, 66, f. 30A, No. 11	Mataura Falls	D.M.; holotype.
Taxites manawao Hector.		
1880. *Taxites manoao.* Hector, App. Off. Cat. S.E., p. 48	Jurassic	..
1886. *Taxites manawao.* Hector, Cat. Ind. Col. Exh., pp. 31, 66, f. 30A, Nos. 2, 6 ..	Waikawa, Mataura Falls	D.M.; 2 syntypes.
Taxites matai Hector.		
1880. *Taxites matai.* Hector, App. Off. Cat. S.E., p. 48	Cretaceo-Tertiary	..
1886. *Taxites maitai.* Hector, Cat. Ind. Col. Exh., p. 61, f. 24A, No. 12.. ..	Shag Point	..
1886. „ Hector, Cat. Ind. Col. Exh., p. 65, f. 30, No. 5 ..	Clent Hills	D.M.; syntype.
Taxites miro Hector (MS.).		
1880. *Taxites miro.* Hector, App. Off. Cat. S.E., p. 48..	Cretaceo-Tertiary to Jurassic	..
1886. „ Hector, Cat. Ind. Col. Exh., p. 31	Clent Hills	..
Taxites totara Hector (MS.).		
1880. *Taxites totara.* Hector, App. Off. Cat. S.E., p. 48	Jurassic	..
1886. „ Hector, Cat. Ind. Col. Exh., p. 31	Waikato Heads	..
Taxites totaranui Hector (MS.).		
1886. *Taxites totaranui.* Hector, Cat. Ind. Col. Exh., p. 31	Waikato Heads	..
Thinnfeldia australis Ettingshausen (MS.).		
1887. *Thinnfeldia australis.* Ett., Denkschr. d. math-wiss, cl. d. k. Akad., vol. 53, p. 7	Mount Potts	C.M.; chirotypes—Mount Potts, 3; Clent Hills, 3.
Tympanorphora paradoxus Brogan.		
1880. *Zympanophora paradoxus.* Hector, App. Off. Cat. S.E., p. 47	Jurassic	..
1886. *Tympanophora paradoxus.* Hector, Cat. Ind. Col. Exh., p. 32	Waikato Heads	..
Vertebraria novæ-zealandiæ Hector.		
1886. *Vertebraria novæ-zealandiæ.* Hector, Cat. Ind. Col. Exh., p. 65, f. 30, No. 4..	Clent Hills	D.M.; holotype.
Zamites etheridgei Crié (MS.).		
1888. *Zamites etheridgei.* Crié, C.R. Acad. Sci. Paris, vol. 107, p. 1014.. ..	Clent Hills, Wairoa Gorge, Mataura	..
Zamites mataurensis Ettingshausen (MS.).		
1887. *Zamites mataurensis.* Ett., Denkschr. d. math-wiss. cl. d. k. Akad., vol. 53, p. 7	Mataura, Waikawa	C.M.; chirotypes, Mataura, 1.
Zympanophora paradoxus. (See **Tympanophora.**)		

CHAPTER VI.

THE GENOTYPES OF RASTELLIGERA, PSIOIDEA, AND CLAVIGERA.

In a paper read before the Wellington Philosophical Society in 1878 Hector proposed three new genera of *Brachiopoda—Rastelligera*, *Psioidea*, and *Clavigera*. This paper was published the following year in abstract, with the remark that it would appear in the reports of the Geological Survey Department.* Under the title of "Contributions to New Zealand Palæontology: 2—*Brachiopoda*," the full paper was again referred to in 1880,† with the statement that it was partly prepared for publication. Unfortunately, it never appeared. Hector's genera have not been accepted outside New Zealand, nor by New Zealand workers with the exception of Hector's assistants on the Survey—viz., Cox, McKay, and Park.

It is, of course, quite possible and probable that the fossils on which the new genera were based will be found to belong to genera already established. The writer has not had time to study this point fully, nor would it be an easy matter to decide in the present state of New Zealand libraries. In case it is found that new genera are needed, it is desirable to know exactly where Hector's proposals stand.

So far as the definition of the characters of the proposed genera is concerned, Hector's work is fairly satisfactory. It is true that the genera of the *Spiriferacea* are based mainly on the characters of the spiralia, while Hector relied mainly on the characters of the hinge and the external form; but on the principle of correlation of parts his *differentia* may be found to be sufficient. His failure lay in neglecting to name, describe, and figure any species, without which it is, of course, impossible to constitute a genus. It is, however, possible to supply this deficiency from the manuscript material at our disposal.

Hector was at all times ready to apply manuscript names to new species, and there is evidence that he did so in this case. *Clavigera* and *Rastelligera* appear to be based on specimens from the Hokanui Hills,‡ for the first notices of them appear in remarks on the collections made by Cox and McKay in 1878.§ Cox speaks of "the comb-toothed Spirifers" (*Rastelligera*) in Bed 41, "grits," Otapiri Series. Hector mentions "an *Athyris*-like shell belonging to a new subgenus *Clavigera*" in the Bastion Series, "*Clavigera* with seven species" and "*Rastelligera* with five species" in the Otapiri Series, and "the earliest appearance of *Clavigera* and *Rastelligera*" in the Wairoa Series. The first locality mentioned for *Psioidea* is in Beds 33 and 34 (*Psioidea* Beds), Oreti Series, Nelson, in which two species are stated to occur, while *Clavigera*, *Rastelligera*, and *Psioidea* are mentioned in the overlying Otapiri Series.||

Two manuscript names were published in 1881, when McKay cited *Rastelligera taylori* Hector and *Clavigera tumida* Hector in beds of the Otapiri Series, south slope of hill, east bank of the Mataura River, one mile and a half from Gore. It does not appear clearly whether these are new names applied to fossils from this locality, or identifications of earlier-named species.¶ It is only in the latter case, which seems most probable, that these species can be of value as genosyntypes. There seems, however, to be no collection preserved from this locality, although it should be easy to collect topotypes.

* "On the Fossil *Brachiopoda* of New Zealand." T.N.Z.I., vol. 11, pp. 537–39 (1879).

† 15th Ann. Rep. Col. Mus. and Lab., p. 11.

‡ Mr. McKay, however, informs me that he has always considered a specimen from Nugget Point as the "type" of *Rastelligera*.

§ Cox, S. H.: "Report on the Geology of the Hokanui Ranges, Southland," R.G.E., vol. 11, pp. 25–48 (1878). McKay, A.: "Notes on the Sections and Collections of Fossils obtained in the Hokanui District," R.G.E., vol. 11, pp. 49–90. Hector, J.: Prog. Rep., vol. 11, pp. vi–xii (1878.)

|| Hector, J.: Prog. Rep., vol. 12, p. 11 (1879).

¶ The name *taylori* suggests Taylor's Creek or Crossing, in the Hokanui Hills.

In 1886 Hector published figures of two species of *Clavigera*, and of one species each of *Rastelligera* and *Psioidea*, but without giving specific names.* This is as far as the published evidence will take us.

The manuscript material consists of the printed but unpublished plates of *Brachiopoda* already referred to in the historical section (*ante*, p. 12). These plates are now issued in this bulletin. Plate I is labelled *Clavigera*, and contains ten figures; Plate II is labelled—1–4 *Spiriferina*, 5–9 *Rastelligera;* Plate III is labelled—1–5 *Spiriferina*, 6–7 *Epithyris;* Plate IV is labelled—8–11 *Athyris*, 12 *Spiriferina*, but 13 is not labelled. That fig. 13, Plate IV, should be referred to *Psioidea* is evident from a comparison with the figure published in 1876. Some years ago Messrs. A. Hamilton and A. McKay worked through these plates, and labelled such figures as Mr. McKay was sure of. Thus we have,—

- *Clavigera bisulcata* Hector (MS.) (*fide* McKay). Fig. 1, Plate I.
- *Clavigera cuneiformis* Hector (MS.) (*fide* McKay). Figs. 2, 2*a*, Plate I; and fig. 40, No. 3, Cat. Ind. Col. Exh.
- *Clavigera gracilis* Hector (MS.) (*fide* McKay). Fig. 3, Plate I; and fig. 40, No. 2, Cat. Ind. Col. Exh.
- *Clavigera tumida* Hector (MS.) (*fide* McKay). Fig. 5, Plate I.
- *Clavigera* spp. innom. Figs. 4, 7, Plate I.
- *Rastelligera elongata* Hector (MS.) (*fide* McKay). Fig. 8, Plate II.
- *Rastelligera* sp. innom. Fig. 6, Plate II (perhaps the same as fig. 40, No. 1, Cat. Ind. Col. Exh.).
- *Rastelligera* spp. innom. Figs. 5, 7, 9, Plate II.
- *Psioidea* sp. innom. Figs. 13, *a–d*, Plate IV (probably the original of fig. 41, No. 1, Cat. Col. Ind. Exh.).

There is, further, in the Geological Survey collections a series of *Brachiopoda* in trays arranged according to species. Amongst them are the following:—

- *Clavigera:* 9 species, 69 specimens, from 15 localities.
- *Rastelligera:* 5 species, 54 specimens, from 9 localities.
- *Psioidea:* 10 species,† 54 specimens, from 10 localities.

The species are labelled "No. 1," "No. 2," &c., without specific names, with the exception of 10 specimens from the Baton River, labelled "*Psioidea cuspidatus*." It is possible to identify the specimens from which some of the figures were made, and, by means of the locality numbers, to fix their locality.

The chirotype of *C. bisulcata* comes from loc. 371, "Benmore sandstone, Benmore railway-cutting, Southland (Rhætic)," and was collected by McKay in 1878. The chirotype of *C. cuneiformis* comes from loc. 366, "Blue sandstone and chert, main branch of Taylor's Creek, Hokanui Hills, Southland (Rhætic)," and was also collected by McKay in 1878. The chirotype of *C. gracilis* comes from loc. 371, "Benmore sandstone, Benmore railway-cutting, Southland (Rhætic)": it consists not only of the figured internal cast, but also of part of an external cast. The chirotype of *C. tumida* also comes from loc. 371. It is quite probable that *C. bisulcata*, *C. gracilis*, and *C. tumida* are synonyms, in which case the last should take precedence as being the only previously published name. The chirotype of *R. elongata* cannot be so certainly identified. It is probably a specimen from loc. 368, "*Trigonia* Beds, slopes of southern peak of Benmore, Hokanui Hills, Southland (Rhætic)," collected by McKay in 1878. The chirotype of the unnamed species of *Psioidea* has not been identified with certainty.

Should it be found that the proposed genera are really new, genolectotypes may be chosen from the above species. Preference should, perhaps, be given to the species figured in the "Catalogue of the Indian and Colonial Exhibition" (1886). These are *Clavigera cuneiformis*, *Clavigera gracilis*, *Rastelligera* sp. innom., and *Psioidea* sp. innom.

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* Cat. Ind. Col. Exh., p. 70, f. 40, Nos. 1, 2, and 3; p. 73, f. 41, No. 1.

† Numbered sp. 1 to 11, but No. 6 is missing.

CHAPTER VII.

BIBLIOGRAPHY.

The following list of papers includes not only those in which fossils are named, described, or figured, but also those that deal with the geology of districts from which fossils have been collected. By a reference to the indexes it is possible to find easily all papers written by a given author and the most important papers dealing with any given locality. Several references not given in the bibliographies of Hamilton, Wilckens, and Park are included, but it cannot be claimed that the list is complete. There are no doubt many Continental references to New Zealand fossils, particularly to those in the Vienna Museum, that have not yet been found by bibliographers of New Zealand geology.

Papers in which descriptions, figures, or new names of fossils are included are marked with an asterisk.

1841.

Dieffenbach, E. "An Account of the Chatham Islands." Journ. Roy. Geog. Soc., vol. 11, pp. 195–215. (Records the occurrence of fossiliferous strata.)

1843.

Gray, J. E. "On the Fossil Shells from New Zealand." In Dieffenbach, E.: "Travels in New Zealand." Vol. 2, pp. 258 and 296. London, 1843. (Genera only, East Cape, Chatham Islands, Parengarenga, Kawia, Waingaroa.)

1845.

Dieffenbach, E. "On the Geology of New Zealand." Rep. Brit. Assoc. Trans., p. 50. (Tertiary. Genera only.)

1848.

Mantell, G. A. "On the Fossil Remains of Birds collected in various Parts of New Zealand by Mr. Walter Mantell, of Wellington." Q.J.G.S., vol. 4, pp. 225–38.

——— "Additional Remarks on the Geological Position of the Deposits in New Zealand which contain Bones of Birds." *Ibid.*, pp. 238–41. (First mention of beds of the Wanganui System.)

1850.

Forbes, E. "Note on Fossiliferous Deposits in the Middle Island of New Zealand." Q.J.G.S., vol. 6, p. 343. (Genera only. Banks River and Blind Bay; collected by Mr. F. Manse; presented to Museum of Practical Geology, London.)

* Mantell, G. A. "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." *Ibid.*, pp. 319–42, pl. 28, figs. 1–21, and pl. 29, figs. 1–12. (Fossils of Ototara limestone, Onekakara clay, infusorial earth of Taranaki, and Lower Waihora.)

1851.

Mantell, G. A. "Petrifactions and their Teachings; or, A Handbook to the Gallery of Organic Remains of the British Museum." London, 1851. ("The Geology of New Zealand," pp. 96–98, from the observations of W. Mantell. Refers to fossiliferous rocks at Kakanui, Onekakara, and the western side of the North Island.)

1855.

Forbes, C. "On the Geology of New Zealand; with Notes on its Carboniferous Deposits." Q.J.G.S., vol. 11, pp. 521–30. (Numerous references to fossiliferous beds associated with the coal-measures at Nelson and elsewhere.)

1858.

Thomson, J. T. "Extracts from a Journal kept during the Performance of a Reconnoissance Survey of the Southern Districts of the Province of Otago, New Zealand." Journ. Roy. Geog. Soc., 1858, pp. 298–332. (Mataura Falls, Waiau Gorge.)

1859.

Haast, J. "Letter to His Honour the Superintendent, Nelson, N.Z." *New Zealand Government Gazette* (Province of Nelson), vol. 8, No. 20, p. 90. (Gives an account of his itinerary. Awatere, &c.)

Hochstetter, F. "Report of a Geological Exploration of the Coalfield in the Drury and Hunua District, in the Province of Auckland." *Auckland Provincial Government Gazette*. vol. 8, No. 2, 29th Jan., 1859, pp. 14–17. (Tertiary.)

——— "Lecture on the Geology of the Province of Auckland, New Zealand." *Ibid.*, No. 14, 8th July, 1859, pp. 87–100. (Jurassic, Upper and Lower Tertiary.)

——— "Lecture on the Geology of the Province of Nelson." *New Zealand Government Gazette* (Province of Nelson), vol. 8, No. 20, pp. 90–103.

——— "Bericht über geologische Untersuchungen in der Provinz Auckland." Sitz. k. Akad. Wissensch. Wien, bd. 27, pp. 123–27. (*Fide* Park.)

* Huxley, T. H. "On a Fossil Bird and a Fossil Cetacean from New Zealand." Q.J.G.S., vol. 15, pp. 670–77; figs. 1, 2, 3, 4, p. 672 (*Palæudyptes antarcticus* and *Phocænopsis mantelli*. Tertiary.)

1860.

* Heaphy, C. "On the Volcanic Country of Auckland, New Zealand; with Notes on Fossils by the Editor (T. R[upert] J[ones])." Q.J.G.S., vol. 17, pp. 242–52. (Specific determinations of *Foraminifera*, Orakei Creek.)

1861.

Haast, J. "Report of a Topographical and Geological Exploration of the Western Districts of the Nelson Province, New Zealand." By authority: Nelson, 1861. Pp. viii, 150. Chap. iii, Geology, pp. 89–124. (Appeared earlier in Zeitsch. deutsch. geol. Gesellsch.) (Fossils in the beds of the West Coast coalfields.)

* Owen, R. "On the Remains of a Plesiosaurian Reptile (*Plesiosaurus australis*) from the Oolitic Formation in the Middle Island of New Zealand." Rep. Brit. Assoc. Trans., pp. 122, 123. (Specimen supplied by J. H. Hood, from the Waipara River.)

1862.

CARPENTER, W. B. "Introduction to the Study of the *Foraminifera*." Ray Society. (*Cassidulina*, p. 198; *Amphistegina*, p. 247: in the "Tertiary of New Zealand.")

HAAST, J. "Notes on the Geology of the Province of Canterbury." *New Zealand Government Gazette* (Province of Canterbury), vol. 9, No. 18, pp. 121–31. (Fern Gully, Mount Rawley (Clent Hills); Fossil Gully, Rangitata River (Mount Potts); Kowai River, Malvern Hills.)

LINDSAY, W. L. "The Place and Power of Natural History in Colonization. Being Portions of a Lecture prepared for and at the Request of the Young Men's Christian Association." Dunedin, 1862. Pp. 29. Also reprinted in the *Edinburgh New Philosophical Journal*, April and July, 1863, and as a separate, Edinburgh, 1863, entitled "The Place and Power of Natural History in Colonization; with Special Reference to Otago (New Zealand)." (A strong plea for the foundation of a museum of natural history and the inauguration of palæontological work.)

TAYLOR, R. "The Geology of New Zealand." *Chapman's New Zealand Monthly Magazine*, vol. 1, pp. 176–83. Auckland. (Fossils in volcanic grit at Hicks Bay and Whangaroa, and at Wanganui.)

——— "The Geological Age of New Zealand." *Ibid.*, pp. 216–25. ("*Carcharius Megalodon*, *Annularia australis*," and *Terebratula* fossil in New Zealand. Deals mainly with distribution of plants and animals and age of the land-surface.) (For book form, see 1867.)

1863.

* COUNT M. "'On the Palæontology of New Zealand.' By Dr. Zittel, Proc. Imp. Geol. Inst., Vienna, 20th January, 1863." Q.J.G.S., vol. 19, 1863, pt. 2 (misc.), p. 20.

HAAST, J. "Reports of the Provincial Geologist on the Coal-measures and Lignitiferous Beds of the River Kowai, Tributary of the River Waimakariri." *New Zealand Government Gazette* (Province of Canterbury), vol. 10, No. 15, 23rd September, 1863, pp. 149–56. (Malvern Hills.)

* HOCHSTETTER, F. VON. "Neu-Seeland." Stuttgart, 1863. 4to. Pp. xx, 555. Also translation by Sauter, E.: "New Zealand"; Stuttgart, 1867; pp. vii, 515. (Contains an historical sketch of New Zealand geology, as well as results of Hochstetter's investigations.)

ZITTEL, K. A. "Beiträge zur Paläntologie von Neuseeland." N.J. f. Min., 1863, pp. 146–59. (*Fide* Wilckens.)

——— "Mitteilung über die von Hochstetter auf Neuseeland gesammelten Versteinerungen." Verh. k.-k. geol. Reichsanst., bd. 13, heft i, pp. 2–3.

1864.

HOCHSTETTER, F. VON, and PETERMANN, A. "The Geology of New Zealand: in Explanation of the Geographical and Topographical Atlas of New Zealand, by Dr. F. von Hochstetter and Dr. A. Petermann, from the Scientific Publications of the Novara Expedition; translated by Dr. C. F. Fischer. Also lectures by Dr. F. Hochstetter delivered in New Zealand." Auckland, 1864. (*Cf.* Hochstetter, 1859; also reprint by the Geological Society of London.)

HAAST, J. "Report on the Geological Survey of the Province of Canterbury." Proc. Prov. Council of Canterbury, session 22, 1864. Christchurch, 1864. Pp. 31. (P. 4: Mount Potts and Clent Hills.)

* Hochstetter, F. von. "Reise der österreichen Fregatte 'Novara' um die Erde." Geol. Th., 1 bd. Wien. 4vo.

Abth. 1. Hochstetter, F. von: "Geologie von Neu-Seeland: Beiträge zur Geologie der Provinzen Auckland und Nelson." Pp. xlvii, 274. Maps and plates.

Abth. 2. Hochstetter, F. von: "Paläontologie von Neu-Seeland: Beiträge zur Kentniss der Fossilen Flora und Fauna der Provinzen Auckland und Nelson." Pp. xxvi, 318; 26 plates.

I. Unger, F.: "Fossile Pflanzenreste." Pp. 1–13, taf. 1–4.

II. Zittel, K. A.: "Fossile Mollusken und Echinodermen." Pp. 15–68, taf. 6–15.

III. Karrer, F.: "Die Foraminiferen-Fauna des tertiären Grünsandsteines der Orakei-Bay bei Auckland." Pp. 69–86, taf. 16.

IV. Stolickza, F.: "Fossile Bryozoen aus dem tertiären Gründsandsteine der Orakei-Bay bei Auckland." Pp. 87–158, taf. 17–20.

V. Stache, G.: "Die Foraminiferen der tertiären Mergel des Whaingaroa-Hafens (Prov. Auckland)." Pp. 159–304, taf. 21–23.

VI. Jaeger, G.: "Bericht über einen fast vollständigen Schädel von *Palapteryx*." Pp. 305–18, taf. 25–26.

1865.

Crawford, J. C. "Essay on the Geology of the North Island of New Zealand." N.Z. Exh., 1865. Dunedin, 1865. Pp. 27.

Hector, J. "On the Geology of Otago, New Zealand." Q.J.G.S., vol. 21, pp. 124–28.

Lindsay, W. L. "On the Tertiary Coals of New Zealand." Proc. Roy. Soc. Edin., pp. 374–80. (Flora of the coal-measures.)

1867.

Hutton, F. W. "Geological Report on the Lower Waikato District." R.G.E., vol. 2, pp. 1–8, with map and sections. (Jurassic and Tertiary.)

Taylor, R. "The Age of New Zealand." Auckland. (Amplified from paper of same name in 1862. Describes a living representative of *Plesiosaurus!*)

1868.

Buchanan, J. "Kaikoura District." R.G.E., vol. 4, pp. 34–41. (Cretaceous and Tertiary. Discovery of Amuri Bluff beds.)

Hector, J. "Taranaki District." Prog. Rep., vol. 4, pp. 2–13. (Older and newer Tertiary. White Cliffs.)

——— "Marlborough and Eastern Nelson." *Ibid.*, pp. 17, 18. (Classification of formations described by Buchanan in same volume.)

——— "Pakawau Coalfield." *Ibid.*, pp. 18–22. (Plant fossils.)

1869.

Hacket, T. R. "Geology of the Okarita District." R.G.E., vol. 5, pp. 8–15. (Annelid in slate near mouth of Omoeroa River, determined as Triassic (Maitai) by Hector.)

Haast, J. "Saurier in der Tertiarformation in Neuseeland." Verh. k.-k. geol. Reichsanst., pp. 350, 351. (*Fide* Wilckens.)

Hector, J. "Mataura District, Otago, and Southland." Prog. Rep., vol. 5, pp. ii–vi. (Mesozoic and Cretaceo-Tertiary. Hokanui Hills; Otapiri Gorge; Morley Creek.)

——— "Waipara District, Canterbury." *Ibid.*, pp. x–xiii.

Hutton, F. W. "Notes to accompany the Map of the East Cape District." *Ibid.*, pp. 7, 8. (Cretaceo-Tertiary and Tertiary.)

1870.

Buchanan, J. "On the Wanganui Beds (Upper Tertiary)." T.N.Z.I., vol. 2, pp. 163–66. (Genera only.)

Cockburn Hood, J. H. "Geological Observations on the Waipara River, New Zealand." Q.J.G.S., vol. 26, pp. 409–13. (Relates the collection of crocodile and other saurian remains, which were sent to England, but were lost in the wreck of the "Matoako.")

Haast, J. "Notes on a Collection of Saurian Remains from the Waipara River, Canterbury, in the Possession of J. H. Cockburn Hood, Esq." T.N.Z.I., vol. 2, pp. 186–89.

——— "On the Geology and Palæontology of the Waipara District." *Ibid.*, p. 420 (abstract). (Printed in full, R.G.E., vol. 6, 1871.)

*Hector, J. "Catalogue of the Colonial Museum, Wellington, New Zealand." Wellington. P. 8vo. Pp. 237. (Fossils, 171–202. Several chironyms.)

——— "On Mining in New Zealand." T.N.Z.I., vol. 2, pp. 360–84. (Buller Coalfield; Cobden limestone.)

*Owen, R. "Notice of some Saurian Fossils discovered by J. H. Hood, Esq., at Waipara, Middle Island, New Zealand." Geol. Mag., vol. 7, pp. 49–53, pl. 3, figs. 1–5. (*Plesiosaurus hoodi* and *P. crassicostatus*. Based on sketches by Hector of specimens in the Colonial Museum.)

Traill, C. "On the Tertiary Series of Oamaru and Moeraki." T.N.Z.I., vol. 2, pp. 166–69. (Genera only.)

1871.

Haast, J. "On the Geology of the Waipara District, Canterbury; with Geological Maps and Sections." R.G.E., vol. 6, pp. 5–19. (Cretaceous and Tertiary.)

——— "Notes on the Geology of the Central Portion of the Southern Alps, including Mount Cook." *Ibid.*, pp. 19–24. (Annelid in moraine of Hochstetter Glacier. References to Clent Hills.)

——— "On the Geology of the Amuri District, in the Provinces of Nelson and Marlborough." *Ibid.*, pp. 25–46. (Culverden beds (Jurassic), Cretaceous and Tertiary.)

Hector, J. "Notes on the Geology of the Hawke's Bay District." *Ibid.*, pp. 158–64. (Tertiary.)

Hutton, F. W. "On the Relative Ages of the Waitemata Series and the Brown Coal Series of Drury and Waikato." T.N.Z.I., vol. 3, pp. 244–49, pl. 27.

1872.

Haast, J. "Report on the Geology of the Malvern Hills, Canterbury." R.G.E., vol. 7, pp. 1–88. (Mesozoic plant fossils and Cretaceous of Malvern Hills; also reference to Mount Potts, Clent Hills, and Curiosity Shop.)

——— "Report on the Coal Deposits of the Ashburton District, Province of Canterbury." *Ibid.*, pp. 141–46. (Tertiary. References to Mount Potts and Clent Hills.)

Hector, J. "Palæontology." 7th Ann. Rep. Col. Mus. Lab., p. 5. (Canterbury, Haast; Chatham Islands and Amuri, Travers.)

* ——— "On the Remains of a Gigantic Penguin (*Palæudyptes antarcticus* Huxley) from the Tertiary Rocks of the West Coast of Nelson." T.N.Z.I., vol. 4, pp. 341–46, pls. 17, 18. (Also lists of Tertiary *Mollusca*.)

Hutton, F. W. "On the Geology of the District of Southland, in the Province of Otago." R.G.E., vol. 7, pp. 96–112. (Map and sections.) (Mesozoic and Tertiary.)

——— "Synopsis of the Younger Formations of New Zealand." *Ibid.*, pp. 182–84 (Gives numbers of Tertiary fossils determined and described in "Catalogue of Tertiary *Mollusca*" and Cretaceous fossils not there enumerated. See also 1873.)

——— "On the Alluvial Deposit of the Lower Waikato and the Formation of Islands by the River." T.N.Z.I., vol. 4, pp. 333–36. (Diatoms.)

1873

HECTOR, J. "Geological Survey." 8th Ann. Rep. Col. Mus. Lab., pp. 6–7. (Fifty plates prepared to illustrate the "Fossil Flora.")

* HUTTON, F. W. "Catalogue of the Tertiary *Mollusca* and *Echinodermata* of New Zealand in the Collection of the Colonial Museum." Wellington, 1873. Roy. 8vo. Pp. xvi, 48.

——— "List of Shells." In Crawford, J. C.: "Notes on Miramar Peninsula." T.N.Z.I., vol. 5, pp. 396–400.

——— "On the Geographical Relations of the New Zealand Fauna." *Ibid.*, pp. 227–56. (Reprinted in Ann. Mag. Nat. Hist., ser. 4, vol. 13, 1874.)

——— "Synopsis of the Younger Formations of New Zealand." Q.J.G.S., vol. 19, pp. 373–79. (See also 1872.)

1874.

HECTOR, J. "Palæontology." 9th Ann. Rep. Col. Mus. Lab., pp. 5, 6. (Reefton, Nugget Point, Catlin's River, East Cape District.)

*——— "On the Fossil *Reptilia* of New Zealand." T.N.Z.I., vol. 6, pp. 353–58, pls. 27–31.

HUTTON, F. W. "Geology of New Zealand: Table of Sedimentary Rocks of New Zealand." Geol. Mag., dec. 2, vol. 1, p. 515.

* KNIGHT, C. "On the Teeth of the *Leiodon*." T.N.Z.I., vol. 6, pp. 358–63, pls. 24–26.

* MOJSISOVICS VON MOJSVÁR, E. "Über die triadischen Pelecypoden-Gattungen *Daonella* und *Halobia*." Abh. k.-k. geol. Reichsanst., bd. vii, heft 2, p. 32–33, taf. iii, f. 7, 8, 9. (*Halobia hochstetteri.*)

1875.

DUNCAN, P. M. "On some Fossil *Alcyonaria* from the Tertiary Deposits of New Zealand." Q.J.G.S., vol. 31, pp. 675, 676, pl. 38B. (From Oamaru.)

HECTOR, J. "Palæontology." 10th Ann. Rep. Col. Mus. Lab., pp. 4, 5. (Waipara, Weka Pass, Culverden, Rakaia, Trelissic, Cape Kidnappers, Castle Point, Taipos, Tairua (? Taueru) River, Raglan district, Wangaroa North.)

* HUTTON, F. W. "Description of Three New Tertiary Shells in the Otago Museum." T.N.Z.I., vol. 7, p. 458, pl. 21. (*Cominella striata* and *Zizyphinus hodgei*, Wanganui; *Venus* (?) *sulcata*, Napier.)

HUTTON, F. W., and ULRICH, G. H. F. "Report on the Geology and Goldfields of Otago." Dunedin, 1875. 8vo. Pp. 244. (Fossil lists: pp. 38–40, 43–44, 45, 51–54, 58–61, 66, 70.)

PURNELL, C. W. "On the Wanganui Tertiaries." T.N.Z.I., vol. 7, pp. 453–57. (Genera only.)

1876.

HECTOR, J. "Palæontology." 11th Ann. Rep. Col. Mus. Lab., pp. 4, 5. (Reefton, Callaghan's Hill, Waimea, Redman's Creek, Abbey Rocks, Napier, Buller, Amuri.)

HUTTON, F. W. "On the Cause of the Former Great Extension of the Glaciers in New Zealand." T.N.Z.I., vol. 8, pp. 383–87.

——— "Age of the Ototara Formation." (Letter to Editor.) Geol. Mag., dec. 2, vol. 3, p. 381. (In reference to the beds from which *Harpactocarcinus tumidus* was derived.)

* NEWTON, E. T. "On Two Chimæroid Jaws from the Lower Greensand of New Zealand." Q.J.G.S., vol. 32, pp. 326–31, pl. 21, figs. 1–9. (*Ischyodus brevirostris* and *Callorhyncus hectori*, Amuri Bluff.)

* WOODWARD, H. "On a New Fossil Crab from the Tertiary of New Zealand, collected by Dr. Hector, F.R.S., F.G.S., Director of the Geological Survey of New Zealand; with a note by Dr. Hector." *Ibid.*, pp. 51–56, pl. 7, figs. 1, 2. (*Harpactocarcinus tumidus.*)

1877.

Cox, S. H. "Report on Raglan and Waikato District." R.G.E., vol. 9, pp. 9–16. (Triassic, Cretaceo-Tertiary, and Tertiary.)

——— "Report on Westland District." *Ibid.*, pp. 63–95. (Reefton Series—Devonian.)

——— "Report on Country between Poverty Bay and Napier." *Ibid.*, pp. 96–105. (Cretaceo-Tertiary and Tertiary.)

——— "Report on the Geology of the Mount Somers District." R.G.E., vol. 10, pp. 1–10. (Cretaceo-Tertiary.)

——— "Report on Waikato District." *Ibid.*, pp. 11–26. (Jurassic, Cretaceo-Tertiary, and Tertiary.)

——— "Report on the Geology of the Wangarei District." *Ibid.*, pp. 95–106. (Cretaceo-Tertiary. Whangarei.)

——— "Report on Country between Opotiki and East Cape." *Ibid.*, pp. 107–13. (? Jurassic and Tertiary.)

Crawford, J. C. "On Probable Reasons why Few Fossils are found in the Upper Palæozoic and Possible Triassic Rocks of New Zealand." T.N.Z.I., vol. 9, pp. 561–64.

Haast, J. "Notes on the Geology of the Clent Hills and Mount Somers Districts, in the Province of Canterbury." R.G.E., vol. 8, pp. 1–19. (Clent Hills plants and Mount Potts *Spirifer* beds.)

——— "Notes to accompany a Geological Map and Sections of the Shag Point District, Province of Otago." *Ibid.*, pp. 19–26. (Cretaceo-Tertiary and Tertiary.)

Hector, J. "Clent Hills and Mount Somers." Prog. Rep., vol. 8, pp. v, vi. (Criticism of Haast's remarks in same volume on age of Mount Potts and Clent Hills fossils.)

——— "North-east Portion of South Island." *Ibid.*, pp. vi–xiii. (Criticism of Hutton's paper in same volume, and list of fossils from Amuri Bluff.)

*——— "South-east District of Otago." *Ibid.*, pp. xiii, xiv. (Note on *Belemnites lindsayi.*)

——— "East Cape District." *Ibid.*, pp. xvi–xx. (Post-Tertiary to Lower Cretaceous.)

*——— "Kaipara District." Prog. Rep., vol. 9, pp. v, vi. (Contains three new chironyms.)

——— "Coal-measures." *Ibid.*, pp. ix, x. (Palæontological evidence for conformity of Amuri Group, Amuri Limestone and *Leda* Marls.)

——— "Geological Survey Collections." 12th Ann. Rep. Col. Mus. Lab., pp. 6, 7. (Waikato Heads, Waikawau Creek, Oamaru District, Manawatu Gorge to Napier, Whangarei.)

*——— "On a New Trilobite (*Homalonotus expansus*)." T.N.Z.I., vol. 9, p. 682, pl. 27, fig. 2. (From Reefton.)

Hutton, F. W. "Report on the Geology of the North-east Portion of the South Island, from Cook Straits to the Rakaia." R.G.E., vol. 8, pp. 27–58. (Map and sections.) (Primary, Secondary, Cretaceous, and Tertiary.)

——— "On the Relation between the Pareora and Ahuriri Formations." T.N.Z.I., vol. 9, pp. 590–93. (Middle Tertiary.)

*——— "Descriptions of some New Tertiary *Mollusca* from Canterbury." *Ibid.*, pp. 593–98, pl. 16, figs. 1–13. (Lower or Middle Tertiary. Twenty new species.)

McKay, A. "Reports relative to Collections of Fossils in S.E. District of the Province of Otago." R.G.E., vol. 8, pp. 59–73. (Secondary.)

——— "Reports relative to Collections of Fossils made in the West Coast District, South Island." *Ibid.*, pp. 74–115. (Cretaceo-Tertiary and Reefton Series—Devonian.)

McKay, A. "Reports relative to Collections of Fossils made in the East Cape District, North Island." *Ibid.*, pp. 116–64. (Cretaceo-Tertiary and Tertiary.)

——— "Report on Weka Pass and Buller District." *Ibid.*, pp. 36–42. (Cretaceo-Tertiary.)

——— "Report on Country between Cape Kidnappers and Cape Turnagain." *Ibid.*, pp. 43–53. (Cretaceous, Cretaceo-Tertiary, and Tertiary.)

——— "Report on Kaikoura Peninsula and Amuri Bluff." *Ibid.*, pp. 172–84. (Cretaceous and Cretaceo-Tertiary)

——— "Report on Cape Campbell District." *Ibid.*, pp. 185–91. (Cretaceous and Cretaceo-Tertiary.)

——— "Oamaru and Waitaki Districts." R.G.E., vol. 10, pp. 41–66. (Cretaceo-Tertiary. Deals with the country between the Waipara and Oamaru.)

——— "Report on the Country between Masterton and Napier." *Ibid.*, pp. 67–94. (Cretaceo-Tertiary and Tertiary.)

——— "On the Reptilian Beds of New Zealand." T.N.Z.I., vol. 9, pp. 581–90.

Smith, S. P. "Sketch of the Geology of the Northern Portion of Hawke's Bay." T.N.Z.I., vol. 9, pp. 565–76. (See discussion, Hector, Prog. Rep., vol. 9, p. 8; 1877.)

1878.

Anon. "Fossil Localities arranged according to Age." R.G.E., vol. 11, Appendix I, pp. 189–98.

——— "Index to Geographical Distribution [of Fossil Localities]." *Ibid.*, Appendix II, pp. 199–204.

——— "Index to Locality Numbers (1–431)." *Ibid.*, Appendix III, pp. 205–15.

Cox, S. H. "Report on the Geology of the Hokanui Ranges, Southland." *Ibid.*, pp. 25–48 (map and sections). (Permo-Carboniferous to Jurassic, Cretaceo-Tertiary, and Tertiary.)

——— "Report on the Geology of the Te Anau District." *Ibid.*, pp. 110–18. (Cretaceous, Cretaceo-Tertiary, and Tertiary.)

Hector, J. "Wairarapa." Prog. Rep., vol. 11, pp. iii, iv. (Cretaceous to Tertiary.)

* ——— "Mount Potts." *Ibid.*, pp. v, vi. (Mount Potts Saurian, *Glossopteris*, and invertebrates.)

——— "Southland District." *Ibid.*, pp. vi–xii. (List of Mesozoic fossils.)

——— "Geological Survey Collections." 13th Ann. Rep. Col. Mus. Lab., pp. 5, 6. (Hokanui Hills, Mount Potts, discovery of Carboniferous fossils in the Maitai calcareous slates, Nelson, and of graptolites at Collingwood.)

* ——— "On the Belemnites found in New Zealand." T.N.Z.I., vol. 10, pp. 484–89, pls. 22, 23, figs. 1–4. (Cretaceous, Triassic.)

——— "On the Relative Ages of the Australian, Tasmanian, and New Zealand Coalfields." *Ibid.*, pp. 532, 533 (abstract only). (Records the discovery of *Glossopteris* by McKay at Mount Potts.)

McKay, A. "Report on East Wairarapa District." R.G.E., vol. 11, pp. 14–24. (Cretaceous and Tertiary.)

——— "Notes on the Sections and Collections of Fossils obtained in the Hokanui District." *Ibid.*, pp. 49–90. (Permo-Jurassic.)

——— "Report relative to the Collection of Fossils from the Mount Potts *Spirifer* Beds." *Ibid.*, pp. 91–109 (map). (Permo-Carboniferous to Older Secondary, and Cretaceo-Tertiary. Records the discovery of the *Glossopteris* beds of Mount Potts. Also reference to Clent Hills.)

——— "Report on the Wairoa and Dun Mountain Districts." *Ibid.*, pp. 119–59. (Carboniferous, Triassic, Cretaceo-Tertiary, and Tertiary.)

1879.

HAAST, J. VON. "Geology of the Provinces of Canterbury and Westland, New Zealand." Christchurch, 1879. Pp. 486.

HECTOR, J. "Palæontology: Geological Survey Collections." 14th Ann. Rep. Col. Mus. Lab., pp. 6–8. (A list of fossils from the Baton River Beds; ammonite in the limestone of Waipawa Gorge; collections from Nelson, &c.)

——— "Geology." Prog. Rep., vol. 12, pp. 1–17. (Classification adopted in construction of map for Sydney Exhibition. Repeated in a slightly different form in Journ. and Proc. Roy. Soc. N.S.W., vol. 13, pp. 69–80.)

——— "Mokau District." *Ibid.*, pp. 20–22 (map). (Jurassic, Cretaceo-Tertiary, and Tertiary.)

——— "Napier District." *Ibid.*, pp. 26–27. (Cretaceous and Tertiary.)

——— "East Wairarapa District." *Ibid.*, pp. 27–29. (Cretaceo-Tertiary and Tertiary.)

——— "District around Wellington." *Ibid.*, pp. 29–30. (Mount Torlesse Annelid—Carboniferous.)

——— "North-west District of South Island." *Ibid.*, pp. 30–41. (Silurian, Trias, Permian, Cretaceo-Tertiary, and Tertiary.)

*——— "On the Fossil *Flora* of New Zealand." T.N.Z.I., vol. 11, pp. 536, 537.

*——— "On the Fossil *Brachiopoda* of New Zealand." *Ibid.*, pp. 537–39. 1879.

——— "Handbook of New Zealand." Sydney International Exhibition, 1879. Wellington, 1879. Geology, pp. 17–30. (Contains lists of fossils in each formation. Later editions, 1880, 1883, 1886.)

McKAY, A. "The Geology of the District between Waipukurau and Napier." R.G.E., vol. 12, pp. 69–75. (Cretaceo-Tertiary and Tertiary; ammonite in Waipawa chalk marls.)

——— "The Southern Part of the East Wairarapa District." *Ibid.*, pp. 75–86. (Cretaceo-Tertiary and Tertiary.)

——— "The District between the Kaituna Valley and Queen Charlotte Sound." *Ibid.*, pp. 86–97. (Cretaceo-Tertiary. Picton.)

——— "The District between the Wairau and Motueka Valleys." *Ibid.*, pp. 97–121. (Carboniferous, Permian, Trias, Cretaceo-Tertiary, and Tertiary.)

——— "The Baton River and Wangapeka Districts, and Mount Arthur Range." *Ibid.*, pp. 121–31. (Silurian, Cretaceo-Tertiary, and Tertiary.)

——— "The Geology of the Neighbourhood of Wellington." *Ibid.*, pp. 131–35. (Carboniferous and Pliocene.)

1880.

HECTOR, J. "Palæontology." 15th Ann. Rep. Col. Mus. Lab., pp. 8–10. (Kaipara, Komiti Point, Mataura Falls, Curiosity Shop, Trelissick Basin, Cairn Range, Okuku River, Motunau, Lake Wakatipu.)

——— "Handbook of New Zealand." Wellington, 1880. (Second edition, revised.) Geology, pp. 19–32. (The lists of fossils are somewhat different from those of the first edition, 1879. Later editions, 1883, 1886.)

*——— "Appendix to Official Catalogue, New Zealand Court, International Exhibition, Sydney, 1879." Wellington, 1880. Pp. 67. (Fossil lists, pp. 2–31, 33–43, 47–50. Many manuscript names of plants.)

——— "On the Geological Formations of New Zealand compared with those of Australia." Journ. and Proc. Roy. Soc. N.S.W., vol. 13, pp. 65–80. (The introduction to the above is repeated in Prog. Rep., vol. 13, pp. ii–iv; 1881. The rest of the paper is slightly altered from "Geology," Prog. Rep., vol. 12, pp. 1–14; 1879.)

* TATE, R. "On the Australian Tertiary Palliobranchs." Trans. Roy. Soc. S. Austral., vol. 3, pp. 140–70, pls. 7–11. (*Waldheimia* (?) *insolita* in New Zealand, p. 152; *Rhynconella squamosa*, pp. 166, 167, pl. 9, fig. 9, *a–b*.)

* TENSION-WOODS, J. E. "Corals and *Bryozoa* of the Neozoic Period in New Zealand. Palæontology of New Zealand, Pt. IV." Wellington, 1880. Pp. 34; 3 plates and frontispiece.

1881.

COX, S. H. "Geology of the Rodney and Marsden Counties." R.G.E., vol. 13, pp. 13–39. (Cretaceous, Cretaceo-Tertiary, and Tertiary.)

HECTOR, J. "Auckland District." Prog. Rep., vol. 13, pp. xi–xiv. (Cretaceous, Cretaceo-Tertiary, and Tertiary.)

——— "Mataura River." *Ibid.*, pp. xv, xvi. (Jurassic.)

——— "Curiosity Shop." *Ibid.*, pp. xvi–xix. (Cretaceo-Tertiary and Tertiary.)

——— "The Trelissick Basin." *Ibid.*, pp. xx–xxii. (Cretaceo-Tertiary and Tertiary.)

——— "The Older Secondary and Palæozoic Rocks of the North Canterbury and Amuri Districts." *Ibid.*, pp. xxii–xxx.

* ——— "Notes on New Zealand *Cetacea*, Recent and Fossil" (abstract). T.N.Z.I., vol. 13, pp. 334–36, pl. 18, figs. 1–10.

MCKAY, A. "Mataura Plant Beds, Southland County." R.G.E., vol. 13, pp. 39–48. (Permian-Jurassic and Tertiary.)

——— "Discovery of Chalk near Oxford, Ashley County." *Ibid.*, pp. 49–53. (Cretaceo-Tertiary.)

——— "Of the Trelissick Basin, Selwyn County." *Ibid.*, pp. 53–74 (with map). (Cretaceo-Tertiary and Tertiary.)

——— "Curiosity Shop, Rakaia River, Canterbury." *Ibid.*, pp. 75–82. (Cretaceo-Tertiary and Tertiary.)

——— "On the Older Sedimentary Rocks of Ashley and Amuri Counties." *Ibid.*, pp. 83–107. (Carboniferous (Annelid beds), Triassic, and Jurassic. Description of the Mount Torlesse Annelid.)

——— "On the Motunau District, Ashley County." *Ibid.*, pp. 108–18. (Cretaceo-Tertiary and Tertiary.)

——— "District West and North of Lake Wakatipu." *Ibid.*, pp. 118–47. (Cretaceo-Tertiary. Bob's Cove, Lake Wakatipu.)

——— "On the Genus *Rhynconella*." T.N.Z.I., vol. 13, pp. 396–98.

* VINE, G. R. In Hamilton, A.: "On the *Foraminifera* of the Tertiary Beds at Petane, near Napier." *Ibid.*, p. 393–96, pl. 16, figs. 1–16.

1882.

ANON. "Index to Fossiliferous Localities in New Zealand." R.G.E., vol. 14, pp. 118–28. (Localities 1–486. Includes table of fossiliferous formations in New Zealand.)

COX, S. H. "North Auckland District, including Thames, Coromandel, Island of Kawau, and Drury Coalfield." *Ibid.*, pp. 17–41 (with map). Cretaceous, Cretaceo-Tertiary, and Tertiary.)

——— "District between the Aorere and Takaka Valleys, Collingwood." *Ibid.*, pp. 42–56 (with map). (Cretaceo-Tertiary.)

ETTINGSHAUSEN, C. VON. "Über de Genetische Gliederung der Flora von Neuseeland." Sitz. k. Akad. Wissensch. Wien, bd. 58, abth. 1, pp. 953–77. (*Fide* Ett., 1887.)

HECTOR, J. Auckland District. Prog. Rep., vol. 14, pp. xvi–xix. (Cretaceous, Cretaceo-Tertiary, and Tertiary.)

——— "Waitaki Valley and Alps of North Otago." *Ibid.*, pp. xxi–xxxii. (Outlines the general argument for the Cretaceo-Tertiary formation.)

McKay, A. "Geology of the Waitaki Valley and Parts of Vincent and Lake Counties." R.G.E., vol. 14, pp. 56–92 (with map). (Permian, Triassic, Cretaceo-Tertiary, and Tertiary.)

——— "On the Younger Deposits of the Wharekauri Basin and the Lower Waitaki Valley." *Ibid.*, pp. 98–106. (Cretaceo-Tertiary and Tertiary.)

* Kirk, T. W. "Description of New Tertiary Fossils." T.N.Z.I., vol. 14, p. 409. (Three new species—viz., *Trivia zealandica, Marginella hectori, Pleurotoma tuberculata*—and three identifications. Petane.)

1883.

Hector, J. "Reefton District." Prog. Rep., vol. 15, p. xxv. (Comparison of Baton River and Reefton fossils.)

——— "Handbook of New Zealand." Wellington, 1883. (Third edition, revised.) Geology, pp. 24–41. (The geological chapter is identical with that in the second edition, 1880. See 1879, 1880, 1886.)

* Hutton, F. W. "Descriptions of some New Tertiary Shells from Wanganui." T.N.Z.I., vol. 15, pp. 410, 411. (Five new species.)

McKay, A. "On the Geology of the Reefton District, Inangahua County." R.G.E., vol. 15, pp. 91–153. (Reefton (Devonian) Formation, Cretaceous and Cretaceo-Tertiary.)

Montgomery, A. "Some Fossil Plants." (Letter to Editor.) N.Z. Journ. Sci., vol. 1, pp. 141, 142. (A find of dicotyledons at Pukerau, including *Griselinia lucida*.)

1884.

Cox, S. H. "On the District between the Maruia and Buller Rivers." R.G.E., vol. 16, pp. 1–10 (with map). (Cretaceo-Tertiary and Tertiary.)

——— "On the Springfield Colliery." *Ibid.*, pp. 19–22. (Jurassic fern-beds of Malvern Hills.)

——— "On Mount Somers and Malvern Hills District." *Ibid.*, pp. 22–43. (Carboniferous (Annelid beds), Jurassic (fern-beds), Cretaceo-Tertiary, and Tertiary.)

Hector, J. "Table of Sedimentary Beds (in New Zealand)." Prog. Rep., vol. 16, pp. xii–xv.

——— "Maruia and Buller Rivers." *Ibid.*, pp. xv–xviii. (Cretaceo-Tertiary and Tertiary.)

——— "Mount Somers and Malvern Hills." *Ibid.*, pp. xx–xxii. (Carboniferous (Annelid beds), Cretaceo-Tertiary, and Tertiary.)

——— "North-east Otago." *Ibid.*, pp. xxii–xxv. (Cretaceo-Tertiary and Tertiary.)

——— "Kawhia." *Ibid.*, pp. xxxiv–xxxviii. (Trias-Jurassic. Comparison with Hokanui section.)

Hutton, F. W. "On the Origin of the Fauna and Flora of New Zealand." N.Z. Jour. Sci., vol. 2, pp. 1–20. (Reprinted in Ann. Mag. Nat. Hist., ser. 5, vol. 13, 1884, pp. 425–48, and vol. 15, 1885, pp. 77–107.)

McKay, A. "On the North-eastern District of Otago." R.G.E., vol. 16, pp. 45–66 (with map). (Cretaceo-Tertiary and Tertiary.)

——— "On the Relations of the Tertiary and Cretaceo-Tertiary Strata on the Coast-line between Auckland and Mahurangi." *Ibid.*, pp. 101–6.

——— "On the Geology of the Coal-bearing Area between Whangarei and Hokianga." *Ibid.*, pp. 110–34 (with map). (Cretaceo-Tertiary. Extensive correlations with beds in the South Island.)

——— "On the Geology of the Kawhia District." *Ibid.*, pp. 140–48 (with map). (Triassic, Jurassic, and Cretaceo-Tertiary.)

1885.

* Filhol, H. "Mission de l'île Campbell. Recueil de mémoires, rapports et documents relatifs à l'observation du passage de Vénus sur le soleil du 9 Décembre, 1874." Institut de France: Académie des Sciences. Paris, 1885. 4to. III, 2e part., No. 3, Geologie, Chap. II, pp. 141–80. (Tertiary. Describes *Waldheimia campbellica* n. sp., and figures *Pentacrinus* sp. ind.)

Haast, J. von. "On the Geological Structure of the Southern Alps of New Zealand, in the Provincial Districts of Canterbury and Westland." T.N.Z.I., vol. 17, pp. 332–37. (A criticism of the geological map published by the Survey so far as it applies to Canterbury, and a re-statement of his views as to the age of the Mount Potts and Clent Hills beds.)

Hector, J. "Note on the Geological Structure of the Canterbury Mountains." *Ibid.*, pp. 337–40. (A reply to Haast's paper in same volume. A more detailed reply appears in Prog. Rep., vol. 17, 1886, pp. xx–xxxi.)

——— "Geology, &c." 19th Ann. Rep. Col. Mus. Lab., pp. 5, 6. (Fossils of the lake-basins of Otago; Kawhia to Mokau.)

Hutton, F. W. "On the Age of the Orakei Beds, near Auckland." T.N.Z.I., vol. 17, pp. 307–13.

* ——— "Description of New Tertiary Shells." *Ibid.*, pp. 313–32, pl. 18, figs. 1–22. (Seventy-seven new species from Wanganui and Petane.)

——— "Sketch of the Geology of New Zealand." Q.J.G.S., vol. 41, pp. 191–220.

——— "On the Geological Position of the 'Weka-Pass Stone' of New Zealand." *Ibid.*, pp. 266–78. (An unconformity between Cretaceous and Tertiary.)

——— "On the Correlations of the 'Curiosity-Shop Beds' in Canterbury, New Zealand." *Ibid.*, pp. 547–64.

Neumayr, G. "Die geographische Verbreitung der Juraformation," &c. Denkschr. k. Akad. Wissensch. Wien, bd. 1, p. 120 (*fide* Bœhm).

1886.

Davis, J. W., "On some Fish-Remains from the Tertiary Strata of New Zealand." Q.J.G.S., vol. 42, Proc., pp. 4, 5.

* Grove, E., and Sturt, G. "On a Fossil Marine Diatomaceous Deposit from Oamaru, Otago, New Zealand." Journ. Quecket Micr. Club, ser. 2, vol. 2, p. 321 (1886), and vol. 3, pp. 7, 63, 131 (1887).

Haast, J. "On the Character and Age of the New Zealand Coalfields." Rep. Brit. Assoc., p. 643.

Hector, J. "Geological Collections." 20th Ann. Rep. Col. Mus. Lab., pp. 4–7. (Marlborough and Amuri Districts, Waipa River to Pirongia, Huntly to Raglan, Pahi, Komiti Point.)

——— "Exhibits at the Indian and Colonial Exhibition." 21st Ann. Rep. Col. Mus. Lab., pp. 4–8. "Geological." *Ibid.*, pp. 10, 11; "Geological Survey Branch." *Ibid.*, pp. 11–13. (Kai Iwi, Okehu, Nukumaru, Waitotara, Whenuakura, Masterton, Kaimanawas, Mokau, Moeraki District, Malvern Hills, Waihola Lake, Waihao River, Weka Pass, Shag Point.)

——— "Kaikoura District." Prog. Rep., vol. 17, pp. xii–xxxvii. (Cretaceous and Cretaceo-Tertiary. Contains also a discussion of the fossils and age of the central group of formations in all parts of the Dominion.)

——— "Auckland District." *Ibid.*, pp. xxxvii–xl. (Cretaceo-Tertiary and Tertiary.)

——— "Handbook of New Zealand." Wellington, 1886. (Fourth edition, revised.) Geology, pp. 28–35. (The geological chapter has been greatly abbreviated as compared with earlier editions—1879, 1880, and 1883—and the lists of fossils omitted.)

* Hector, J. "Detailed Catalogue and Guide to the Geological Department's Exhibits at the Indian and Colonial Exhibition, and Outline of the Geology of New Zealand." Wellington, 1886. Roy. 8vo. Pp. 101. "Outline of the Geology of New Zealand" also published as a separate; pp. 37–101. (Contains lists and numerous figures of New Zealand fossils, including some new species.)

Hutton, F. W. "On the Geology of Scinde Island." T.N.Z.I., vol. 18, pp. 327–32. (Tertiary.)

* ——— "New Species of Tertiary Shells." *Ibid.*, pp. 333–35. (Eleven species.)

* ——— "The Wanganui System." *Ibid.*, pp. 336–67. (Map and sections.) (Upper Tertiary. Short citation and synonymy of 280 species of *Invertebrata.*)

McCoy, F. (Memorandum on Fossils from Mount Potts and the Clent Hills.) Prog. Rep., vol. 17, p. xxi, footnote.

McKay, A. "On the Geology of the Eastern Part of Marlborough Provincial District." R.G.E., vol. 17, pp. 27–136 (with map). (Cretaceous, Cretaceo-Tertiary, and Tertiary.)

——— "Notes on the Geology of Scinde Island and some Parts of the Northern District of Hawke's Bay." *Ibid.*, pp. 185–92. (Tertiary.)

——— "On the Geology of Cabbage Bay District, Cape Colville Peninsula." *Ibid.*, pp. 192–202 (with map). (Cretaceo-Tertiary.)

——— "On the Age of the Napier Limestones." T.N.Z.I., vol. 18, pp. 367–74 (Miocene and Pliocene.)

Park, J. "Auckland Provincial District." R.G.E., vol. 17, pp. 136–70 (with map). (Cretaceo - Tertiary and Tertiary. Waipa – Kawhia District, Huntly – Raglan District, Waitemata, Eden, and Manakau Counties, Kaipara District.)

——— "On the Kakahu District, Canterbury." *Ibid.*, pp. 170–78 (with map). (Cretaceo-Tertiary and Tertiary.)

——— "On the Older Fossiliferous Rocks in Nelson." *Ibid.*, pp. 178–81.

Tate, R. "Supplemental Notes on the Palliobranchs of the Older Tertiary of Australia, and a Description of a New Species of *Rhynconella.*" Trans. Roy. Soc. S. Austral., vol. 8, pp. 94, 95, pl. 6, fig. 3, *a–c*. (List of species common to the older Tertiaries of Australia and New Zealand.)

——— "The Lamellibranchs of the Older Tertiary of Australia (Part I)." *Ibid.*, pp. 96–158, pls. 2–12. (Several identifications of New Zealand species.)

* Teller, F. "Die Pelecypodenfauna von Werchojansk in Ostsibirien." in Mojsisovics, L. "Arktische Triasfaunen." Mém. Acad. Imp. Sci. St. Pétersb., sér. 7, tom. 33, pp. 107, 111, 113, 115, 123, 124, 151–53. (*Fide* Bœhm.) (*Pseudomonotis richmondiana.*)

1887.

Anon. "Index to Fossiliferous Localities in New Zealand." R.G.E., vol. 18, pp. 255–70. (Including table of fossiliferous formations in New Zealand localities, 1–703.)

* Ettingshausen, C. von. "Beiträge zur Kenntniss der fossilen Flora Neuseelands." Denkschr. k. Akad. Wissensch. Wien, bd. 53, pp. 143–94, 9 taf. (Descriptions and figures of Tertiary and Cretaceous leaf fossils; names only of Triassic specimens.)

* ——— "On the Fossil Flora of New Zealand." Geol. Mag., dec. 3, vol. 4, pp. 363–67.

Haast, J. von. "Notes on the Age and Subdivisions of the Sedimentary Rocks in the Canterbury Mountains, based upon the Palæontological Researches of Professor Dr. C. Baron von Ettingshausen in Gratz (Austria)." T.N.Z.I., vol. 19, pp. 449–51.

Hector, J. "Geological Collections." 22nd Ann. Rep. Col. Mus. Lab., p. 3. "Geological Survey Branch." *Ibid.*, pp. 5–14. (Mokihinui, Nelson, Buller District, East Cape District, Hawke's Bay District, Oamaru District, Hokanui Hills, Mataura, Waikawa, King-country, Kaipara District.)

——— "Southern Amuri District." Prog. Rep., vol. 18, pp. ix–xiv. (Kaikoura, Weka Pass, and Amuri Bluff. Cretaceo-Tertiary.)

——— "Malvern Hills." *Ibid.*, pp. xiv, xv. (Cretaceous.)

* ——— "Moeraki and Hawksbury Survey District." *Ibid.*, pp. xv–xxvi. (Shag Point, Brighton, and Waihola. Cretaceous and Cretaceo-Tertiary. Description of the Brighton *Belemnitella*.)

——— "The Lower Greensand and Cretaceo-Tertiary Formations." *Ibid.*, pp. xxii–xxiv.

——— "Hawke's Bay District." *Ibid.*, pp. xxiv–xxxix. (Passage-formation between the Mataura (Upper Jurassic) and the Amuri (Lower Greensand) Series, and Tertiary.)

——— "Western Wellington and Taranaki." *Ibid.*, pp. xl–xlii. (Cretaceo-Tertiary and Tertiary.)

——— "Oamaru District." *Ibid.*, pp. xliv, xlv. (Cretaceous and Cretaceo-Tertiary. Esdaile collection.)

——— "Hokanui Hills." *Ibid.*, p. xlv. (Mesozoic.)

——— "Kaipara District." *Ibid.*, pp. l, li. (Cretaceo-Tertiary and Tertiary.)

* Hill, H. "A Description of a *Scaphites* found near Cape Turnagain." T.N.Z.I., vol. 19, pp. 387, 388. (Some doubt exists as to whether the fossil described was found in New Zealand.)

Hutton, F. W. "On the Geology of the Trelissick or Broken River Basin, Selwyn County." *Ibid.*, pp. 392–412. (See McKay, 1887; Hutton, 1888.)

——— "On the Geology of the Country between Oamaru and Moeraki." *Ibid.*, pp. 415–30.

——— "Note on the Geology of the Valley of the Waihao, in South Canterbury." *Ibid.*, pp. 430–33.

——— "The *Mollusca* of the Pareora and Oamaru Systems of New Zealand." Proc. Linn. Soc. N.S.W., ser. 2, vol. 1, pp. 205–37. (Citation and references of 268 species.)

McKay, A. "The Waihao Greensands, and their Relation to the Ototara Limestone." T.N.Z.I., vol. 19, pp. 434–40. (Reply to Hutton in same volume.)

——— "On the Younger Secondary and Tertiary Formations of Eastern Otago, Moeraki to Waikouaiti." R.G.E., vol. 18, pp. 1–23 (with map). (Cretaceous, Cretaceo-Tertiary, and Tertiary.)

——— "On the Grey-marls and Weka Pass Stone in Kaikoura Peninsula and Amuri Bluff." *Ibid.*, pp. 74–78. (Cretaceo-Tertiary.)

——— "On the Junction of the Amuri Limestone and Weka Pass Stone, Weka Pass, North Canterbury." *Ibid.*, pp. 78–91. (Cretaceo-Tertiary.)

——— "On the Identity and Geological Position of the Greensands of the Waihao Forks, Waihao Valley, South Canterbury." *Ibid.*, pp. 91–119. (Reply to Hutton, 1887.)

——— "On the Geology of East Auckland and the Northern Part of Hawke's Bay." *Ibid.*, pp. 182–219. (Cretaceous, Cretaceo-Tertiary, and Tertiary.)

——— "On the Geology of the Malvern Hills." *Ibid.*, pp. 230–33. (Cretaceous.)

——— "On the Geology of the Coast-line, Moeraki Peninsula to Kakanui; and Further Notes on the Geology of North-east Otago." *Ibid.*, pp. 233–40. (Cretaceous, Cretaceo-Tertiary, and Tertiary.)

Park, J. "On the Geology of the Western Part of Wellington Provincial District, and Part of Taranaki." *Ibid.*, pp. 24–73 (with map). (Cretaceo-Tertiary and Tertiary.)

PARK, J. "On the Age of the Waireka Tuffs, Quartz-grits, and Coal at Teaneraki and Ngapara, Oamaru." *Ibid.*, pp. 137–41. (Cretaceo-Tertiary.)

——— "On the Jurassic Rocks of the Hokanui Hills, Mataura, and Waikawa." *Ibid.*, pp. 141–55 (with map of Waikawa).

——— "On the Upper Wanganui and King-country." *Ibid.*, pp. 167–82. (Cretaceo-Tertiary and Tertiary.)

——— Kaipara and Wade Districts, Auckland. *Ibid.*, pp. 219–29. (Cretaceo-Tertiary and Tertiary.)

* TATE, R. "The Lamellibranchs of the Older Tertiary of Australia (Part II)." Trans. Roy. Soc. S. Austral., vol. 9, pp. 142–89 and 196–200, pls. 14–20. (*Dosinia grayi*, p. 179; *Panopœa orbita*, pp. 183–84, pl. 18, fig. 3; *Toredo heaphyi*, pp. 183–84.)

——— "The Scaphopods of the Older Tertiary of Australia." *Ibid.*, pp. 190–94, pl. 20. (*Entalis mantelli*, pp. 190, 191.)

* WATERS, A. W. "On Tertiary Chilostomatous *Bryozoa* from New Zealand." Q.J.G.S., vol. 43, pp. 40–72, text figs. 1, 2, pls. 6–8.

* ——— "On Tertiary Cyclostomatous *Bryozoa* from New Zealand." *Ibid.*, pp. 337–50, text fig. p. 346, pl. 18. (Napier, Petane, Waipukurau, Whakaati (not Waikato), Shakespeare Cliff, Wanganui, Tanner's Run, Trig. Station.)

1888.

* CRIÉ, L. "Sur les affinités des flores jurassiques et triassiques de l'Australie et de la Nouvelle-Zélande." C.R. Ac. Sc., cvii, pp. 1014–17.

* DAVIS, J. W. "Report on the Fossil Fish-remains of the Tertiary and Cretaceo-Tertiary Formation of New Zealand." Trans. Roy. Dub. Soc., ser. 2, vol. 4, pp. 1–50; plates.

* ——— "Note on a Species of *Scymnus* from the Upper Tertiary of New Zealand." Geol. Mag., dec. 3, vol. 5, pp. 315–16. (*Scymus acutus*, Napier Series, Esk River.)

* ETTINGSHAUSEN, C. VON. "Contributions to the Tertiary Flora of Australia." Mem. Geol. Sur. N.S.W., Palæontology, No. 2. Sydney, 1888. (Translated by the author from the original memoirs in the Denkschr. d. math-naturw. Cl. d. k. Akad. Wien, bd. 103, 1887. Pp. 82–85 and 90–91 refer to New Zealand, and are same as T.N.Z.I., vol. 23 (1891), pp. 237–41 and 243–46.)

HECTOR, J. "Whangarei and Hobson Counties." Prog. Rep., vol. 19, pp. xxxvi, xxxvii. (Cretaceous.)

——— "Waipara and Weka Pass." *Ibid.*, p. xxxviii. (Discusses the relation of the Grey-marls to the Weka Pass Stone and the Mount Brown beds.)

HUTTON, F. W. "On some Railway Cuttings in the Weka Pass." T.N.Z.I., vol. 20, pp. 257–63. (Cretaceous, Lower and Upper Tertiary.)

——— "On the Greensands of the Waihao Forks." *Ibid.*, pp. 264–67. (Reply to McKay, 1887.)

——— "On some Fossils lately obtained from the Cobden Limestone at Greymouth." *Ibid.*, pp. 267–69.

* ——— "On a Trilobite from Reefton, New Zealand, new to Australasia." Proc. Linn. Soc. N.S.W., ser. 2, vol. 2 (1887), pp. 257, 258.

——— "On the Rocks of the Hauraki Goldfields." Trans. Austr. Assoc. Adv. Sci., vol. 1, pp. 245–74. (Tertiary. Cabbage Bay.)

McKAY, A. "On the Geology of the Northern District of Auckland." R.G.E., vol. 19, pp. 37–57 (with map). (Cretaceous, Cretaceo-Tertiary, and Tertiary.)

PARK, J. "On the Probable Discovery of Oil and Coal in Wairarapa North County." *Ibid.*, pp. 20–24 (with map). (Cretaceous and Tertiary.)

——— "On the Geology of Waipara and Weka Pass Districts." *Ibid.*, pp. 25–35 (with map). (Cretaceo-Tertiary and Tertiary.)

PARK, J. "On the Geology of the Owen and Wangapeka Goldfields." *Ibid.*, pp. 74–88 (with map). (Silurian and Cretaceo-Tertiary.)

* TATE, R. "The Gastropods of the Older Tertiary of Australia (Part I)." Trans. Roy. Soc. S. Austral., vol. 10, pp. 91–176, pls. 1–13. (*Typhis hebetatus* Hutton = *T. McCoyi* Ten.-Woods, p. 91.)

WILSON, H. "On the Oxford Chalk Deposit, Canterbury, New Zealand." T.N.Z.I., vol. 20, pp. 274–76.

1889

HECTOR, J. "Geological Survey Branch." 23rd Ann. Rep. Col. Mus. Lab., pp. 14–16. (Hokianga Harbour, Weka Pass.)

*DE LATOUR, H. A. "On the Fossil Marine Diatomaceous Deposit near Oamaru." T.N.Z.I., vol. 21, pp. 293–311, pls. 18–22. (280 species.)

HOWCHIN, W. "The *Foraminifera* of the Older Tertiary of Australia (No. 1, Muddy Creek, Victoria)." Trans. Roy. Soc. S. Austral., vol. 12, pp. 1–20, pl. 1. (*Polymorphina dispar*.)

* LYDEKKER, R. "Catalogue of the Fossil *Reptilia* and *Amphibia* in the British Museum (Natural History): Part II."

TATE, R. "The Gastropods of the Older Tertiary of Australia (Part II)." Trans. Roy. Soc. S. Austral., vol. 11, pp. 116–74, pls. 2–10. (*Ancillaria hebera*, p. 147.)

1890.

* CASTRACANE. "Sul depositi di Jackson's Paddock, Oamaru, Nella Nouva Zelandia." Roma, 1890. Pp. 4. (*Fide* Hamilton).

GREGORY, J. W. "Some Additions to the Australian Tertiary *Echinoidea*." Geol. Mag., dec. 3, vol. 7, pp. 481–92, pls. 13 and 14.

HECTOR, J. "Geological Survey Branch." 24th Ann. Rep. Col. Mus. Lab., pp. 4–6. (Awatere and Amuri districts.)

——— "Amuri District." Prog. Rep., vol. 20, pp. xxxi–liv. (Deals particularly with the Upper Awatere Valley. Cretaceous and Cretaceo-Tertiary.)

HUTTON, F. W. "On the Relative Ages of the New Zealand Coalfields." T.N.Z.I., vol. 22, pp. 377–87. (Cretaceous and Tertiary. *Cf.* Hector, 1892, Buller Coalfield.)

MCKAY, A. "On the Geology of Marlborough and the Amuri District of Nelson." R.G.E., vol. 20, pp. 85–185. (Mainly a recapitulation; the part referring to the Cretaceous beds of the Awatere River is new.)

PARK, J. "Coal in the Upper Rangitikei Valley." *Ibid.*, pp. 64–67. (Tertiary.)

—— "On the Geology of Collingwood County, Nelson." *Ibid.*, pp. 186–243 (and map). (Palæozoic and Cretaceo-Tertiary.)

—— "On the Conformable Relations of the Different Members of the Waitemata Series." T.N.Z.I., vol. 22, pp. 391–99. (Lower Tertiary.)

1891.

* ETTINGSHAUSEN, C. VON. "Contributions to the Knowledge of the Fossil Flora of New Zealand." T.N.Z.I., vol. 23, pp. 237–310, pls. 24–32. (Translated from the German by C. Juhl. In the main, identical with the original paper in German, 1887. The figures are copied from the original figures.)

HILL, H. "On the Relations of the Kidnappers and Pohui Conglomerates to the Napier Limestones and Petane Marls." *Ibid.*, pp. 340–53. (Traverses McKay's classification of 1886.)

MCKAY, A. "On a Deposit of Diatomaceous Earth at Pakaraka, Bay of Islands." T.N.Z.I., vol. 23, pp. 375–79.

1892.

ANON. "Index to Fossiliferous Localities in New Zealand." R.G.E., vol. 21, appendix, pp. 120–45. (Including table of fossiliferous formations in New Zealand. Localities 1–764.)

——— "Index to Fossiliferous Localities according to the Counties in which they occur." *Ibid.*, Appendix, pp. 146–78. (Contains a short account of the geology of each county. Anonymous, but written by A. McKay. An uncollected saurian occurring at Mount Potts is described on p. 147.)

HECTOR, J. "Geological Survey Collections." 26th Ann. Rep. Col. Mus. Lab., pp. 1–3. (Cobden limestone (Westbrooke coll.), Waipara, Waikaka, Kaitangata.)

——— "Buller Coalfield." Prog. Rep., vol. 21, pp. xxxv–xli. (Reply to Hutton on "Age of the Coalfields," 1890.)

——— "Waipara." *Ibid.*, pp. l–liii. (Discusses Cretaceo-Tertiary question.)

——— "Henley Breccias." *Ibid.*, pp. lv–lix. (Waihola and Kaitangata.)

——— "Auckland District." *Ibid.*, pp. lxii–lxxxiv. (Pakaraka and Kaeo. Cretaceo-Tertiary and Tertiary.)

* HINDE, G. J., and HOLMES, W. M. "On the Sponge Remains in the Lower Tertiary Strata near Oamaru, Otago, New Zealand." Journ. Linn. Soc. Zool., vol. 24, pp. 177–262, pls. 7–15.

HUTTON, F. W. "On the Foliated Rocks of Otago." T.N.Z.I., vol. 24, pp. 359–65. (Graptolites of Collingwood, p. 362.)

McKAY, A. "On the Geology of Marlborough and South-east Nelson: Part II." R.G.E., vol. 21, pp. 1–28. (Cretaceous, Cretaceo-Tertiary and Tertiary.)

——— "On the Prospects of Coal at Pakaraka, Bay of Islands, Auckland." *Ibid.*, pp. 59–63. (Cretaceo-Tertiary.)

——— "On the Geology of the District surrounding Whangaroa Harbour, Mongonui County, Auckland." *Ibid.*, pp. 63–72 (and map). (Cretaceous, Cretaceo-Tertiary and Tertiary.)

——— "On the Lignites of Cooper's Beach, Mongonui, Auckland." *Ibid.*, pp. 72–76. (Fossil fruit. Tertiary.)

——— "On the Geology of the Middle Waipara and Weka Pass Districts, North Canterbury." *Ibid.*, pp. 97–103. (Cretaceo-Tertiary and Tertiary; an unconformity between the Grey-marls and Mount Brown beds.)

1893.

HECTOR, J. "Geological Survey Collections." 27th Ann. Rep. Col. Mus. Lab., pp. 1, 2. (North Auckland district, Kawakawa and Hikurangi.)

HUTTON, F. W. "On a New Plesiosaur from the Waipara River, New Zealand." Q.J.G.S., vol. 49, Proc., p. 151 (abstract). (*Cimoliosaurus caudalis* n. sp.; description not given: see Hutton, 1894.)

* ——— "The Pliocene *Mollusca* of New Zealand." Macleay Memor. Vol., Lin. Soc. N.S.W., 1893, pp. 35–92, pls. 6–9. (Plates by H. Suter.)

McKAY, A. "Geological Explorations of the Northern Part of Westland." Parl. paper C.–3, pp. 132–86 (map).

——— "On a Diatom Deposit near Pakaraka, Bay of Islands, Auckland." T.N.Z.I. vol. 25, pp. 375–77.

1894.

* DAVIS, J. W. "Report on the Fossil-fish Remains of New Zealand." R.G.E., vol. 22, pp. 93–120, and table. (Abstract from Trans. Roy. Dub. Soc., 14th Dec., 1887. Critical notes as to localities appended by Hector.)

Hector, J. "Northern Auckland." Prog. Rep., vol. 22, pp. ix–xxv (with map of Kawakawa Coalfield). (Cretaceo-Tertiary and Tertiary.)

Hill, H. "Notes on the Geology of the Country between Dannevirke and Wainui, Hawke's Bay." T.N.Z.I,. vol. 26, pp. 392–96. (Cretaceo-Tertiary and Pliocene.)

* Hutton, F. W. "On a New Pleisosaur from the Waipara River." T.N.Z.I., vol. 26, pp. 354–58, pl. 42. (*Cimoliosaurus caudalis:* see Hutton, 1893.)

* ——— "On *Conchothyra parasitica.*" *Ibid.*, pp. 358, 359, pl. 43, figs. 1–5.

McKay, A. "On the Prospects of finding Coal near Shannon, on the Wellington and Manawatu Railway Line." R.G.E., vol. 22, pp. 1, 2. (Upper Tertiary. Crustacean fossils numerous.)

——— "On the Geology of the Northern Part of Westland and the Gold-bearing Drifts between the Teremakau and Mikonui Rivers." *Ibid.*, pp. 11–50 (with map). (Discusses distribution of land and sea in Tertiary.)

——— "On the Hikurangi Coalfield." *Ibid.*, pp. 55–69. (Cretaceo-Tertiary.)

——— "On the Geology of Hokianga and Mongonui Counties, Northern Auckland." *Ibid.*, pp. 70–90 (with map). (Cretaceo-Tertiary and Tertiary.)

——— "Geological Reports on Older Auriferous Drifts of Central Otago." Parl. paper C.–4. Pp. 48 (map and sections). (Cretaceo-Tertiary. Bob's Cove, Lake Wakatipu, Kyeburn, Swinburn, Livingstone.)

* Tate, R. "Critical List of the Tertiary *Mollusca* and *Echinodermata* of New Zealand in the Collection of the Colonial Museum." R.G.E., vol. 22, pp. 121–27. (Refers only to the *Echinodermata.*)

1895.

Gordon, H. A. "Explorations in the Urewera Country." Parl. paper C.–3, pp. 157–65 (with map). (Accompanied by A. McKay. Cretaceous and Tertiary. District south of Opotiki.)

McKay, A. "Report on the Geology of the South-west Part of Nelson and the Northern Part of the Westland District." Parl. paper C.–13. Pp. 28 (and map). Also reprinted in 1896 and 1897. (A general account of the stratigraphy, without specific references to fossils.)

1896.

McKay, A. "The Geology of the Aorere Valley, Collingwood County, Nelson." Parl. paper C.–11, pp. 4–26 (with map). (Cretaceo-Tertiary and Tertiary.)

——— "The Enner Glynn Coal-mine, and the Coal-bearing Area within Brook Street Valley, near the Town of Nelson." *Ibid.*, pp. 28–30. (Tertiary.)

——— "Wilson River and Preservation Inlet Goldfield, Fiord County, Otago." *Ibid.*, pp. 31–43 (with map). (Silurian—graptolite beds—and Cretaceo-Tertiary.)

——— "Prospect of finding Coal on the Tiraumea Estate, Upper Tiraumea Valley." *Ibid.*, pp. 49–51 (with map). (Tertiary.)

Pritchard, G. B. "A Revision of the Fossil Fauna of the Table Cape Beds, Tasmania, with Descriptions of the New Species." Proc. Roy. Soc. Vict., vol. 8 (n.s.), pp. 74–150, pls. 2–4. (Several references to New Zealand species.)

1897.

Harris, G. F. "Catalogue of Tertiary *Mollusca* in the Department of Geology, British Museum (Nat. Hist.). Part I: The Australasian Tertiary *Mollusca.*" Pp. xxvi, 407; 8 plates.

McKay, A. "Report on the Geology of the Cape Colville Peninsula, Auckland." Parl. paper C.–9, pp. 1–75 (with map). (Cabbage Bay. Cretaceo-Tertiary.)

1898.

Griffiths, A. P. "Notes on a Fossil Punga found in the Silverton Mine." Trans. N.Z. Inst. M.E., vol. 2, pp. 35, 36, and plate. (Not a fossil.)

Hamilton, A. "A List of Recent and Fossil *Bryozoa* collected in various Parts of New Zealand." T.N.Z.I., vol. 30, pp. 192–99.

* Tate, R. "On Some Recent and Fossil Australasian Species of *Philobryæ*." Trans. Roy. Soc. S. Austral., vol. 22, pp. 86–89, pl. 4. (*Mytilicardia trigonopsis* Hutt. = *Philobrya trigonopsis*.)

1899.

McKay, A. "Report on Petroleum at New Plymouth, Taranaki." Parl. paper C.–9, pp. 3–10. (Tertiary.)

——— "Report on the District between Stratford and the Tangarakau River." *Ibid.*, pp. 28–30. (Tertiary.)

McKay, W. A. "Report on the Geology of the Trooper Range, Castle Point District, Wellington." *Ibid.*, pp. 33–36. (Cretaceous and Tertiary.)

——— "Report on Geology of East Coast from the Kaiwhata River to Glenburn, East Coast of Wellington." *Ibid.*, pp. 36–43. (Cretaceous and Tertiary.)

* Murdoch, R. "Description of *Sigaretus* (?) *drewi* and *Cirsonella* (?) *neozelanica*, with Notes on New Zealand Land *Mollusca*." Proc. Malac. Soc., vol. 3, pp. 320–25, pl. 16.

Tate, R. "On some Older Tertiary Fossils of Uncertain Age from the Murray Desert." Trans. Roy. Soc. S. Austral., vol. 13, pt. 1, pp. 102–11, pl. 1. (*Ancilla hebera*, p. 108.)

——— "A Revision of the Older Tertiary *Mollusca* of Australia: Part I." *Ibid.*, pp. 249–77, pl. 8. (Numerous references to New Zealand species.)

1900.

Bœhm, G. "Reisenotizen aus Neu-Seeland." Zeitsch. deutsch. geol. Gesellsch., bd. 51, pp. 169–77. (Discusses the Cretaceo-Tertiary of Kaikoura Peninsula and Oamaru.)

Hill, H. On the Geology of the District between Napier and Puketitiri." T.N.Z.I., vol. 32, pp. 183–88. (Miocene and Pliocene.)

Hutton, F. W. "The Geological History of New Zealand." *Ibid.*, vol. 32, pp. 159–83.

* Maclaren, J. M. "Geology of the Coromandel Goldfields." Parl. paper C.–9 (maps and sections). (? Cretaceous (plants) and Lower Eocene (marine). Figures *Blechnum priscum*, *Flabellaria sub-longirachis*, *Bambusites australis*.)

* Murdoch, R. "Description of some New Species of Pliocene *Mollusca* from the Wanganui District, with Notes on other Described Species." T.N.Z.I., vol. 32, pp. 216–21, pl. 20, figs. 1–10. (Seven new species.)

Park, J. "Notes on the Coalfields of New Zealand." Trans. Inst. Mining and Metall., vol. 8, pp. 148–55. (Also N.Z. Mines Record, vol. 3, 349 ff.)

1901.

Dieseldorff, A. "Beiträge zur Kenntniss der Gesteine und Fossilen der Chathaminseln sowie einiger Gesteine und neuer Nephritfundorte Neu-Seelands." Inaug. Diss. Marburg, 1901. 8vo. Pp. 58; 4 plates; maps. (*Fide* Wilckens.)

McKay, A. "Report on Supposed Coal-seams in Kaiata Range, Greymouth." Parl. paper C.–10, pp. 7, 8. (Cretaceo-Tertiary and Tertiary.)

——— "Report on the Kaimanawa Ranges, Hawke's Bay." *Ibid.*, pp. 12–21 (with map). (Pliocene.)

McKay. A. "Report on the Petroleum-bearing Rocks of Poverty Bay and East Cape Districts, Auckland, New Zealand." *Ibid.*, pp. 21–25 (with map and sections). (Cretaceous and Tertiary.)

Ortmann, A. E. "The Theories of the Origin of the Antarctic Faunas and Floras." Am. Nat., vol. 25, pp. 139–42. (Contains references to all theories of older land connections with New Zealand.)

1902.

Fox, C. E. "The Volcanic Beds of the Waitemata Series." T.N.Z.I., vol. 34, pp. 452–93. (Lower Tertiary.)

* Frech, L. "Lethæa geognostica." I[ter] Th.: Lethæa palæozoica; II, pp. 89, 102, 115 (Unter-Silur), 585 (Triad. Eiszeit), 602–4 (Dyas, Trias.), 687 (Graptolithen). Stuttgart, 1897–1902. (*Fide* Wilckens.)

Hamilton, A. "On the Septarian Boulders of Moeraki, Otago." T.N.Z.I., vol. 34, pp. 447–51, pls. 29–35. (Suggests that the bone-fragment described by Mantell as avian may be reptilian.)

Hutton, F. W. "On a New Fossil *Pecten* from the Chatham Islands." *Ibid.*, p. 196, pl. 8. (Miocene.)

* Ortmann, A. E. "Tertiary Invertebrates: Reports of the Princeton University Expeditions of Patagonia, 1896–99," pp. 45–332, pls. 11–34. Princeton, 1901–6. 4to. (Numerous references to, and comparisons with, New Zealand fossils.)

1903.

* Benham, W. B. "On some Remains of a Gigantic Fossil Cirripede from the Tertiary Rocks of New Zealand." Geol. Mag., dec. 4, vol. 10, pp. 110–19, pl. 9, figs. 1, 2, and pl. 10, figs. 3–11. (*Pollicipes* (?) *aucklandicus*, Motutapu, Auckland Harbour.)

Dennant, J., and Kitson, A. E. "Catalogue of the Described Species of Fossils (except *Bryozoa* and *Foraminifera*) in the Cainozoic Fauna of Victoria, South Australia, and Tasmania." Rec. Geol. Surv. Vict., vol. 1, pt. 2, pp. 89–147 (with map). (Numerous references to New Zealand species. A full bibliography of the Tertiary palæontology of Australia.)

Hamilton, A. "List of Papers on the Geology of New Zealand." T.N.Z.I., vol. 35, pp. 489–546.

* Ihering, H. von. "Les brachiopodes tertiare de Patagonie." An. Mus. Nac. Buenos Aires, tomo 9 (ser. 3a, t. 2), pp. 321–49, and plates. (Concludes that there are no species common to New Zealand and Patagonia. Names *Magellania novara*, *Terebratella neozelandica*, *Terebratulina suessi.*)

Park, J. "On the Geology of the Rock-phosphate Deposits of Clarendon, Otago." T.N.Z.I., vol. 35, pp. 391–402. (Upper Eocene.)

1904.

*Bœhm, J. "Über tertiäre Brachiopoden von Oamaru, Südinsel, Neu-Seeland." Zeitsch. deutsch. geol. Gesell., bd, 56, Briefl. Mittl., pp. 146–50, taf. 15. (*Terebratula oamarutica*, *Terebratella oamarutica*, *Terebratulina oamarutica*. Everett's Quarry, Kakanui.)

Chapman, F. "Fossil Fish Remains from the Tertiaries of Australia: Part I." Proc. Roy. Soc. Vict., vol. 17 (n.s.), pp. 267–97, pls. 11, 12. (Numerous references to New Zealand species.)

* Hamilton, A. "Notes on a Small Collection of Fossils from Wharekauri, on the Waitaki River, North Otago." T.N.Z.I., vol. 36, pp. 465–67, pls. 37, 38. (*Aturia ziczac.*)

Hutton, F. W. "Index Faunæ Novæ Zealandiæ." London, 1904. (Discusses the origin of the New Zealand fauna, pp. 4–20.)

* Lemoine, P., and Douvillé, R. "Sur le Genre *Lepidocyclina* Gümbel." Mem. Soc. géol. France (Paléont.), tom. 13, fasc. 1. Pp. 40. [P. 32, *Miogypsina orakeiensis* (Karrer.)]

Park, J. "On the Subdivision of the Lower Mesozoic Rocks of New Zealand." T.N.Z.I., vol. 36, pp. 373–404. (Nugget Point district, Catlin's River district, Nelson, Mount Potts district.)

——— "On the Age and Relations of the New Zealand Coalfields." *Ibid.*, pp. 405–18. (Abandons Cretaceo-Tertiary theory and suppresses Hutton's Pareora system.)

——— "On the Geology of North Head, Waikouaiti, and its Relation to the Geological History of Dunedin." *Ibid.*, pp. 418–30, pl. 32. (Tertiary.)

——— "On the Jurassic Age of the Maitai Series." *Ibid.*, pp. 431–46. (Subsequently referred by Park to the Carboniferous.)

——— "On the Discovery of Permo-Carboniferous Rocks at Mount Mary, North Otago." *Ibid.*, pp. 447–53. (Subsequently referred by Park to Permo-Triassic.)

* Wilckens, O. "Revision der Fauna der Quiriquina-Schichten." N.J. f. Min. Beilage band 18, pp. 181–284, and plates. (Comparison of *Conchothyra parasitica* (N.Z.) with *Pugnellus tumidus* (Chili), p. 207, and figure of *C. parasitica*, taf. 18, f. 3, *a*, *b*.)

1905.

Arber, E. A. N. "Catalogue of the Fossil Plants of the *Glossopteris* Flora in the Department of Geology." Brit. Mus. (Nat. Hist.), p. lxi.

* Bather, F. A. "The Mount Torlesse Annelid." Geol. Mag., dec. 5, vol. 11, pp. 532–41, figs. 1–7, p. 537. (*Torlessia McKayi ; Dentalium huttoni.*)

* Clarke, E. de C. "The Fossils of the Waitemata and Papakura Series." T.N.Z.I., vol. 37, pp. 413–21, pl. 32, figs. 1–5. (Describes *Flabellum papakurense, Amussium papakurense, Vaginella aucklandica ;* notes on other species. Lower Tertiary.)

Fuchs, T. "Einige Bemerkungen zu der jüngst erscheinenen Mittheilung des Herrn G. Bœhm. Über tertiäre Brachiopoda von Oamaru, Südinsel, Neu-Seeland." Monatsb. deutsch. geol. Gesellsch., bd. 57, pp. 170–72.

* Hutton, F. W. "Three New Tertiary Shells." T.N.Z.I., vol. 37, pp. 472–73, pl. 44, figs. 1–3. (*Pleurotoma hamiltoni, Mitra hectori, Pecten hilli.* Lower Tertiary.)

* ——— "Revision of the Tertiary *Brachiopoda* of New Zealand." *Ibid.*, pp. 474–81, pl. 45, figs. 1–5, pl. 46, figs. 1–7. (Describes as new—*Magellania parki, Terebratella kakanuiensis, Bouchardia rhizoida.*)

Ihering, H. von. "Les mollusques fossiles du tertiare et du crétacé supérieur de l'Argentine." An. Mus. Nac. Buenos Aires, ser. 3, vol. 7, pp. 611, pl. 18. (*Fide* Wilckens.)

* Park, J. "Description of a New Species of *Pecten* from the Oamaru Series." *Ibid.*, p. 485. (*Pseudamussium* (*Pecten*) *huttoni.*)

——— "On the Marine Tertiaries of Otago and Canterbury, with Special Reference to the Relations existing between the Pareora and Oamaru Series." *Ibid.*, pp. 489–551.

Kilien, W., and Piroutet, M. "Sur les fossiles éocrétaciques de la Nouvelle Calédonie." Bull. Soc. géol. France, ser. 4, tom. 5, p. 114. (*Fide* Wilckens.)

* Suter, H. "Notes on some New Zealand *Pleurotomidæ*." Proc. Malac. Soc., vol. 6, pp. 200, 201.

* ——— "Notes on some Species of *Chione* from New Zealand." *Ibid.*, pp. 202–5.

1906.

* ANDREW, A. R. "On the Geology of the Clarendon Phosphate Deposits, Otago, New Zealand." T.N.Z.I., vol. 37, pp. 447–82, pls. 4, 5. (Describes and figures *Magellania marshalli* n. sp.; figures *Squalodon grateloupi* (?) Pedroni. (Lower Tertiary.)

BATHER, F. A. "The Age of the Mount Torlesse Annelid." (Letter to Editor.) Geol. Mag., dec. 5, vol. 3, pp. 46, 47. (Refers horizon to "not below Trias and not above Jurassic, and probably Liassic.")

* BOULT, C. N. "The Occurrence of Gold at Harbour Cone." T.N.Z.I., vol. 38, pp. 425–46. (Note on *Pseudamussium huttoni* Park, p. 432, pl. 9, fig. 1, *a*, *b*, *c*. Lower Tertiary.)

* HUTTON, F. W. "On *Crassatellites trailli*." *Ibid.*, pp. 65, 66. (*Mactropsis trailli*. Lower Tertiary.)

LEMOINE, P. "Études géologiques dans le Nord de Madagascar," pp. 410–14. Paris, 1906. (Discusses Cretaceo-Tertiary question and quotes lists of fossils.)

THOMSON, J. A. "The Gem Gravels of Kakanui, with Remarks on the Geology of the District." T.N.Z.I., vol. 37, pp. 482–95. (Lower Tertiary.)

1907.

* BELL, J. M.; WEBB, E. J. H.; and CLARKE, E. DE C. "The Geology of the Parapara Subdivision." Bull. No. 3 (n.s.), N.Z. Geol. Surv. (Palæontology of the Aorere Series (graptolites), Slaty Creek, pp. 34–37, pl. 8.)

FRASER, C., and ADAMS, J. H. "The Geology of the Coromandel Subdivision." Bull. No. 4 (n.s.), N.Z. Geol. Surv. (Palæontology of the Torehine Series, pp. 54, 55: "not later than Lower Eocene.") (See also Thomas, A. P. W., 1907.)

* KIDSTON, R., and GWYNNE-VAUGHAN, D. T. "On the Fossil *Osmundaceæ*." Trans. Roy. Soc. Edin., vol. 45, pt. 3, pp. 759–80, pls. 1–6. (*Osmundites dunlopi* and *O. gibbiana* from Jurassic rocks near Gore.)

* SUTER, H. "Descriptions of some Tertiary Shells from New Zealand." Proc. Malac. Soc., vol. 7, pp. 207–10, pl. 18.

——— "Review of the New Zealand *Acmæidae*, with Descriptions of New Species and Subspecies." *Ibid.*, pp. 315–26. (*Acmæa rubiginosa*, p. 315.)

* THOMAS, A. P. W. "Report on the Fossils of the Manaia Hill Beds (Coromandel)." Bull. No. 4 (n.s.), N.Z. Geol. Surv., pp. 48–50, pl. 9. (*Inoceramus* and *Belemnites*. (?) Upper Jurassic.)

WILCKENS, O. "Die Lamellibranchiaten, Gastropoden, &c., der oberen kreide Sudpatagoniens." Ber. naturf. Gesellsch., Freiburg, i, B., bd. 15, pp. 91–155, pls. 2–9. (*Conchothyra parasitica*.)

1908.

* ARTHABER, G. VON. "Lethæa geognostica." II Th., Das Mesozoicum, bd. 1, Trias., p. 241. (*Fide* Bœhm.) (Refers to *Halobia hochstetteri*.)

* FRECH, F. "Marine Trias in New Caledonien und Neuseeland." *Ibid.*, pp. 506, 509, taf. 48, f. 4, *a–d*. (*Fide* Bœhm.) (*Pseudomonotis richmondiana* and *P. richmondiana truncata*.)

MERRIAM, J. C. "Triassic *Ichthyosauria*, with Special Reference to the American Forms." Mem. Univ. California, vol. 1, No. 1. Pp. 196, pls. 18. (*Fide* Wilckens.)

MORGAN, P. G. "The Geology of the Mikonui Subdivision, North Westland." Bull. No. 6 (n.s.), N.Z. Geol. Surv. (Palæontology of the Koiterangi Series (? Cretaceo-Tertiary), p. 104; palæontology of the Upper Miocene Beds, pp. 108, 109.)

Shakespear, E. M. R. "On some New Zealand Graptolites." Geol. Mag., dec. 5, vol. 5, pp. 145–48. (Collingwood.)

* Stromer von Reichenbach, E. "Die *Archæoceti* des ägyptischen Eocäns." Beitr. Paläont. Œsterr.-Ung., bd. 21, pp. 106–78, plates. (Refers to *Kekenodon onamata* Hector.)

* Thomson, J. A. "Fossils from Kakanui." T.N.Z.I., vol. 40, pp. 98–103, pl. 14, figs. 1–6. (Describes as new *Isis hamiltoni, Cardita benhami,* and *Turbo marshalli,* and notes on other species.)

1909.

Bell, J. M. "Reconnaissance of North Cape Peninsula." 3rd Ann. Rep. (n.s.), N.Z. Geol. Surv. Dept., Parl. paper C.–9, pp. 5, 6. (Miocene. Parengarenga, Tom Bowline Bay.)

——— "Work in the Dun Mountain Subdivision." *Ibid.*, pp. 6–9.

* Bell, J. M., and Clarke, E. de C. "The Geology of the Whangaroa Subdivision." Bull. No. 8 (n.s.), N.Z. Geol. Surv. (Palæontology of the Kaeo Series, pp. 55–58, pl. 12. Cretaceous and Tertiary.)

Borissjak, A. "*Pseudomonotis ochotica* der krym-kaukasischen Trias." Bull. Com. géol. Russie, tom. 28, p. 100. (*Fide* Bœhm). (Refers to *Pseudomonotis richmondiana.*)

Isaacson, E. D. "Notes on the Graptolite-bearing Rocks of New Zealand." Geol. Mag., dec. 5, vol. 6, pp. 74, 75. (Discusses the question of whether one or two zones are present.)

* Marshall, P. "Some New Zealand Fossil Cephalopods." T.N.Z.I., vol. 41, pp. 143–45, pl. 14a. (Trias-Jura. Five new species. No reference to plate.)

* Marshall, P., and Browne, R. "The Geology of Campbell Island and the Snares." In "Subantarctic Islands of New Zealand," vol. 2, pp. 700–3. Wellington, 1909. (Tertiary.)

Park, J. "The Geology of the Queenstown Subdivision." Bull. No. 7 (n.s.), N.Z. Geol. Surv., pp. 66, 67. (Bob's Cove, Lake Wakatipu. Lower Miocene.)

Wilckens, O. "Die Geologische, Paläontologische und Petrographische Literatur uber Neuseeland bis zum Jahr 1907." N.J. f. Min., bd. 2, pp. R. 265–301, 433–64.

1910.

Bell, J. M. "Geological Reconnaissance of the Mokau Country." 4th Ann. Rep. (n.s.), N.Z. Geol. Surv. Dept., Parl. paper C.–9, pp. 5–9. (Tertiary ?)

Clarke, E. de C. In Webb, E. J. H.: "The Geology of the Mount Radiant Subdivision." Bull. No. 11 (n.s.), N.Z. Geol. Surv., p. 18. (Fossils of the Kongahu Series. Tertiary.)

Clarke, E. de C. "Geological Survey of Part of New Plymouth Subdivision." 4th Ann. Rep. (n.s.), N.Z. Geol. Surv. Dept., Parl. paper C.–9, pp. 19–24. (A further summary appeared in the 5th Ann. Rep., 1911. The full bulletin was issued in 1912.)

* Hamilton, A. In Webb, E. J. H.: "The Geology of the Mount Radiant Subdivision." Bull. No. 11 (n.s.), N.Z. Geol. Surv., p. 18. (*Magellania magna* sp. nov. Tertiary.)

Hamilton, A. "The Present Position of New Zealand Palæontology; with a List of Papers on the Palæontology of New Zealand, including the Titles of those Stratigraphical Papers containing Important Lists of Fossils." T.N.Z.I., vol. 42, pp. 46–63.

Marshall, P. In Adams, J. H.: "The Geology of the Whatatutu Subdivision." Bull. No. 9 (n.s.), N.Z. Geol. Surv., pp. 21–23. (Fossils of Whatatutu Series. Upper Miocene.)

Morgan, P. G. "Report on Probable Occurrence of Petroleum and other Minerals in Eastern Wairarapa District." Parl. paper C.–16; pp. 6. (Tertiary. East side of Wairarapa Plain; "Taipos," &c.)

Park, J. "The Geology of New Zealand." Dunedin, 1910. 8vo. Pp. 488. (Numerous figures and lists of fossils reproduced from various sources. A very complete bibliography.)

Suter, H. "List of Recent Shells found Fossil in New Zealand." T.N.Z.I., vol. 42, pp. 8–13.

1911.

Chapman, F. "A Revision of the Species of *Limopsis* in the Tertiary Beds of Southern Australia." Proc. Roy. Soc. Vict., vol. 23 (n.s.), pt. 2, pp. 419–32, pls. 33–35. (*L. insolita:* pp. 425–29; pl. 84, fig. 5; pl. 85, fig. 11.)

Hall, T. S. "On the Systematic Position of the Species of *Squalodon* and *Zeuglodon* described from Australia and New Zealand." Proc. Roy. Soc. Vict., vol. 23 (n.s.), pt. 2, pp. 257–65, pl. 36.

Marshall, P. "New Zealand and Adjacent Islands." Handbuch der Regionalen Geologie, vii band, 1 abth. Heidelberg, 1911.

Marshall, P., Speight, R., and Cotton, C. A. "The Younger Rock-series of New Zealand." T.N.Z.I., vol. 43, pp. 378–407. (An argument for the existence of one rock-series only, embracing the Cretaceous, Cretaceo-Tertiary, Lower and Middle Tertiary of older classifications. See reply by Park, 1911.)

Morgan, P. G. "Field-work in the Buller–Mohikinui Subdivision." 5th Ann. Rep. (n.s.), N.Z. Geol. Surv. Dept., Parl. paper C.–9, pp. 3–9.

Park, J. "The Unconformable Relationship of the Lower Tertiaries and Upper Cretaceous of New Zealand." Geol. Mag., dec. 5, vol. 8, pp. 539–49. (A reply to Marshall, Speight, and Cotton, 1911.)

* Suter, H. "Two New Fossil *Mollusca*." T.N.Z.I., vol. 42, pp. 595, 596, pls. 30, 31. (Describes *Turritella semiconcava* and *Mactra chrydæa* from Kaitangata and Mataroa.)

1912.

* Chapman, F. "New or Little-known Victorian Fossils in the National Museum. Part XV. Some Tertiary Gasteropoda." Proc. Roy. Soc. Vict., vol. 25 (n.s.), pt. 1, pp. 186–92. (*Acmæa octoradiata* Hutton, pp. 186, 187.)

Clarke, E. de C. "The Geology of the New Plymouth Subdivision, Taranaki Division." Bull. No. 14 (n.s.), Geol. Surv. N.Z. (Palæontology of the Onairo Series, pp. 19–21. Miocene.)

Marshall, P. "The Geology of New Zealand." Wellington. 8vo. Pp. viii, 218 (with map).

——— "The Younger Rock-series of New Zealand." Geol. Mag., dec. 5, vol. 9, pp. 314–20. (A reply to Park, 1911.)

Morgan, P. G. "The Geology of the Greymouth Subdivision, North Westland." Bull. No. 13 (n.s.), Geol. Surv. N.Z. (Palæontology of the coal-measures, pp. 60, 61; of the Greymouth Series, pp. 69–73.)

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——— (Otapiri Creek to Benmore.) *Ibid.*, pp. v–vi.

——— "Mount Somers District." *Ibid.*, pp. vi–vii.

——— "Waikato District" *Ibid.*, pp. vii–viii.

——— "Oamaru and Waitaki Districts." *Ibid.*, pp. ix–x.

——— "Masterton and Napier Districts." *Ibid.*, pp. x–xi.

——— "Wangarei." *Ibid.*, pp. xii–xiii.

CHAPTER VIII.

LIST AND INDEX OF FOSSIL LOCALITIES.

Besides serving as an index to the localities mentioned in this bulletin, the list given below states the collections from each locality in the possession of the Geological Survey.† The age ascribed to each collection is that assigned to it by its collector, or by Sir James Hector and Mr. A. McKay. Sufficient details are given about each locality to allow of its location with ease on the map, and it is hoped that the list will thus serve to make New Zealand geological literature more easy of comprehension by those unacquainted with the place-names. The literature dealing with any given collection and locality may be found by one of two methods—either by consulting the other pages of this bulletin to which a reference is indicated, or by searching through the list of papers in Chapter VII for the few years succeeding the date of the collection, keeping in mind that the titles of the papers generally deal with the district in which the locality occurs, and seldom with the actual locality.

The old provincial boundaries are used in this list, because many old papers refer to them. They differ in some respects from the modern land-district boundaries, especially in that part of Nelson (the Amuri district) lying between Marlborough and North Canterbury.

The localities from which new species have been described are marked with an asterisk. The following abbreviations are used :—

Carb. = Carboniferous.	J. = Jurassic.	Perm. = Permian.
Cret. = Cretaceous.	L. = Liassic.	Rh. = Rhætic.
C.-T. = Cretaceo-Tertiary.	L.G. = Lower Greensand.	S. = Silurian.
D. = Devonian.	M. = Miocene.	T. = Triassic.
E. = Eocene.	P. = Pliocene.	

† Excluding those collections made by the reorganized Survey, which have not yet, with one exception, been given locality numbers.

—	Collector and Date.	Locality Number.	Number of Specimens.	Page in this Bulletin.
*Amuri Bluff, Marlborough	..	..	..	10, 11, 16,
Fern-beds, Kai's Hill, Amuri Bluff. *J.*	McKay, 1876	1	2	17, 20, 21,
Calcareous conglomerate, east wing, Amuri Bluff. *L.G.* ..	" "	2	32	54, 56, 58,
Belemnite beds, east wing, Amuri Bluff. *L.G.*	" "	3	15	64.
Trigonia beds, east wing, Amuri Bluff. *L.G.*	" "	4	14	
" " " *L.G.*	" "	5	194	
Aporrhais beds, east wing, Amuri Bluff. *L.G.*	McKay, 1873, 1876	6	52	
Greensands below Black grit, east wing, Amuri Bluff. *L.G.*	Ditto ..	7	4	
Black grit, east wing, Amuri Bluff. *C.-T.*	" ..	8	380	
Boulder sands (Saurian beds), east wing, Amuri Bluff. *C.-T.*	" ..	9	96	
Concretionary greensands, east wing, Amuri Bluff. *C.-T.*	" ..	10	87	
Teredo limestone, east wing, Amuri Bluff. *C.-T.* ..	" ..	11	75	
Amuri limestone, Amuri Bluff	" ..	12	153	
Amuri group, west wing, Amuri Bluff. *L.G.* and *C.-T.* ..	" ..	13	4089	
Oaro Creek, west wing, Amuri Bluff. *L.G.* and *C.-T.* ..	"	14	55	
Amuri Bluff, old collections	H. H. Travers and J. Buchanan	24	2	
" "	Haast, 1869 ..	25	..	
Raised beach (450 ft.), Amuri Bluff	McKay, 1876	158	2121	
Grey marls, Weka Pass stone, and greensand conglomerate, Amuri Bluff. *C.-T.*	" "	275	61	
Recent, Amuri Bluff Hill	" "	767	70	
Amuri district. (See Amuri Bluff and Nelson.) The Amuri district of Nelson is a block of land between Canterbury and Marlborough, reaching the sea on the east coast. It is now included in the Canterbury Land District.	..	..	..	55, 60, 62 64, 66.
Anakaka. (See Onakaka.)				
Anatori, Collingwood County, Nelson.				
Greensands on coast between Anatori and Big River. *C.-T.*	Park, 1889 ..	739	63	
*Aniseed Valley, Nelson. *T.*	Hector, 1866	142	41	15, 34.
Aohanga Falls. (See Akiteo River.)				
Aorere River, Collingwood County, north-west Nelson ..	..	..	..	60, 68.
The Castles, Slate River, Aorere River. *C.-T.*	Cox, 1881 ..	47	145	
Greensands, junction of Boulder Creek with Aorere River. *C.-T.*	Park, 1889 ..	738	26	
*Aotea, west coast of Auckland, between Whangaroa and Kawhia Harbours. *C.-T.* (See also Raglan: Loc. 268)	Hector, 1866	51	4	
Arthur, Mount, Nelson. (See Baton River)	..	..	..	15, 59.
Ashburton River, Canterbury	..	..	..	55.
Fossil Point, Ashburton River. *Oamaru Formation* ..	Haast, 1872 ..	104	31	
Limestone Bluff, Ashburton River. *Up. E.*	Cox, 1876 ..	474	203	
*Ashley County, Canterbury	..	..	..	41, 60.
Otapiri beds, Wharfdale, Ashley County. *Rh.*	McKay, 1879	460	2	
Annelid beds, Ashley Gorge. *Carb.*	McKay, 1871, 1907	807	17	
AUCKLAND PROVINCE	..	..	..	10, 17, 52,
CENTRAL. (See Auckland town, Eden, Te Karaka.)				54, 60, 62,
EAST. (See Bay of Plenty, Coromandel, East Cape district, Poverty Bay, Urewera, Waihou, Waikare-moana.)				63, 67.
NORTH. (See Aotea, Hokianga, Kaeo, Kaipara, Kawakawa, Kawhia, Mangonui, Marsden, North Cape, Pakaraka, Rodney, Tom Bowline Bay, Waitangi, Whangarei, Whangaroa.)	..	..	..	60, 65, 67, 68.
SOUTH-WEST. (See Awakino, King-country, Kupakupa, Mercer, Miranda Redoubt, Mokau, Ongaruhe, Papakura, Raglan, Waikato, Waingaro, Wanganui River.)				
Auckland town. (See Cheltenham, Howick, Onehunga, Orakei Bay, Manukau, Parnell, Takapuna.)	..	..	..	9, 61.
Awakino River, south Auckland.				
Secondary rocks. *J.*	Park, 1887 ..	661	9	
Limestone. *C.-T.*	" " ..	663	1	
*Awamoa, on coast between Oamaru and Kakanui, north-east Otago	..	..	..	9, 20.
Awamoa beach and creek. *M.*	McKay, 1876	170	16568	
Awamoa. *M.*	Traill, 1865 ..	213	..	
" *M.*	" 1874 ..	254	27	
Awamoa bridge, Dunedin–Oamaru Road. *Up. E.* ..	McKay, 1876	327	67	
Marls under Ototara limestone, Cape Hills, at northern end of Awamoa beach. *C.-T.*	" 1883	499	25	
(See also Parimoa).				

	Collector and Date.	Locality Number.	Number of Specimens.	Page in this Bulletin.
Awamoko. (See Ngapara.)				
Awanui, East Cape district, Auckland.				
Awanui. *Cret.*	McKay, 1874, 1886	89	127	
Awatere Point, south of Awanui. *Cret.*	Ditto ..	127	41	
Secondary beds, Awanui. *C.-T.*	McKay, 1887	688	223	
Fossiliferous calcareous rock, Awanui. *C.-T.*	„ 1892	778	26	
Awatere Point. (See Awanui.)				
*Awatere River, Marlborough	..	..	..	52, 66.
Awatere River (lower). *Up. M.*	Buchanan 1867	126	212	
Black Birch Creek, Blairich, Awatere Valley. *M.* ..	McKay, 1885	559	1	
Gladstone and Middlehurst Runs, Upper Awatere. *C.-T.*..	„ 1888	741	135	
Banks River	..	..	..	9, 51.
Bannockburn, Cromwell, Central Otago.				
Plants. *M.*	McKay, 1882	510	52	
Shells and fish-remains. *M.*	„ „	511	25	
Bastion Hill, opposite Flag Hill, west side of Otapiri Creek, Hokanui Hills, Southland.				
Upper *Plagiostoma* beds, west face of Bastion Hill. *L.* ..	McKay, 1878	345	106	
Baton River, Wangapeka River, Motueka River, Nelson ..	..	..	..	15, 30, 31, 59.
Grits and marls over coal at junction below Taylor's house, Baton River. *C.-T.*	McKay, 1879	42	16	
Mount Arthur, gorge of Baton River, above Taylor's. *S.*	„ „	128	3150	
Marls overlying chalky limestone, Baton River. *C.-T.* ..	Hector, 1868	324	21	
Baton River, near junction of the Clark River. *C.-T.* ..	McKay, 1879	462	451	
Clark River, near junction of the Baton River. *C.-T.* ..	„ „	463	25	
(See also Motueka River.)				
Bay of Plenty. (See Opotiki, Raukokore, Te Kahu.)				
Benmore, Hokanui Hills, Southland	..	..	..	50, 75.
Benmore. *T.*	Hector, 1869	137	9	
Benmore Yards. *R.*	McKay, 1878	363	32	
Trigonia beds, slopes of south peak of Benmore. *Rh.* ..	„ „	368	50	
Benmore sandstone, south peak, Benmore. *Rh.* ..	„ „	369	2	
* „ Benmore railway-cutting. *Rh.* ..	„ „	371	77	
Monotis sandstone, south peak of Benmore. *T.* ..	„ „	374	7	
Inoceramus beds, overlying big conglomerate, Benmore Run. *Perm.*	„ „	378	59	
Birch's. (See Kaimanawa.)				
Black Birch Creek. (See Awatere.)				
Black Birch Creek, Pahau River, Hurunui River, south-east Nelson. *Oamaru formation.*	Haast, 1869 ..	305	16	
Black Point. (See Waitaki.)				
Blairich. (See Awatere River.)				
*Blind Bay, near Nelson	..	..	..	9, 51.
Bloody Jack's Island, Catlin's River, south-east Otago.				
Mainland opposite. *L.*	McKay, 1873	148	243	
Bluff River. (See Clarence River.)				
Bobbie's Creek. (See Waipara.)				
Bobby's Head, near Palmerston, Otago.	..	..	..	60, 68, 73.
Between south end of Mount Royal and sea at Bobby's Head. *C.-T.*	McKay, 1886	608	7	
Tertiary beds on coast at Bobby's Head	„ „	632	..	
Bob's Cove. (See Wakatipu.)				
Boby's (Booby's) Creek. (See Waipara.)				
Brighton, near Dunedin, Otago. (See Green Island) ..	..	..	..	64.
*Brighton, west coast of Nelson.				
Welshman's Terrace, Fox River; roof of coal. *Cret.* ..	McKay, 1873–4	28	66	
Island sandstone, Woodpecker Bay, near Brighton. *C.-T.*	„ 1874	31	299	
Above Island sandstone, Woodpecker Bay, near Brighton. *C.-T.*	„ „	33	29	
St. Kilda, Brighton. *C.-T.*	„ „	45	1362	
Seal Rock, Woodpecker Bay, near Brighton. *C.-T.* ..	„ „	46	26	
Fox River, Brighton. *M.*	„ „	125	8	
*Broken River. (See Trelissick Basin)	..	..	..	64.
*Brown, Mount. (See Waipara River.)				
Brunner. (See Greymouth.)				
Brunnerton. (See Greymouth.)				
Buller River. (See Hughie's, Inangahua River, Maruia River, and Westport.)	..	..	..	56, 58, 61, 64, 67, 74, 75.
Bushy Park. (See Shag Valley.)				
Cabbage Bay, west side Cape Colville Peninsula, Auckland ..	..	..	..	63, 65, 68.
Cairn Range. (See Malvern Hills)	..	..	..	46, 59.

—	Collector and Date.	Locality Number.	Number of Specimens.	Page in this Bulletin.
*Callaghan's Hill, Westland	..	..	..	56.
Callaghan's Hill. *M.*	Hector, 1866	26	1	
,, *M.*	McKay, 1875	153	478	
,, *M.*	Hector, 1869	225	24	
Campbell, Cape, Marlborough	..	..	..	9, 53.
Eastern shore of Lake Grassmere, near Cape Campbell. *C.-T.*	McKay, 1876	314	18	
(See also Flaxbourne.)				
*Campbell Island	..	..	..	62, 73.
Canterbury Province	..	..	..	10, 53, 55, 59, 71.
Central. (See Ashburton, Clent Hills, Curiosity Shop, Fern Gully, Lyndon, Malvern Hills, Oxford, Rakaia River, Mount Somers, Mount Torlesse, Trelissick.)				
North. (See Ashley, Hurunui, Kohai, Kowai, Motunau, Okuku, Waikare, Waipara, Weka Pass, and *cf.* Amuri district of Nelson)	..	..	..	17, 57, 60.
South. (See Kakahu, Mueller Glacier, Ohau, Pareora, Mount Potts, Waihao)	..	..	..	58, 62.
Cape Hills. (See Oamaru.)				
Castle Hill. (See Trelissick Basin.)				
Castle Hill Mine. (See Kaitangata.)				
* Castlepoint, east coast of Wellington	..	..	..	56, 69.
Castlepoint. *Lower P.*	McKay, 1874–5	37	9	
,, *Up. M.*	,, 1875	81	814	
Nummulitic limestone, Whareharua, near Castlepoint ..	Hector, 1874	844	..	
Castle Range. (See Pourerere.)				
Castle Rock. (See Oreti River.)				
Castles, The. (See Aorere River.)				
*Catlin's River, south of Nugget Point, Otago	..	..	..	16, 35, 36, 42, 56, 71.
Mouth of Catlin's River. *J.*	McKay, 1873	20	80	
Pholadomya Point, Catlin's River. *J.*..	,, ,,	21	67	
Nugget Point to Catlin's River	,, ,,	801	14	
(See also Bloody Jack's Island, Nugget Point, Owaka Creek, Tautuku.)				
Cave Hill. (See Collingwood.)				
Cave Valley. (See Oamaru.)				
*Caverhill, Mount, Nelson. (Exact locality uncertain.)				
Mount Caverhill. *M.*	Haast, 1869 ..	216	20	
*Caversham, Dunedin, Otago.				
Caversham. Old collections from Otago Provincial Survey. *C.-T.*	..	53	17	
Caversham. *C.-T.*	McKay, 1873	53		
,, *C.-T.*	,, 1876	309	32	
(See also Green Island.)				
Chain Hills, near Dunedin, Otago.				
Chain Hills. Plants. Old collections. *C.-T.*	..	797	3	
Chasm Creek. (See Mokihinui.)				
*Chatham Islands	..	..	..	9, 51, 55, 69, 70.
Chatham Islands. *Up. E.*	Travers ..	792	134	
Cheltenham, North Shore, Auckland.				
Volcanic grit, Cheltenham Beach. *M.*	Park, 1887 ..	697	..	
North end of Cheltenham Beach. *M.*	McKay, 1887	731	4	
Cheviot Hills, Nelson.				
West slope of Cheviot Hills, Coast Range. *C.-T.* ..	,, 1882	502	6	
Upper Pareora beds, Cheviot Hills. *M.*	,, ,,	505	35	
Clarence River, Marlborough	..	..	..	17.
Coverham, Middle Clarence Valley. *Cret.*	McKay, 1884	518	16	
Waipapa Boat-harbour, mouth of Clarence River. *C.-T.*	,, 1885	555	84	
Quail Flat, Middle Clarence Valley. Plants. *C.-T.* ..	,, ,,	560	61	
,, ,, *C.-T.*	,, ,,	568	174	
,, ,, Fresh-water shells.	.. ..	571	31	
C.-T.		572	74	
Amuri limestone, Seymour River, Middle Clarence Valley. *C.-T.*	,, ,,	570	51	
Grey marls, mouth of Seymour River, Middle Clarence Valley. *C.-T.*	,, ,,	610	12	
Weka Pass stone, Seymour River, Middle Clarence Valley. *C.-T.*	,, ,,	569	41	
Grey marls, Muzzle River, Middle Clarence Valley. *C.-T.*	,, 1886	611	22	
,, Dart River, Middle Clarence Valley. *C.-T.* ..	,, ,,	612	9	
Great Post-Miocene conglomera e, Bluff River, Middle Clarence Valley. *P.*	,, 1885	613	15	

—	Collector and Date.	Locality Number.	Number of Specimens.	Page in this Bulletin.
Clarence River, Marlborough—*continued.*				
Black grit, Coverham, Middle Clarence Valley. *C.-T.* ..	McKay, 1885	614	..	
Bluff River, at junction with Clarence, Middle Clarence Valley. *C.-T.*	,, ,,	615	38	
Red Hill Creek, Bluff River, Middle Clarence Valley. *C.-T.*	,, ,,	616	..	
Grey marls, Bluff River, Middle Clarence Valley. *C.-T.* ..	,, ,,	617	40	
Weka Pass stone, Bluff River, Middle Clarence Valley. *C.-T.*	,, ,,	618	2	
Clarendon, thirty miles south-west of Dunedin	..	..	..	70, 72.
Clark River. (See Baton River and Motueka River.)				
*Clent Hills, Ashburton County, Canterbury	..	..	..	10, 15, 21,
Smyth River, Lake Heron. *C.-T.*	Haast, 1872 ..	102	14	42–48, 53,
Potato Gully, Clent Hills. Plants. *J.* (?)	,, ,, ..	405	194	55, 57, 58,
Plant-beds, Potato Gully, Clent Hills. *J.*	McKay, 1877	546	..	62, 63.
Coal-beds, Lake Heron, Clent Hills. *C.-T.*	Haast, 1872 ..	788	7	
Clifton, Nelson. *M.*	Hector, 1868..	303	..	
Clyde, Wairoa River, Hawke's Bay. *P.*	McKay, 1887	706	42	
Coal Creek, McRae's, Lora, Hokanui Hills	..	..	..	45, 46.
Coal Creek, Otapiri River. (See Otapiri.)				
*Cobden, near Greymouth, West Coast, Nelson. (See Greymouth)	..	..	..	65, 67, 75.
Collingwood, Nelson, north-west corner of South Island ..	..	..	..	14, 15, 17,
Graptolite beds, Golden Ridge, Collingwood. *Low. S.* ..	Cox, 1882 ..	547	533	28, 29, 58,
Graptolites from Golden Ridge Claim, Taitapu, Collingwood	Park, 1889 ..	740	125	60, 66–68,
Dirty greensands, Puponga Point, Collingwood County. *C.-T.*	,, ,, ..	742	28	72, 73.
Ferruginous sandstone, Puponga Point, Collingwood County. *Up. E.*	,, ,, ..	743	34	
Blue clays on coast near Onakaka, Collingwood County. *C.-T.*	,, ,, ..	745	..	
Cave limestone, Cave Hill, Collingwood County. *C.-T.* ..	,, ,, ..	746	45	
Collingwood Coal-mine, Collingwood County. Plants ..	Hector ..	796	10	
Slaty Creek, Collingwood. *Ordovician*	Clarke, 1907..	848	22	
(See also Anatori, Pakawau.)				
Conical Hill. (See Otapiri.)				
*Conway River, between Marlborough and south-east Nelson.				
Conway River. *Cret.*	Buchanan, 1868	36	25	
Cook's Cove. (See Tolago Bay.)				
Cooper's Beach, Mangonui, north Auckland	..	..	..	67.
Coromandel, east of Auckland. (See also Cabbage Bay, Manaia Hill, Moehau)	..	..	..	35, 36, 60, 69, 72.
Coverham. (See Clarence River.)				
*Cowan's. (See Oreti River)	..	..	..	35.
Cromwell, Central Otago. Plants. *C.-T.* (See also Bannockburn)	..	419	..	
*Culverden, south-east Nelson	..	..	..	55, 56.
Culverden. *Oamaru formation*	Haast, 1869 ..	110	134	
,, ,, ...	McKay, 1874	303	..	
*Curiosity Shop, Rakaia River, Canterbury	..	..	..	17, 55, 59
Curiosity Shop. *Oamaru formation*	McKay, 1879	311	2699	60, 62.
,, *Up. E.* and *C.-T.*	,, ,,	549	598	
Dannevirke, seventy-nine miles south-west of Napier, Hawke's Bay	..	..	..	68.
Dart River, Marlborough. (See Clarence River.)				
Dart River, Nelson. (See Motueka.)				
*Deans, The. (See Waipara River.)				
Devil's Bridge. (See Oamaru.)				
Doctor's Gorge. (See Waipara.)				
Donald, Mount. (See Weka Pass.)				
*Dorset's, Forty-mile Bush, Wellington. *M.* or *Old. P.* ..	McKay, 1877	180	41	
Drury, south of Auckland	..	..	..	52, 55, 60.
Dun Mountain, east of Nelson	..	..	..	58, 73.
Dun Mountain. *Carb., Maitai Series*	Hector, 1866; McKay, 1878	143	25	
Fossiliferous slates, Dun Mountain tramway. *Carb.* ..	McKay, 1878	399	..	
Dunback, Shag Valley, Waihemo County, Otago.				
Dunback and "The Grange" (Kitchener's). *C.-T.* ..	McKay, 1886	598	..	
(See also Shag Valley.)				
Duncan's. (See Tokomaru.)				
Dunedin, Otago	..	..	..	71.
Otago Harbour. *Recent*	..	331	4	
(See also Caversham, Chain Hills, Green Island.)				

—	Collector and Date.	Locality Number.	Number of Specimens.	Page in this Bulletin.
Dunsdale, Hokanui Hills, Southland.				
Lower plant-beds, Dunsdale. *J.*	Park, 1887	667	1	
*Dunstan, Central Otago. Fresh-water shells	..	824	12	
East Cape district, Auckland. (See also Akuaku, Awanui, Hicks Bay, Roparua, Tokomaru, Tolago, Tuparoa, Waipau, Waipiro)	..	..	..	35, 51, 54, 56, 57, 64, 70.
Eden County, central Auckland	..	..	..	63.
Eighty-eight Valley, Waimea County, Nelson	..	..	..	15, 33, 35, 43, 44.
Plant-beds, Eighty-eight Valley. *L.* or *Rh.*	McKay, 1878	195	89	
Trigonia beds, Eighty-eight Valley. *L.* or *Rh.*	,, ,,	196	550	
Spiriferina beds, Eighty-eight Valley. *L.* or *Rh.*	,, ,,	197	107	
Monotis beds, Eighty-eight Valley. *T.*	,, ,,	432	50	
Halobia beds, Eighty-eight Valley. *T.*	,, ,,	433	88	
Mytilus beds, Eighty-eight Valley. *T.*	,, ,,	434	100	
Psioidea beds, Eighty-eight Valley. *T.*	,, ,,	435	115	
Kaihiku beds, Eighty-eight Valley. *Perm.*	,, ,,	436	639	
Sellen's, Eighty-eight Valley. *Carb.*	,, 1879	473	2	
Elizabeth, Point. (See Greymouth.)				
*Esk River, Hawke's Bay	..	..	..	65.
Pumice sands, Kawaka Station, Esk River. *P.*	McKay, 1886	681	52	
Esk River. *P.*	,, ,,	683	369	
Beds between bands of Petane limestone, Esk River. *P.*	,, ,,	717	25	
Upper band of Petane limestone, Lower Esk to Petane Hotel. *P.*	,, ,,	720	466	
Plant-beds, pumice sands, Kawaka Station, Esk River. *P.*	,, ,,	721	3	
Kawaka Hill (inland of Patea Road)	(?) ..	793	1	
(See also Petane.)				
Evans Bay. (See Wellington.)				
*Farewell, Cape, Nelson (north-east corner of South Island).				
Kaipuki Cliffs, Cape Farewell district. *Up. E.* (?)	Hector, 1867	230	13	
Fossil Point, Cape Farewell. *Oamaru formation.*	,, 1868	296	50	
Fern Gully, Mount Rowley, Upper Ashburton River, Canterbury. (See Clent Hills.)	..	..	..	43, 47, 53.
Flag Hill, Hokanui Hills, Southland	..	..	..	33, 35.
Avicula beds, Flag Hill. *J.*	McKay, 1877	333	58	
Astarte beds, top of Flag Hill. *J.*	,, ,,	336	36	
Highest *Spirifer* bed, north face of Flag Hill. *J.*	,, 1878	339	242	
Lower belemnite beds, north face of Flag Hill. *J.*	,, ,,	341	32	
Little *Spirifer* grit, north face of Flag Hill. *J.*	,, ,,	342	33	
Upper *Plagiostoma* bed, west face of Flag Hill. *L.*	,, ,,	343	29	
,, north face of Flag Hill. *L.*	,, ,,	344	133	
Upper ammonite bed, west face of Flag Hill. *L.*	,, ,,	347	8	
Overlying Cannon-ball sandstone, Flag Hill to North Peak section. *L.*	,, ,,	351	24	
Lower part of lower ammonite beds, Flag Hill to North Peak section. *L.*	,, ,,	357	63	
Plant-beds, top of Flag Hill. *J.*	Park, 1887	671	30	
Flaxbourne, Cape Campbell district, Marlborough. (Flaxbourne is now called Ward.)				
Flaxbourne. *C.-T.* or *Cret.*	McKay, 1876	265	1	
Flaxbourne River. *M.*	McKay, 1876, 1884	563	6	
(See also Cape Campbell.)				
Forest Hill Range, Southland. *Up. E.*	McKay, 1878	247	..	
Forty-mile Bush. (See Dorset's.)				
Fossil Gully, Mount Potts (= Rocky Gully *apud* McKay.) (See Mount Potts.)	..	..	..	40, 53.
Fossil Point, Canterbury. (See Ashburton River.)				
,, Nelson. (See Cape Farewell.)				
*Foulwind, Cape. (See Westport.)				
Fox River. (See Brighton, Nelson.)				
Gisborne district, Poverty Bay, east Auckland.				
Bryant's Farm, near Gisborne. *C.-T.* or *T.*	McKay, 1874	65	8	
Ormond. *P.*	,, ,,	212	39	
Limestone, twelve miles north of Ormond, Gisborne–Opotiki Road. *P.*	,, 1887	710	9	
Pumice sands, Gisborne–Opotiki Road. *P.*	,, ,,	711	2	
Whakamarumaru, Matapiro, Gisborne	Fulton	846	1	
Gladstone. (See Ruamahanga River.)				
Glenburn, east coast, Wellington.	..	..	..	69.
Golden Ridge. (See Collingwood.)				
Goodwood, near Palmerston South, Otago.				
Anderson's Farm, Goodwood Estate. *C.-T.*	McKay, 1886	607	3	
(See also Pleasant River.)				

—	Collector and Date.	Locality Number.	Number of Specimens.	Page in this Bulletin.
*Gore, Southland. (See also Mataura)	..	..	..	14, 33, 35, 39, 41, 43, 45, 49, 72.
Graham River. (See Motueka River.)				
Grassmere Lake. (See Cape Campbell.)				
Great Barrier Island, Hauraki Gulf	Hutton, 1866	292	..	
Green Island, near Dunedin, Otago (not an island).				
Greensands, Green Island. *C.-T.*	McKay, 1873	22	102	
Belemnitella beds, Brighton, Green Island. *C.-T.*	„ 1886	628	51	
(See also Caversham, Scrogg's Hill.)				
Green Valley, Upper Shag Valley, Otago. *C.-T.*	McKay, 1883	507	4	
Grey Coalfield. (See Greymouth.)				
Grey, Mount, north Canterbury	..	..	..	9.
Greymouth, north Westland. (Some of the localities below are in south-west Nelson.)	..	..	..	65, 69, 74.
Ten-mile Creek, on coast north of Grey River; roof of coal-seam. *Cret.*	McKay, 1873–4	27	261	
Brunner Mine, Grey Valley. *Cret.* (?)	„ 1874	29	37	
Nine-mile Bluff, north of Greymouth. *Cret.*	„ 1873	32	73	
*Cobden limestone, Greymouth. *Cret.*	„ „	35	314	
Port Elizabeth	„ „	58	73	
Darkie's Terrace, west slope of the Cobden Range. *C.-T.*	„ „	59	51	
Foraminiferal limestone, Greymouth. *C.-T.*	„ „	61	101	
Cobden limestone, Greymouth	Hector, 1869	64	1	
Point Elizabeth, five miles north of Grey River. *C.-T.*	(?) ..	266	..	
Cobden limestone, Marsden–Greymouth Road. *C.-T.*	McKay, 1873	286	1	
Brunner Mine, Grey Coalfield. *Cret.*	Hector, 1869	412	44	
Marls overlying *Crystellaria* limestone, Greymouth. *M.*	McKay, 1882	497	64	
Coal-beds, Brunnerton. *C.-T.*	„ „	509	6	
Cobden limestone, quarries at Greymouth. *C.-T.*	(?) 1891	757	126	
Nummulitic limestone, Greymouth. *C.-T.*	(?) „	758	46	
Hakarimata Range. (See Raglan.)				
Hamilton, Mount, Wallace County, Southland. *Cret.*	Hector, 1869	415	10	
*Hampden, north-east Otago (also known as Onekakara).	..	..	..	9, 51, 52.
(?) Hampden. *C.-T.*	Traill, 1865 ..	214	2	
Hampden Beach and Moeraki Peninsula. *C.-T.*	McKay, 1883	501	84	
Middle part of north side of Moeraki Peninsula. *C.-T.*	„ 1886	595	99	
Hampden Beach, one to two miles north of Hampden. *C.-T.*	„ „	596	175	
Hampden Beach, north end from one mile south of White (or Duffy's) Bluff. *C.-T.*	„ „	597	58	
White Bluff, north end of Hampden Beach. *C.-T.*	„ „	623	6	
Happy Valley. (See Motunau.)				
Hapuka River, Looker-on Mountains, east Marlborough. *C.-T.*	McKay, 1876	293	16	
Harbour Cone, Otago Peninsula, near Dunedin	..	..	..	72.
*Harris, Mount. (See Waihao River.)				
*Hautapu Falls. (See Rangitikei River.)				
Hauturu. (See Kawhia.)				
Hawke's Bay Province	..	..	..	55, 58, 63, 64.
Grey marls of northern part of Hawke's Bay. *C.-T.* (?)	Cox, 1876 ..	284	8	
(See also Ahuriri, Clyde, Dannevirke, Esk, Kereru, Kidnappers, Mahia, Manawatu, Maungakuri, Mohaka, Napier, Ngaruroro, Petane, Pohui, Pourere, Ruataniwha, Scinde Island, Shrimpton's, Te Aute, Te Kopanga, Tukituki, Turnagain, Waimirima, Waipawa, Waipukurau, Woodville.)				
Hawksbury Survey District, east Otago. (See also Waikouaiti)	..	..	..	64.
Heao. (See Wanganui River.)				
Heathstock. (See Waipara.)				
Heaver's Creek. (See Kekerangu.)				
Hedgehope, Hokanui Hills, Southland.				
Henley, twenty-one miles south-west of Dunedin	..	..	..	67.
Heron Lake. (See Clent Hills.)				
Heslington, Mount. (See Wairoa Gorge.)				
*Hicks Bay, East Cape district. *Oamaru formation*	Hector, 1874..	263	30	53.
Highfield Ridge. (See Waiau-ua.)				
Hikurangi. (See Whangarei)	..	..	..	67, 68.
Hobson County, north Auckland	..	..	..	65.
Hochstetter Glacier, Mount Cook district, Canterbury	..	..	..	55.
Hokanui Hills, Southland	..	..	..	15, 16, 33–46, 49, 50, 54, 58, 64, 65.
Orepuki Stream, Hokanui Hills. *Up. E.*	Hector, 1869	262	76	
Higher part of Lower *Plagiostoma* beds, Hokanui Hills. *L.*	McKay, 1878	348	154	
Lower part of Lower *Plagiostoma* beds, Hokanui Hills. *L.*	„ „	349	111	
Between lower part of Lower *Plagiostoma* beds and Middle Ammonite bed, Hokanui Hills	„ „	350	29	

	Collector and Date.	Locality Number.	Number of Specimens.	Page in this Bulletin.
Hokanui Hills, Southland—*continued.*				
Hokanui Hills. Old mixed collections	..	837	21	
(See also Bastion Hill, Benmore, Dunsdale, Flag Hill, Hedgehope, Makarewa, Mandeville, Morley Creek, North Peak, Otamita River, Otapiri, Mount Peel, Taylor's.)				
Hokianga, west side, north Auckland	..	..	..	61, 66, 68.
Hokianga Harbour. *Tertiary beds*	Hector, 1874	198	..	
The Narrows, Hokianga Harbour. *C.-T.*	McKay, 1888	730	8	
Orbitolite limestone, Hokianga South Head. *M.* ..	,, ,,	733	67	
Howick, fifteen miles south-east of Auckland.				
Slate-grit bed, beach near Howick, *M.* (?)	Park, 1885 ..	533	37	
Teredo bed, beach near Howick. *M.*	,, ,, ..	534	23	
Maungamaungaroa Bridge, Howick. *C.-T.* (?)	,, ,, ..	541	693	
Hughie's old diggings, Lower Buller Gorge. *C.-T.*	McKay, 1874	15	12	
Huntly, sixty-five miles south of Auckland. (See Raglan) ..	..	..	..	62, 63.
Hunua, near Drury, Auckland	..	..	..	52.
*Hurunui River, between north Canterbury and south-east Nelson.				
Hurunui Mound. *M.*	Haast, 1869 ..	232	27	
*Hutchinson's Quarry. (See Oamaru.)				
*Inangahua River, Buller River, west Nelson.				
Junction Inangahua and Buller Rivers. *C.-T.*.. ..	McKay, 1874	48	94	
Ferry, Westport–Reefton Road, Inangahua River. *C.-T.*	,, ,,	49	36	
*Christie's, Inangahua Valley. *C.-T.*	,, ,,	50	29	
Isolated Hills, near Waiau, south-east Nelson.				
Isolated Hills. *Up. E.* or *M.*	McKay, 1885	558	18	
Central part of Isolated Hills. *M.*	,, ,,	565	47	
Ivitai, Mount = Puke ivitai or Puke iwi tahi.				
*Jackson's Paddock, near Oamaru.				
Janet's Peak. (See Shag Valley.)				
Jebson's Coal-mine. (See Malvern Hills.)				
Jenkin's Hill, Bishopdale, Nelson. Railway-cutting. *C.-T.* or *Low. Tert.*	McKay, 1874	62	30	
Johnston's. (See Ruataniwha Plain.)				
Judge's Bay. (See Parnell.)				
Kaeo, Whangaroa County, north Auckland	..	..	..	67, 73.
Kaeo River. *C.-T.* (?)	McKay, 1875	107	281	
Shepherd's Farm, Kaeo Run. *M.*	,, 1890	755	144	
Kaiata, north Westland	..	..	..	69.
Kaihiku, between Clinton and Balclutha, south Otago ..	..	..	..	15, 35.
Lower Kaihiku Gorge. Plants. *Perm.*	McKay, 1873	16	37	
Wairoa Series, Kaihiku Gorge. *T.*	,, ,,	75	..	
Kaihiku Series, lower part of Kaihiku Gorge. *Perm.* ..	,, ,,	131	62	
Kaihiku Gorge	Buchanan ..	841	19	
Kai-iwi. (See Wanganui)	..	..	..	62.
*Kaikoura, east coast, Marlborough	..	..	..	15, 54, 58, 62, 69.
Dark marls, extremity of Kaikoura Peninsula. *C.-T.* ..	McKay, 1876	157	1	
Below Amuri limestone, Kaikoura Peninsula. *C.-T.* ..	,, ,,	294	5	
Grey marls, Kaikoura Peninsula. *C.-T.*	,, 1886	619	3	
Limestone quarry, Kaikoura	Captain Fraser	825	..	
Kaimanawa Range, north Wellington	..	..	..	62, 69.
Greensands under *Balanus* limestone, Birch's, Kaimanawa Range. *P.*	Park, 1886 ..	585	255	
Plant sandstones under *Balanus* limestone, Birch's, Kaimanawa Range. *P.*	,, ,, ..	586	13	
Balanus limestone. Kaimanawa Range. *P.*	,, ,, ..	587	76	
*Kaipara district, north Auckland..	..	..	..	57, 59, 62–65.
Komiti Point, Kaipara. *M.*	Cox, 1880 ..	451	617	
Opposite Captain Colbeck's, Kaipara River. *C.-T.* (?) ..	,, ,, ..	465	5	
Tangiteroria, Wairoa River. *Cret.*	,, 1879 ..	467	5	
Beach, Hargreave's Run, opposite Komiti. *Up. E.* ..	Park, 1885 ..	530	25	
Strawberry Bay, Wairoa side of Komiti Peninsula. *Up. E.*	,, ,, ..	531	25	
Lower Komiti Point beds, Kaipara Harbour. *C.-T.* (?) ..	,, ,, ..	542	194	
Upper Komiti Point beds (dirt-bed). *M.*	,, ,, ..	543	247	
Greensands, Pahi, Kaipara Harbour. *C.-T.*	..	544	408	
Gibson's, Te Ope Creek, Pahi. *C.-T.*	Park, 1887 ..	696	..	
Greensands below limestone, Colbeck's Landing, Pahi. *C.-T.*	,, ,, ..	698	104	
Limestone, Colbeck's Landing, Pahi. *C.-T.*	..	699	4	
Beds below hydraulic limestone, Batley. *C.-T.* ..	Park, 1887 ..	700	4	
Pahi greensands, Pahi Township. *C.-T.*	McKay, 1887	732	24	
Amuri Series, Paparoa River. *C.-T.*	,, 1888	734	8	

	Collector and Date.	Locality Number.	Number of Specimens.	Page in this Bulletin.
*Kaipuki Cliffs. (See Cape Farewell.)				
*Kaitangata, south-east Otago	..	..	..	67, 74.
Measley Beach, near Kaitangata. *C.-T.* (?)	Hector, 1869	280	14	
Castle Hill Shaft, Kaitangata. *C.-T.*	" 1891	759	366	
Measley Beach. *M.*	" "	760	373	
Kaituna Valley, Marlborough	..	..	..	59.
Kaiwaiki. (See Wanganui River.)				
Kaiwhata River, east coast, Wellington	..	..	..	69.
*Kakahu River, south Canterbury	..	..	..	63.
Coal-beds, Kakahu River. *C.-T.*	Monro, 1869	56	..	
Weka Pass stone, Kakahu River. *C.-T.*	McKay, 1876	162	14	
Greensands overlying coal-beds, Kakahu River. *C.-T.* ..	" "	163	21	
Coal-beds, Kakahu River. *C.-T.*	" "	164	377	
Pareora beds, Kakahu River. *M.*	Park, 1885 ..	577	172	
Greensands under Weka Pass stone, Kakahu River. *C.-T.*	" " ..	578	35	
Weka Pass stone, Kakahu River. *C.-T.*	" " ..	579	5	
*Kakanui, south of Oamaru, north-east Otago	..	..	..	52, 70, 72 73.
Kakanui limestone, mouth of Kakanui River. *C.-T.* ..	McKay, 1876	169	18	
Ototara limestone, Isolated Hill, north side of mouth of Kakanui River. *C.-T.*	" 1882	489	142	
Volcanic breccia or tuff, underlying Ototara limestone, Isolated Hill. *C.-T.*	" "	490	161	
Chalk marls, left bank, Kakanui River, opposite Maheno. *C.T.*	" "	498	2028	
Ototara limestone, south side of mouth of Kakanui River. *C.-T.*	" 1886	600	87	
Maheno marls, left bank, Kakanui River, a little below Maheno. *C.-T.*	" "	606	931	
Hutchinson's Quarry beds, All Day Bay, one mile south of Kakanui. *Up. E.*	" "	624	41	
Pareora beds, All Day Bay. *M.*	" "	625	112	
Junction between Ototara limestone and dirty greensands representing Hutchinson's Quarry beds, All Day Bay, one mile south of Kakanui. *Up. E.*	" "	626	500	
Isolated Hill, Limekiln Hill, Kakanui. *C.-T.*	" "	627	28	
*Kanieri River, Westland.				
Kanieri River. *M.*	McKay, 1875	154	162	
Kanieri. *M.*	Hector, 1869	227	117	
Karori. (See Wellington.)				
Kartigi Beach. (See Shag Point.)				
Katigi = Kartigi.				
Kawaka. (See Esk River.)				
Kawakawa, Bay of Islands, north Auckland	..	..	..	67, 68.
Whangarei and Kawakawa. *C.-T.*	Hector, 1866	279	5	
Kawakawa. Plants. *C.-T.*	" "	417	..	
Kawakawa. *C.-T.*	Cox, 1879 ..	454	151	
Kawakawa Coal-mine. *C.-T.*..	McKay, 1888	735	2	
Limestone above shell-bed, Kawakawa Coal-mine. *C.-T.*	" 1884	748	69	
Waiomio limestone, Waiomio Creek, Kawakawa. *C.-T.* ..	" 1892	777	8	
Kawakawa (roof of coal) and Whangarei (shells) ..	Old collections	783	14	
*Kawau Island, Hauraki Gulf, Auckland	..	..	..	60.
Kawau Island. *M.*	Hector, 1866..	257	84	
Kawau Island. *M.*	Cox, 1880 ..	548	1	
*Kawhia Harbour and district, west coast, south Auckland ..	..	..	..	10, 15, 16, 22, 33–41, 51, 61–63.
Kawhia Harbour. *J.*	Hector, 1866..	276	336	
Motutara Bluff, north side, Kawhia Harbour. *C.-T.* ..	McKay, 1884	513	12	
Below limestone, near Totara Point, north side Kawhia Harbour. *C.-T.*	" "	515	16	
Waiherike River, south side, Kawhia Harbour. *J.* ..	" "	516	761	
Motutara Bluff, north shore, Kawhia Harbour. *C.-T.* ..	" "	517	18	
Flag Hill Series, south shore, Kawhia Harbour. *J.* ..	" "	520	863	
Takatahi, south shore, Kawhia Harbour. *J.*	" "	521	63	
Putataka beds, north shore, Kawhia Harbour. *J.* ..	" "	522	117	
Bastion Series, coast between Kawhia Harbour and Albatross Point. *L.*	" "	523	65	
Otapiri Series, coast between Kawhia Harbour and Albatross Point. *Rh.*	" "	524	9	
Wairoa Series, coast between Kawhia Harbour and Albatross Point. *T.*	" "	525	2	
Okoko, Waipa–Kawhia Road. *C.-T.*	Park, 1885 ..	526	317	
Shelly limestone, Hauturu, Waipa	" " ..	527	8	
Ammonite beds, north shore, Kawhia Harbour	(?) ..	826	47	

—	Collector and Date.	Locality Number.	Number of Specimens.	Page in this Bulletin.
Kawia. (See Kawhia.)				
Kekerangu, east coast, Marlborough.				
Grey marls, Kekerangu. *C.-T.*	McKay, 1884	514	24	
Kekerangu Creek. *C.-T.*	,, ,,	519	..	
Heaver's Creek, Kekerangu. *C.-T.*	,, 1885	554	583	
Grey marls, Shades Creek, Kekerangu. *C.-T.*	,, ,,	561	8	
Kereru, forty-three miles south-west of Napier, Hawke's Bay.				
Rotella beds, Kereru. *P.*	McKay, 1877	188	973	
Limestone, Kereru. *P.*	,, ,,	189	2	
Lower beds, Kereru. *P.*	,, ,,	190	327	
*Kidnappers, Cape, south end Hawke's Bay	..	..	..	56, 58, 66.
Scinde Island limestone, Cape Kidnappers. *P.*	Hector, 1866; McKay, 1875	77	1	
,, ,, *P.*	McKay, 1875	78	99	
Marly strata, Cape Kidnappers to outlying stacks. *P.* (?)	,, ,,	79	..	
Maraetotara River, Kidnappers district. *Pleistocene* ..	,, ,,	120	7	
Cape Kidnappers and Te Aute Hills. *P.*	Hector, 1867 ..	217	60	
Under Te Aute limestone, Kidnappers section. *P.* ..	Hill, 1887 ..	709	2	
Fossiliferous clays, Cape Kidnappers section. *Recent* ..	McKay, 1886	718	11	
King-country. (See Mokau and Wanganui River)	..	..	..	64, 65.
Kiwi Creek and Range. (See Mohaka River.)				
Knight's Hut. (See Malvern Hills.)				
Kohai Point. (See Kawhia)	..	..	..	39.
Kohai River, north Canterbury. (See Kowhai River) ..	..	..	..	9.
Kohururu. (See Waingaro.)				
Koiterangi, fifteen miles south-east of Hokitika, north Westland	..	..	..	72.
*Komiti Point. (See Kaipara)	..	..	..	59, 62.
Kongahu, north-west Nelson	..	..	..	73.
*Korakonui, east coast, Wellington. *M.*	Hector, 1866 ..	121	2	
*Kowai River, Waimakariri River, Canterbury	..	..	..	35, 53.
Kowhai River, north Canterbury	..	..	..	9.
Kupakupa, Waikato, Auckland.				
Kupakupa Coal-mine. Plants. *C.-T.*	McKay, 1875	123	2	
Aotea sandstone (calcareous), between Ragan and Kupakupa. *C.-T.*	Cox, 1876 ..	268	10	
Limestone between Raglan and Kupakupa. *C.-T.* ..	,, ,, ..	269	3	
Kyeburn, east Central Otago	..	..	..	68.
Pareora beds, Upper Kyeburn. *M.*	McKay, 1883	493	86	
Hutchinson's Quarry beds, Upper Kyeburn. *Up. E.* ..	,, ,,	494	25	
Calcareous sandstones, Swinburn. *C.-T.*	,, ,,	506	11	
Lake County, western Otago	..	..	..	61.
*Landslip Hill, Clutha County, south-east Otago.				
,, Plants. *C.-T.*	Hector, 1869 ..	420	6	
,, Plant cherts. *C.-T.*	Park, 1886 ..	678	26	
*Limekiln Gully. (See Oamaru.)				
,, Hill. (See Kakanui.)				
Limestone Bluff. (See Ashburton River.)				
,, Island. (See Whangarei.)				
Linton. (See Morley Creek.)				
Little Ben Nevis. (See Wairoa Gorge.)				
Livingstone, thirty miles west of Oamaru	..	..	..	68.
Coal greensands, Livingstone line, Oamaru	Park, 1886 ..	676	..	
Lora Creek. (See Coal Creek and Taylor's)	..	..	..	45.
Lottery Creek, Waiau-ua River, south-east Nelson.				
Lottery Creek, Sherwood, Amuri district. *M.*	McKay, 1885	551	175	
Lottery Creek, Sherwood Forest, Amuri district. *M.* ..	,, ,,	556	288	
West branch of Lottery Creek, Amuri district. *Up. E.* ..	,, ,,	557	108	
Lower Gorge of Lottery Creek, Amuri district. *M.* ..	,, ,,	562	2	
(See also Waiau-ua River.)				
Lyell, Buller River, south-west Nelson.				
One mile below Lyell, Buller River	(?) Hector, 1869	274	15	
Lyndon, Waiau-ua River, south-east Nelson.				
Bluff Paddock, Dog Creek, Lyndon Station, Amuri district, Nelson. *M.*	McKay, 1885	564	3	
*Lyndon Lake, West Coast Road, Canterbury. *M.* ..	Hector, 1872 ..	234	25	
*Maerewhenua. (See Waitaki River.)				
Maharahara. (See Woodville.)				
Maheno. (See Kakanui.)				
Mahia Peninsula, north end, Hawke's Bay.				
Raised beach, Mahia Peninsula. *Recent*	McKay, 1887	689	1420	
Mahia township, Mahia Peninsula. *C.-T.*	,, ,,	704	16	
Mahurangi (Warkworth), thirty-two miles north of Auckland ..	..	..	..	61.

—	Collector and Date.	Locality Number.	Number of Specimens.	Page in this Bulletin.
Maitai River, near Nelson (town)	..	..	..	58.
Upper Gorge, Maitai River. *Carb.*	McKay, 1878	400	3	
Makara. (See Wellington.)				
Makarewa, Hokanui Hills, Southland.				
Plant-beds, McRae's, Makarewa. *J.*	Park, 1887 ..	669	46	
*Malvern Hills, west of Christchurch, Canterbury	..	..	..	10, 15–17,
Selwyn River, Malvern Hills. *Cret.*	Haast, 1872 ..	23	143	21, 42, 46,
Surveyor's Gully, Malvern Hills. *C.-T.*	,, 1869 ..	298	..	47, 53, 55,
Knight's Hut, Malvern Hills. Plants. *J.*	Hector, 1869..	422	11	61, 62, 64.
Jebson's Coal-mine, Malvern Hills. Plants. *C.-T.* ..	,, ,, ..	424	10	
Ostrea beds, swamp south of Selwyn River. *C.-T.* ..	McKay, 1879	469	66	
Selwyn Rapids, Malvern Hills. *C.-T.*	,, 1886	589	551	
Selwyn River, left bank, below rapids. *C.-T.*	,, ,,	590	26	
Railway-cutting near Sheath's Coal-mine, Malvern Hills. *C.-T.*	,, ,,	591	6	
Malvern Hills (coal-beds)	Hector, 1890	754	22	
McIlwraith's Coal-mine, Malvern Hills. Plants. *C.-T.* ..	McKay, 1891	763	8	
Cairn Range, Malvern Hills. Plants. (Mixed collection, both *J.* and *C.-T.*)	..	818	41	
Manaia Hill, Coromandel, east of Hauraki Gulf, Auckland ..	..	..	..	3 , 36, 72.
*Manawatu River, north Wellington, and Hawke's Bay ..	..	..	..	57.
Lower end, Manawatu Gorge. *P.*	Buchanan, 1872	109	12	
Limestone, near upper end, Manawatu Gorge. *M.* or *P.*	McKay, 1877	181	303	
Pohangina, opposite Ashhurst, lower end, Manawatu Gorge. *P.*	,, ,,	182	21	
Manawatu Gorge. *P.*	Buchanan, 1874	229	..	
(See also Shannon.)				
Mandeville, east of Hokanui Hills, Southland	..	..	..	3, 36, 39.
Mangaio. (See Wanganui River.)				
Mangapakeha River, east coast, Wellington. *M.*	Hector, 1866; McKay, 1875	117	10	
Mangatawa. (See Mokau.)				
Mangles River, Buller River, Murchison district, south Nelson..	..	814	..	
Mangonui, north Auckland	..	..	..	67, 68.
Mangonui. Plants and seeds. *P.*	Hector, 1866	421	4	
McLeod's, Mangonui Township. Plant fruits. *P.* ..	McKay, 1892	791	15	
Manuherikia River, Clutha River, Central Otago.				
St. Bathan's, Manuherikia River. *M.*	McKay, 1883	512	21	
Fresh-water beds, Manuherikia Valley. *P.* or *M.* ..	McKay ..	815	32	
Manukau Harbour, west of Auckland. (See Auckland, Onehunga, Papakura, Te Karaka)	..	..	..	63.
Marble Point. (See Waiau-ua River.)				
Maraetotara River. (See Kidnappers.)				
MARLBOROUGH PROVINCE	..	..	..	17, 54, 57,
(See Amuri Bluff, Awatere, Cape Campbell, Clarence River, Flaxbourne, Hapuka River, Kaikoura, Kekerangu, Picton.)				6 , 63, 66. 67.
Marsden County, north Auckland	..	..	..	60.
Martin's. (See Wairoa Gorge.)				
Maruia River, Buller River, south-west Nelson	..	..	..	61.
Mary, Mount. (See St. Mary, Mount)	..	..	..	71.
Mason River, Waiau-ua River, south-east Nelson.				
Below the "gates," Mason River. *M.*	McKay, 1885	567	68	
(See also Waiau-ua River.)				
Masterton, Wairarapa district, Wellington	..	..	..	58, 62, 75.
Limestone, Rangitaumau Hill, road Masterton to east coast. *P.*	Park, 1886 ..	580	67	
Below limestone, Rangitaumau Hill, road Masterton to east coast. *P.*	,, ,, ..	581	12	
Mata River. (See Waipapu.)				
Matapiro. (See Gisborne.)				
*Mataroa, north Wellington	..	..	..	74.
Main Trunk Line, 252-mile peg, between Mataroa and Turanga-a-rere. *Tertiary*	Hamilton, 1910	845	6	
*Mataura River and Falls, Southland	..	..	..	9, 15, 16,
Mataura Falls. *J.*	Buchanan, 1863; McKay, 1879	406	151	21, 33, 35, 39, 41–48,
Left bank, Mataura River, below Falls. *Tertiary* (?) ..	McKay, 1879	452	81	49, 52, 54,
One mile below Falls, Mataura River. *Rh.*	,, ,,	461	..	59, 60, 64,
East bank Mataura River, one mile and a half below Mataura. *J.*	,, ,,	470	10	65.
East bank, Mataura River, one mile below Mataura. *J.*				
Shales, one mile and a half below Mataura Falls. *J.* ..	Park, 1887 ..	665	15	
(See also Wyndham River.)				

—	Collector and Date.	Locality Number.	Number of Specimens.	Page in this Bulletin.
Maungakuri River, Hawke's Bay.				
Mouth of Maungakuri River. *Cret.*	McKay, 1875	85	18	
Maungatawa. (See Mokau River.)				
McLean's. (See Ngaruroro River.)				
McRae's. (See Coal Creek and Makarewa)	..	..	..	45.
Measley Beach. (See Kaitangata.)				
Mercer, Waikato, forty-three miles south of Auckland.				
Mercer marls. *C.-T.*	McKay, 1875	101	65	
Mikonui River, south Westland	..	..	..	68, 72.
Miramar Peninsula, Wellington	..	..	..	56.
Miranda, Firth of Thames, Auckland.				
Leda marls, Miranda Redoubt. *C.-T.*	McKay, 1875	100	2	
Moehau, Coromandel. Coal-beds	..	829	14	
Moeraki. (See Hampden)	..	..	..	55, 62, 64, 70.
*Mohaka River, Hawke's Bay.				
Mohaka River. *M.*	Hector, 1871	453	218	
Kiwi Range, north side of Mohaka Valley	McKay, 1885	573	160	
Napier–Taupo Road. *M.*	,, ,,	575	39	
Mohaka Crossing, Te Purutu Creek. *M.*	,, 1887	680	842	
Pumice sands, mouth of the Mohaka River. *P.* ..	,, ,,	687	210	
New diggings below Mohaka Crossing, Mohaka River. *M.*	..	832	44	
Kiwi Creek, above crossing of Mohaka River	..	838	..	
Mokau River and district, west coast, south Auckland ..	..	..	..	59, 62, 73.
Greensands under Mokau limestone, Mokau Valley. *C.-T.*	Park, 1886 ..	584	61	
Coal greensands, Mokau River. *C.-T.*	,, ,, ..	646	21	
Limestone near Totoro, Mokau River. *C.-T.*	,, 1887 ..	655	1	
Yellowish clays, Mokau Gorge, near Totoro. *C.-T.* ..	,, ,, ..	656	5	
Limestone, Te Ruangaruhe, near Totoro. *C.-T.* ..	,, ,, ..	657	5	
,, Wairere Falls, Upper Mokau. *C.-T.* ..	,, ,, ..	658	2	
,, on range, head of Mangatawa, Mokau River. *C.-T.*	,, ,, ..	664	..	
(See also King-country, Awakino River.)				
*Mokihinui River, west coast, Nelson	..	..	..	64, 74.
Inland of White Rock Point, four miles north of Mokihinui River. *Cret.*	McKay, 1874	34	45	
Brewery Creek, Mokihinui River. *Tertiary*	,, ,,	44	199	
*White Rock Point, north of Mokihinui. *C.-T.* or *M.* ..	,, ,,	55	6	
Source of Mokihinui River. *C.-T.*	Hector, 1867	278	9	
Between Ngakawau and Mokihinui Rivers. *C.-T.* ..	,, 1871	281	3	
Between West Wanganui and Mokihinui. *C.-T.* ..	,, 1866	637	33	
Mongonui. (See Mangonui)	..	..	..	67, 68.
Moonlight Range. (See Oreti River.)				
*Morley Creek, Southland	..	..	..	54.
Tertiary beds of coal series, Morley Creek	Hector, (?) 1869	30	5	
Morley Creek. *L.*	,, 1869	144	26	
Morley Creek and Linton. Plants	,, ,,	427	2	
Morrison's. (See Whangarei.)				
Morrison's Taipo. (See Taipos.)				
Motanau. (See Motunau.)				
*Motueka River, Nelson	..	..	..	59.
*Sherry River, Wangapeka River. *C.-T.*	Hector, 1867	215	6	
*Wangapeka. Plants. *Cret.*	,, 1868	413	181	
Graham River, Motueka Valley. *Up. S.*	McKay, 1879	444	4	
Dart River, Wangapeka Valley. *Up. S.*	,, ,,	445	59	
Rolling River, Wangapeka Valley. *Up. S.*	,, ,,	446	..	
,, ,, *Up. S.*	,, ,,	447	2	
Source of the Clarke River, Wangapeka Valley. *Up. S.* ..	,, ,,	448	17	
Coal shales, Upper Wangapeka, four miles from saddle. Plants. *C.-T.*	Park, 1888 ..	726	87	
Wangapeka River. Plants. *C.-T.*	Hector, 1868	789	7	
(See also Baton River.)				
*Motunau, north Canterbury (also spelt "Motanau") ..	..	..	..	59, 60.
Motunau. *M.*	Buchanan, 1867	218	202	
Motunau. *Recent*	,, ,,	219	71	
Chalk marls, Happy Valley Creek, Motunau Flat. *C.-T.* ..	McKay, 1882	503	32	
Pareora beds, Motunau Flats. *M.*	,, ,,	504	35	
*Motutapu Island, Hauraki Gulf, Auckland	..	..	..	70.
Tertiary beds, Motutapu Island. *M.*	Park, 1887 ..	695	43	
*Motutara. (See Kawhia)	..	..	..	37, 38.
*Mueller Glacier, near Mount Cook, Canterbury	..	..	..	41.
Muzzle River. (See Clarence River.)				

	Collector and Date.	Locality Number.	Number of Specimens.	Page in this Bulletin.
*Napier, Hawke's Bay	..	..	..	16, 56–60, 63, 65, 66 69, 75.
Watchman's Island, Napier Harbour	Williams, 1878	222	81	
Western side of Napier Harbour	Hamilton, 1886	713	11	
(See also Petane, Scinde Island.)				
Naseby, Central Otago.				
Limonitic sandstone, Government dam, Mount Ida Water-race, Naseby. *C.-T.*	McKay, 1883	488	159	
Greensands from prospecting-shaft, Naseby	Hector, 1890	753	44	
NELSON (town and province)	..	..	..	10, 15, 30–32, 38, 49, 52, 54, 55, 58, 59, 63, 64, 68, 71.
CENTRAL. (See Aniseed, Baton, Cheviot, Dun, Eighty-eight, Jenkin's, Maitai, Motueka, Richmond, Wairoa)				
NORTH-WEST. (See Anatori, Aorere, Collingwood, Farewell, Kongahu, Pakawau, Takaka, Tata Island, West Wanganui.)				
SOUTH-EAST (Amuri district). (See Black Birch Creek, Conway, Culverden, Isolated Hills, Lottery Creek, Lyndon, Mason River, Waiau-ua River)	..	..	..	55, 62, 62, 64, 66, 67.
SOUTH-WEST. (See Brighton, Buller, Greymouth, Inangahua, Lyell, Mokihinui, Westport)	..	..	..	68.
New Plymouth, Taranaki	..	..	..	69, 73, 74.
*New River, Westland.				
Mount Reilly, New River. *M.*	McKay, 1874	210	..	
New River. *M.*	Hector, 1869	211	16	
Ngakawau. (See Mokihinui)				
Ngapara, west of Oamaru, north-east Otago	..	..	..	
Concretions with fossils, overlying coal-beds, Ngapara. *C.-T.*	McKay, 1882	487	147	65.
Maerewhenua limestone at crossing of Awamoko Creek, north of Ngapara. *C.-T.*	,, ,,	496	25	
(See also Oamaru.)				
*Ngaruroro River, Hawke's Bay.				
McLean's, Ngaruroro. *P.*	Hector, 1871	231	40	
(See also Shrimpton's.)				
Nine-mile Bluff. (See Greymouth.)				
Norsewood, north Wellington.				
Two to three miles south of Norsewood, Woodville Road. *P.*	McKay, 1877	183	..	
North Cape, north Auckland	..	..	..	
Coralline limestone, Tom Bowline Bay, North Cape. *M.*	McKay, 1892	787	6	73.
(See also Parengarenga.)				
North Peak, Hokanui Hills, Southland.				
Overlying Cannon-ball sandstone, Flag Hill to North Peak section. *L.*	McKay, 1878	351	24	
Lower part of lower ammonite beds, Flag Hill to North Peak section. *L.*	,, ,,	357	63	
Ash-beds, North Peak section. *Perm.*	,, ,,	377	7	
Spirifer and Crinoid beds, North Peak. *Perm.*	,, ,,	381	318	
Nugget Point, south-east Otago	..	..	..	15, 16, 33, 37–39, 56, 71.
Nugget Point. *T.*	Hector(?), 1869; McKay, 1873	133	1081	
Wiltshire Beach, Molyneux Bay. *Perm.*	McKay, 1873	134	87	
Between Nugget Point and Cannibal Bay. *L.*	,, ,,	147	34	
Nugget Point. *T.*	Buchanan, 1866	161	122	
Nugget Point to Catlin's River. *T.*	McKay, 1873	801	14	
Nukumaru. (See Waitotara.)	..	..	..	62.
*Oamaru, north-east Otago	..	..	..	14, 17, 51, 55–58, 64, 66, 67, 69, 70, 71.
Cape Wanbrow and coast to Oamaru Breakwater. *Up. E.*	McKay, 1876	171	..	
Hutchinson's Quarry, Oamaru. *Up. E.*	,, ,,	172	1593	
Limekiln Gully, Oamaru. *Up. E.*	,, ,,	173	58	
Devil's Bridge, Oamaru Creek. *C.-T.*	,, ,,	174	77	
One mile south of Devil's Bridge, Oamaru Creek. *M.* (?)..	,, ,,	175	293	
Cape Hills, Oamaru	Traill, 1874 ..	255	5	
Waireka Valley, Oamaru. *C.-T.*	McKay, 1876	288	..	
Cape Hills at breakwater, Oamaru. *Recent*	,, ,,	299	..	
Oamaru. *Oamaru formation*	Hector, 1876	308	109	
Interbedded with volcanic rocks, Oamaru Creek. *Up. E.*..	McKay, 1876	310	43	
South-west side of Cape Hills, Oamaru. *Oamaru formation*	,, ,,	312	54	
Hutchinson's Quarry beds, Oamaru Creek. *Up. E.* ..	,, 1882	491	166	
Hutchinson's Quarry beds, Cape Wanbrow Hills, at northern end of Awamoa Beach. *Up. E.*	,, ,,	492	72	
Oamaru limestone, Cape Valley, Oamaru. *C.-T.* ..	,, ,,	495	118	
Marls under Ototara limestone, Cape Hills, at northern end of Awamoa Beach. *C.-T.*	,, ,,	499	25	
Under Ototara limestone, Cave Valley, Oamaru. *C.-T.* ..	,, 1883	500	..	
Teaneraki (Enfield), Oamaru	Esdaile ..	630	48	

—	Collector and Date.	Locality Number.	Number of Specimens.	Page in this Bulletin.
*Oamaru, north-east Otago—*continued.*				
Tachylite breccias, Oamaru Breakwater. *Up. E.*	Park, 1886	674	1	
Waireka tufas, Teaneraki, Waireka Valley. *C.-T.*	„ „	675	7	
Radiolarian and diatomaceous ooze, Cave Valley. *C.-T.*	McKay	785	510	
Ototara stone, Oamaru	..	827	1	
Cave Valley and Upper Waireka Valley, from chalk ooze and tufaceous greensands	Esdaile	831	157	
South-west of Cape Hills, Oamaru. *Pleistocene.*	..	839	41	
(See also Kakanui, Livingstone, Ngapara, Pukeuri, Waitaki River.)				
Ohau, Lake, Canterbury. Annelid beds. *Carb.*	McKay, 1879	808	..	
Okarita (Okarito) district, Westland	..	..	..	54.
Okehu, north-west Wellington	..	..	..	62.
Okoko. (See Kawhia.)				
Okuku River, Ashley River, north Canterbury	..	..	..	59.
Okuku. *T.*	McKay, 1874	151	7	
Monotis beds, The Brothers, Okuku Range. *T.*	„ 1879	455	134	
White Rock Quarries, Okuku River	..	816	22	
Omoeroa River, south Westland	..	..	..	54.
Onairo. (See Waitara.)	..	..	..	74.
Onakaka. (See Collingwood.)				
Onehunga, Manukau Harbour, eight miles south-east of Auckland.				
Calcareous greensands, Onehunga. *M.*	Park, 1885	535	14	
Teredo bed, Onehunga. *M.*	„ „	536	..	
Onekakara Beach = Hampden, *q.v.*	..	..	..	9, 51, 52.
Ongaruhe River, Wanganui River, west of Lake Taupo, Auckland.				
Yellow sandy clays, Ongaruhe Valley. *C.-T.*	Park, 1887	651	27	
Greensands, Ongaruhe Valley. *C.-T.*	..	652	23	
(See also Wanganui River.)				
*Opotiki, Bay of Plenty, Auckland	..	..	..	57, 68.
Tertiary beds, Opotiki. *Up. E.* (?)	Cox (?), 1876	812	9	
(See also Gisborne.)				
Opunga, Kawhia County, Auckland	..	..	..	41.
*Orakei Bay, near Auckland	..	..	..	52, 54, 62.
Orakei Bay. *C.-T.*	Hector, 1866	297	..	
„ *C.-T.* (?)	Park, 1885	540	326	
Orepuki Stream. (See Hokanui Hills.)				
Orepuki, Tewaewae Bay, Southland. *M.*	Hector, 1891	756	2	
Oreti River, Southland	..	..	..	33, 35.
Moonlight Range, Oreti watershed. *T.*	Hutton, 1872	138	79	
Castle Rock, Oreti Valley. *Oamaru formation*	McKay, 1878	245	3	
Oreti railway-cutting, Dipton, Oreti Valley. *Rh.*	„ „	372	32	
Monotis sandstone, Oreti Railway-station. *T.*	„ „	373	162	
Railway-cutting, north of Oreti Railway-station. *T.*	„ „	376	82	
Spirigera beds overlying big conglomerate, Oreti Valley. *Perm.*	„ „	379	39	
Spirifer and Crinoid beds, near Cowan's Railway-station, Oreti Valley. *Perm.*	„ „	380	974	
Ormond. (See Gisborne.)				
Ormondville, sixty-six miles south of Napier, Hawke's Bay.				
West slope of Puketoi Range, opposite Ormondville. *M.*	Hamilton, 1906	800	47	
OTAGO PROVINCE	..	..	..	10, 54, 56, 71.
CENTRAL OTAGO. (See Bannockburn, Cromwell, Dunstan, Kyeburn, Manuherikia, Naseby)	..	..	..	62, 68.
EAST OTAGO. (See Bobby's Head, Brighton, Caversham, Chain Hills, Dunback, Dunedin, Goodwood, Green Island, Green Valley, Hawksbury, Palmerston, Pleasant River.)				
NORTH-EAST OTAGO. (See Awamoa, Hampden, Kakanui, Livingstone, Mount St. Mary, Ngapara, Oamaru, Otepopo, Ototara, Pukeuri)	..	..	..	60, 61.
SOUTH-EAST OTAGO. (See Bloody Jack's Island, Catlin's River, Kaihiku, Kaitangata, Landslip Hill, Nugget Point, Owaka, Pomahaka, Popotunoa, Puerua)	..	..	..	57.
WEST OTAGO. (See Wakatipu.)				
Otamita River, Hokanui Hills	..	..	..	15.
Otapiri Creek, Hokanui Hills, Southland	..	..	..	46, 54, 75.
Otapiri Creek. *L.*	Hector, 1869	145	34	
Grey marls, Otapiri Creek. *C.-T.* (?)	McKay, 1878	256	69	
Astarte beds, lower end of Otapiri Gorge. *J.*	„ 1877	334	8	

—	Collector and Date.	Locality Number.	Number of Specimens.	Page in this Bulletin.
Otapiri Creek, Hokanui, Hills, Southland—*continued.*				
Highest *Spirifer* beds, Conical Hill, Otapiri Gorge. *J.* ..	McKay, 1878	337	103	
Highest *Spirifer* beds, tableland above Tree Bluff, Otapiri Gorge. *J.*	,, ,,	338	361	
Middle ammonite beds, Otapiri Creek. *L.*	,, ,,	352	440	
Lower amm nite beds, junction of Taylor and Otapiri Creeks. *L.*	,, ,,	355	101	
Below lower ammonite beds, junction of Taylor and Otapiri Creeks. *L.*	,, ,,	356	9	
Taylor's Crossing, Otapiri Creek. *Rh.*	,, ,,	362	75	
Banks of Otapiri, one mile above Taylor's Crossing. *Rh.* ..	,, ,,	367	73	
Otapiri Creek. *J.*	Hector, 1869..	407	..	
Plant-beds, Coal Creek, Otapiri Gorge. *J.*	Park, 1887 ..	670	21	
,, Otapiri Gorge, near Conical Hill. *J.* ..	,, ,, ..	672	20	
Highest *Spirifer* grit, Otapiri Gorge. *J.*	,, ,, ..	673	4	
Otapokiore. (See Wanganui, Upper.)				
*Ototara. (P obably same as Totara, near Oamaru) ..	..	..	..	9, 51.
Otekaike. (See Waitaki River.)				
Otepopo River, north-east Otago. *C.-T.*	McKay, 1878	168	10	
Owaka (Owake) Creek, Catlin's River, south-east Otago ..	..	..	..	15.
Old Mill, Owaka Creek. *J.*	McKay, 1873	19	183	
Owaka Creek. Plants. *J.*	Hector, 1865	408	99	
Owen River, Upper Buller River, Nelson	..	..	..	66.
Coal shales, Owen River	Park, 1888 ..	727	13	
Oxford, central Canterbury	..	..	..	60, 66.
Pahi. (See Kaipara)	..	..	..	62.
Pahua (Pahaoa) River, east coast, Wellington.				
Mouth of Pahua River. *Cret.*	..	842	..	
Pakaraka, north Auckland	..	..	..	66, 67.
Greensands, east of Pakaraka. *C.-T.*	McKay, 1890	751	11	
Diatomaceous deposit, Pakaraka	,, 1892	819	4	
*Pakawau, Collingwood County, north-west Nelson	..	..	..	46, 48, 54.
Pakawau Coalfield. Plants. *Cret.*	Hector, 1868..	410	26	
Greensand, Riley's Creek, Pakawau. *C.-T.*	Park, 1889 ..	747	32	
Palliser Bay. (See Ruamahanga River.)				
Palliser Cape, south-east Wellington. *Oamaru formation* ..	..	840	5	
Palmerston, Otago. (See Bobby's Head, Goodwood, Pleasant River, and Shag Valley.)				
Paonui Point. (See Pourerere.)				
*Papakura, nineteen miles south of Auckland	..	..	..	71.
Papakura limestone, Slippery Creek. *C.-T.*	Park, 1885 ..	537	97	
Papakura limestone, Waikohu Creek. *C.-T.*	,, ,, ..	538	23	
*Paparoa. (See Wanganui River.)				
Parapara, north-west Nelson	..	..	..	72.
Pararoa. (See Kaipara.)				
Parengarenga, North Cape district, north Auckland	McKay, 1892	766	12	51, 73.
*Pareora River, south Canterbury.				
White Rock River, Upper Pareora Valley. *M.*.. ..	McKay, 1876	165	1258	
Clays, lower gorge of the Pareora River. *M.*	,, ,,	166	92	
Coal-beds, lower gorge of the Pareora River. *C.-T.* ..	McKay, 1876; Enys, 1879	167	15	
Lower gorge of the Pareora River. *M.*	Enys, 1879 ..	458	228	
Coal rocks, Pareora River	McKay ..	784	25	
Parikino. (See Wanganui River.)				
Parimoa = Awamoa, *q.v.*				
Parnell, suburb of Auckland.				
Parnell grit, Judges Bay. *M.*	Park, 1887 ..	701	..	
Parua Bay. (See Whangarei.)				
*Patea, north-west coast, Wellington.				
Blue clays, Patea. *P.*	Park, 1886 ..	644	11	
Patea and Waitotara	Old collections	794	2	
Peel, Mount, Hokanui Hills, Southland.				
Astarte beds, road-cutting, north side, Mount Peel. *J.* ..	McKay, 1877	335	1	
*Petane, seven miles north-west of Napier (on Esk River), Hawke's Bay	..	..	..	60–62, 65, 66.
Shelly limestone, Petane. *P.*	Cox, 1876 ..	220	76	
Sandy clays below limestone, Petane. *P.*	,, ,, ..	221	549	
Clays under limestone, Petane. *P.*	McKay, 1887	690	..	
Limestone, Petane. *P.*	,, ,,	691	180	
First limestone bluff on beach north of Petane. *P.* ..	,, ,,	719	5	
Upper band of Petane limestone, Lower Esk to Petane Hotel. *P.*	,, 1886	720	466	
Collection of Petane and Scinde Island fossils	Hamilton, 1884	736	335	

—	Collector and Date.	Locality Number.	Number of Specimens.	Page in this Bulletin.
Picton, Queen Charlotte Sound, Marlborough	..	..	..	59.
Shakespeare Bay and Elevation, near Picton. *C.-T.* ..	Hector, 1865; Hutton, 1873; McKay, 1874	57	71	
Conglomerates, west side Picton Bay. *C.-T.*	McKay ..	790	1	
Pigeon Rock. (See Waitaki.)				
Pipiriki. (See Wanganui River.)				
Pirongia, 108 miles south of Auckland	..	..	..	62.
Pleasant River, east Otago.				
Seaward Ridge, south of Pleasant River mouth. *Up. E.*	McKay, 1886	602	4	
Middle mountain, source of Pleasant River. *C.-T.* ..	,, ,,	603	1	
Calcareous sandstone, Tumai. *C.-T.*	,, ,,	605	44	
Coast between Pleasant River and Waikouaiti Bay. *C.-T.*	Hector, 1891	764	2	
(See also Bobby's Head, Goodwood, Hawksbury.)				
Plenty. (See Bay of Plenty.)				
Pohangina River. (See Manawatu River.)				
Pohui, twenty-six miles north-west of Napier, Hawke's Bay ..	..	..	..	66.
Pohui limestone, Napier–Taupo Road. *M.*	McKay, 1885	575	39	
Te Waka Range, north-west of Pohui. *M.*	,, 1887	703	118	
*Pomahaka River, Clutha River, south-east Otago. *M.* ..	Hector, 1869	329	140	
Popotunoa Gorge, south-east Otago.				
East end, Popotunoa Gorge. *L.*	McKay, 1879	472	..	
Porangahau Creek. (See Ruataniwha Plain.)				
Porirua. (See Wellington.)				
*Port Hills, near town of Nelson. *M.*	McKay, 1874	319	167	
Porter River. (See Trelissick Basin.)				
Potato Gully. (See Mount Potts.)				
*Potts, Mount, Rangitata River, south Canterbury	..	..	..	10, 15–17, 21, 38, 40, 44–48, 53.
Spirifer beds, Mount Potts. *T.*	Haast, 1872; McKay, 1872	136	84	
Spiriferina and Reptilian beds, Mount Potts. *T.* ..	McKay, 1877	401	226	55, 57, 58.
Glossopteris beds, head of Tank Gully, Mount Potts. *T.*	,, ,,	402	8	62, 63, 67, 71.
Pourerere River, south of Cape Kidnappers, Hawke's Bay.				
Paonui Point, Pourerere. *Cret.*	McKay, 1875	84	9	
Mouth of the Pourerere River. *Up. E.*	,, ,,	86	7	
Nummulitic limestone, Paonui Point. *Up. E.*	,, ,,	87	12	
Pourerere River. *M.*	,, ,,	113	124	
,, *Cret.*	,, ,,	114	41	
Flanks of Castle Range, west of Pourerere	..	115	4	
Poverty Bay, east Auckland	..	..	..	57, 70.
*Poverty Bay	Prior to 1874	60	182	
McDonald's section, north side of Poverty Bay. *Cret.* ..	McKay, 1874	90	4	
Grey marls, Cuff's, oil-spring district, Poverty Bay. *C.-T.*	,, ,,	307	11	
(See also Gisborne, Turanganui, Whangara.)				
Preservation Inlet, south-west corner, Otago	..	..	..	15, 68.
Sailor's Creek, No. 2. Graptolite beds..	McKay, 1895–6	804	21	
Puerua River, Clutha River, south-east Otago (also referred to as Purerua River).				
Lower gorge of the Puerua River, *Halobia* beds. *T.* ..	McKay, 1873	17	88	
,, ,, *Spirigera* beds. *T.* ..	,, ,,	18	217	
Upper gorge of the Puerua River. *T.*	,, ,,	135	272	
Puke Ivatai = Puke iwi tahi.				
Puke iwi tahi. (See Shag Point.)				
Pukerau, forty-nine miles north of Invercargill, Southland ..	..	..	..	61.
Puketapu. (See Shag Valley.)				
Puketitiri, twenty-five miles north-west of Napier, Hawke's Bay	..	..	..	69.
Puketoi. (See Ormondville.)				
Pukeuri, six miles north of Oamaru. *Oamaru formation* ..	Traill, 1874 ..	253	47	
Puponga Point. (See Collingwood.)				
Purerua River. (See Puerua River.)				
Putataka, Maori name for Waikato Heads.				
*Puti Point, Kawhia. (See Kawhia.)	..	..	..	35, 37.
Quail Flat. (See Clarence River.)				
Queen Charlotte Sound, Marlborough	..	..	..	59.
Queenstown, Lake Wakatipu, Otago	..	..	..	73.
*Radiant, Mount, west coast, Nelson	..	..	..	73.
*Raglan, Whaingaroa Harbour, south-west coast, Auckland ..	..	..	..	51, 56. 57, 62, 63.
Raglan. *C.-T.*	Hector, 1866; McKay, 1875	43	8	
Hakarimata Range, Raglan County. *T.*	Cox & McKay, 1875	82	32	
Plastic clays, Raglan. *P.* or *Pleistocene*	Ditto ..	96	6	
Limestone on coast, five miles north of Raglan. *Up. E.* ..	,, ..	97	80	

—	Collector and Date.	Locality Number.	Number of Specimens.	Page in this Bulletin.
*Raglan, Whaingaroa Harbour, south-west coast, Auckland—*continued.*				
Brown sandstone and flaggy limestone, north side of Whaingaroa Harbour, opposite Raglan. *C.-T.*	Cox & McKay, 1875	98	564	
Leda marls, north side of harbour, Raglan. *C.-T.*	Ditto	99	134	
*Coralline limestone, Raglan. *C.-T.*	,,	112	61	
(See also Mercer.)		528	154	
Rainy Creek. (See Nelson).				
*Rakaia River, central Canterbury	..	..	..	56, 57, 60.
Redcliff, Rakaia River. Upper part	McKay, 1874	325	7	
,, ,, Lower part. *Up. E.*	,, ,,	326	24	
(See also Curiosity Shop.)				
Rangitauma Hill. (See Masterton.)				
*Rangitikei River, north Wellington	..	..	..	66.
Hautapu Falls, Rangitikei River. *M.*	Hector, 1870	260	1	
Raukokore, Bay of Plenty, east Auckland, shelly limestone. *M.*	McKay, 1887	682	9	
*Redcliff. (See Rakaia River.)				
Redman's Creek, near Ross, north Westland	..	..	..	56.
*Reefton, Inangahua River, south-west Nelson	..	..	..	15, 17, 31, 32, 56–58, 61, 65.
Beds overlying coal, Rainy Creek, Reefton. *Cret.*	McKay, 1874	38	6	
Rainy Creek, Reefton. *Dev.*	,, ,,	129	71	
Lankie's Gully, Reefton. *Dev.*	,, ,,	130	1272	
Coal-beds, Reefton. Plants. *C.-T.*	,, 1882	508	19	
Reilly, Mount. (See New River.)				
*Richmond, south-west of Nelson town	..	..	..	10, 15, 36, 37, 39, 43.
Richmond Hill. *T.*	Old collections	139	23	
Rochfort, Mount. (See Westport.)				
Roding River. (See Wairoa Gorge.)				
*Rodney, Cape, north Auckland	..	..	..	60.
Cape Rodney. *M.*	Hector, 1866; Cox, 1879	246	50	
,, *M.*	Cox, 1880	450	266	
Rolling River. (See Motueka River.)				
Roparua, East Cape district, Auckland.				
Roparua and Tuparoa. *Cret.*	McKay, 1874	88	33	
Ross, Westland.				
Rocks in gold-workings, three miles south of Ross. *M.*	McKay, 1875	155	133	
Royal, Mount. (See Bobby's Head.)				
Rowley, Mount. (See Clent Hills)	..	..	..	43, 47, 53.
Ruamahanga River, Wairarapa, Wellington.				
Taueru River, Wairarapa. *Up. M.*	McKay, 1875	94	478	
Ruamahanga River. *Up. P.*	Buchanan, 1872	108	31	
Ferry at Gladstone, Ruamahanga River. *P.*	McKay, 1883	545	354	
Cliffs at mouth of Ruamahanga River, Palliser Bay. *P.*	,, 1882	749	75	
Ruataniwha Plain, Upper Tukituki River, Hawke's Bay.				
Porangahau Creek, Ruataniwha Plain. *P.*	McKay, 1877	184	47	
*Johnston's, Ruataniwha Plain. *P.*	,, ,,	185	25	
Under Te Aute limestone, south-east corner, Ruataniwha Plain. *P.*	,, 1886	693	15	
Limestone, east of Takapau, Ruataniwha Plain. *P.*	,, 1887	708	13	
Tukipo beds, Tukipo River, Ruataniwha Plain. *P.*	Hill	773	22	
Tertiary beds, south-east corner, Ruataniwha Plain, above Porangahau Creek	McKay	795	1	
(See also Tukituki River.)				
Sailor's Creek. (See Preservation Inlet.)				
Scinde Island, Napier, Hawke's Bay. (Not an island.)	..	..	..	63.
Scinde Island limestone, Scinde Island. *P.*	Hector, 1866	80	8	
Scinde Island. *P.*	McKay, 1877	194	305	
Upper shelly limestone, Scinde Island. *P.*	,, 1885	574	34	
Lowest beds, Scinde Island. *P.*	,, ,,	576	15	
Lower limestone, Scinde Island. *P.*	,, 1887	702	191	
Collection of Petane and Scinde Island fossils. *P.*	Hamilton, 1884	736	335	
Scinde Island beds. *P.*	Hill	774	22	
Upper limestone, Scinde Island	Old collection	781	9	
Between limestones, Scinde Island	Hamilton	834	87	
(See also Napier.)				
Scrogg's Hill, near Saddle Hill, Dunedin.				
Scrogg's Hill. *C.-T.*	McKay, 1886	609	4	
Seaward Downs, Southland. *J.*	Hector, 1868	403	..	
Sellen's. (See Eighty-eight Valley and Wairoa River.)				
Selwyn County. (See Trelissick Basin.)	..	..	..	60.
Selwyn River. (See Malvern Hills.)				

—	Collector and Date.	Locality Number.	Number of Specimens.	Page in this Bulletin.
Seymour River. (See Clarence River.)				
Shades Creek. (See Kekerangu.)				
*Shag Point, north-east Otago	..	..	..	17, 21, 48, 57, 62, 64.
Shag Point. *C.-T.*	Hector, 1865	320	1	
,, Plants. *Cret.*	Buchanan, 1869	414	139	
,, Beach at coal-mine and near MacIntosh's store. *C.-T.*	McKay, 1886	592	359	
Puke iwi tahi. *C.-T.*	,, ,,	593	129	
Little Puke iwi tahi. *C.-T.*	,, ,,	594	200	
Kartigi Beach, north of Shag Point. *C.-T.*	,, ,,	622	..	
Plant-beds under Shag Point coal; section towards mouth of Shag River. *C.-T.*	,, ,,	631	..	
Shag Valley, east Otago.				
Guffie's Quarry, Janet's Peak, Shag Valley. *C.-T.* ..	McKay, 1886	599	41	
Deer Park Spur, Bushy Park, Shag Valley. *Up. E.* ..	,, ,,	601	18	
Calcareous sandstone, Puketapu. *C.-T.*	,, ,,	620	7	
Sea-cliffs, Bushy Park. *M.*	,, ,,	621	3	
Shakespeare Bay. (See Picton.)				
*Shakespeare Cliff. (See Wanganui)	..	..	..	65.
Shannon, Manawatu River, ninty-nine miles north of Wellington	..	..	..	68.
Shaw's Bay, Nugget Point, south-east Otago	..	..	..	38.
*Sherry River. (See Motueka River.)				
Sherwood. (See Lottery Creek.)				
Shrimpton's, Ngaruroro River, Hawke's Bay.				
Shelly limestones, Shrimpton's. *P.*	McKay, 1877	191	1108	
Middle beds, Shrimpton's. *P.*	,, ,,	192	4	
Clays underlying shelly limestones, Shrimpton's. *P.*	,, ,,	193	4	
(See also Ngaruroro River.)				
Sinclair Head. (See Wellington.)				
Slate River. (See Aorere River.)				
Slaty Creek. (See Collingwood)	..	..	..	17, 28, 29, 72.
*Slippery Creek. (See Papakura.)				
Smyth River. (See Clent Hills.)				
Somers, Mount, Ashburton River, Canterbury	..	..	..	57, 61, 75.
Cave Creek, Mount Somers. *C.-T.*	Haast, 1872 ..	103	89	
South Island: North-east district. (See also Marlborough) ..	..	..	..	57.
,, North-west district. (See also north-west Nelson)	..	..	..	59.
,, West Coast. (See also south-west Nelson and Westland)	..	..	..	57.
Southland District (sometimes called province) ..	..	..	..	55, 58, 60.
(See Benmore, Dunsdale, Flag Hill, Forest Hill, Mount Hamilton, Hokanui Hills, Makarewa, Mataura, North Peak, Orepuki, Oreti River, Otapiri, Mount Peel, Pukerau, Seaward Downs, Taylor's Creek, Te Anau, Waikawa, Waimea.)				
Spring Grove Creek. (See Wairoa River)	..	..	..	37.
Station Peak. (See Waitaki.)				
St. Bathan's. (See Manuherikia.)				
St. Kilda. (See Brighton.)				
St. Mary, Mount, Waitaki Valley, Otago	..	..	..	15, 16, 40, 71.
Mount St. Mary, Kurow Range. *T.*	Park, 1905 ..	780	118	
(*Cf.* Loc. 552, under Waitaki River.)				
St. Peters. (See Whangaroa.)				
Stratford, Taranaki	..	..	..	69.
Surveyor's Gully. (See Malvern Hills.)				
Swinburn. (See Kyeburn)	..	..	..	68.
Switzers, Clutha County, south-east Otago.				
Welshman's Gully, Switzers. *Up. E.*	McKay, 1890	752	92	
*Taipos, east coast of Wellington	..	..	..	56, 74.
"Taipos." *M.*	Hector, 1866	93	69	
Morrison's Taipo. *M.*	McKay, 1875	201	..	
Taitapu. (See Collingwood.)				
Takaka River, north-west Nelson	..	..	..	60.
Takaka River. *Up. E.*	Hector, 1868	261	23	
Crystalline limestone, Sparrow's, Takaka River. *C.-T.* (?) ..	Park, 1889 ..	744	2	
Takapuna, Lake, near Auckland.				
Volcanic breccia, coast near Takapuna. *M.*	Park, 1885 ..	539	290	
*Takatahi. (See Kawhia.)	..	..	..	36.
Tangarakau River, Wanganui River, Taranaki	..	..	..	69.
Tangiteroria. (See Kaipara.)				
Tank Gully. (See Mount Potts.)				
Tanner's Run, near Napier	..	..	..	65.

	Collector and Date.	Locality Number.	Number of Specimens.	Page in this Bulletin.
TARANAKI PROVINCE	. .	. .	. .	51, 54, 64, 69, 74.
(See New Plymouth, Stratford, Tangarakau, Urenui, Waitara, Wanganui River, Whenuakura.)				
Tata Island, north-west Nelson.				
Tata Island. *Up. E.*	Hector, 1868 (?)	302	45	
Limestone, Tata Island. *C.-T.*	,, 1887	662	26	
Taueru River. (See Ruamahanga River)	. .	. .	. .	56.
Taupiri. (See Waikato.)				
Tautuku, south-west of Catlin's River, Otago. *L.*	Hector, 1869	146	16	
*Taylor's Creek, Hokanui Hills, Southland	. .	. .	. .	37, 50.
Highest *Spirifer* bed, Upper Lora Stream, near Taylor's. *J.*	McKay, 1878	340	8	
Saddle between Taylor's Creek and Lora Station. *L.* . .	,, ,,	346	8	
Middle ammonite beds, slopes of Bare Hill, behind Taylor's, Lora Stream. *L.*	,, ,,	353	46	
Lower ammonite beds, Taylor's Creek, at junction of south branch, Flag Hill to North Peak section. *L.*	,, ,,	354	45	
Lower ammonite beds, junction of Taylor's Creek with the Otapiri. *L.*	,, ,,	355	101	
Lowest part of lower ammonite bed, Taylor's Creek, below the woolshed. *L.*	,, ,,	358	224	
Lower Cannon-ball sandstone, Taylor's Creek. *Rh.* . .	,, ,,	359	125	
Below Cannon-ball sandstone, Taylor's Creek. *Rh.* . .	,, ,,	360	51	
North-west branch of Taylor's Creek, higher up than outcrop of *Trigonia* beds. *Rh.*	,, ,,	361	66	
Trigonia beds, north-west branch of Taylor's Creek. *Rh.*	,, ,,	364	24	
Blue sandstone, north-west branch of Taylor's Creek. *Rh.*	,, ,,	365	2	
Blue sandstone and chert, main branch of Taylor's Creek. *Rh.*	,, ,,	366	66	50.
Lowest bed, Otapiri Series, south-west branch of Taylor's Creek. *Rh.*	,, ,,	370	38	
Monotis sandstone, north-west branch of Taylor's Creek. *T.*	,, ,,	375	5	
Taylor's Creek. Plants. *L.*	,, ,,	404	. .	
Plant-beds below upper conglomerate, at waterfall, Lora Creek. *J.*	Park, 1887 . .	666	6	
Te Anau, Lake, Southland	. .	. .	. .	58.
Lake Te Anau. *M.*	Cox, 1878 . .	553	7	
,, *M.*	McKay, 1878	805	29	
,, *Up. E.* or *C.-T.*	,, ,,	806	6	
Teaneraki. (See Oamaru)	. .	. .	. .	65.
*Te Aute, Hawke's Bay.				
Shell limestone, Stokes's Run, Te Aute. *P.*	McKay, 1877	187	36	
Cape Kidnappers and Te Aute Hills. *P.*	Hector, 1867	217	60	
Ostrea ingens limestone, Te Aute. *P.*	Park, 1888 . .	737	1	
Te Aute limestone. *P.*	Old collection	770	5	
Te Aute. *P.*	Hamilton . .	833	24	
(See also Cape Kidnappers, Waipawa.)				
*Te Awaiti, east coast of Wellington. *M.*	Old collections	813	3	
Te Kahu, Bay of Plenty. *Recent.*	McKay, 1887	705	14	
Te Karaka, south side of Manukau Harbour, Auckland.				
Brown sands and gravels, Te Karaka. *P.*	Park, 1885 . .	532	105	
Te Kopanga, Patangata County, Hawke's Bay	. .	830	12	
Ten-mile Creek. (See Greymouth.)				
Te Raungaruhe. (See Mokau.)				
Terawhiti. (See Wellington.)				
Teremakau (Taramakau) River, North Westland	. .	. .	. .	68.
Te Waka. (See Pohui.)				
Te Whareponga, East Cape district, Auckland. *Tertiary.* . .	McKay, 1874	72	63	
Thames River, east Auckland	. .	. .	. .	60.
Thomas River. (See Trelissick Basin.)				
Tiraumea, east Wellington	. .	. .	. .	68.
Tokomairiro (Milton), thirty-five miles south-west of Dunedin, Otago.				
Tokomairiro limestone, Waihola Gorge. *C.-T.*	McKay, 1873	40	73	
Black limestone, Tokomairiro. *C.-T.*	Rayer, 1863 . .	41	5	
Tokomaru, East Cape district, Wellington.				
North side, Tokomaru Bay. *M.*	McKay, 1874	223	. .	
Duncan's, between Tolago and Tokomaru Bays. *Up. M.* (?)	,, ,,	249	1417	
Tokomaru Bay. *C.-T.*	,, ,,	287	21	
Tolago Bay, East Cape district, Wellington.				
Cook's Cove, Tolago Bay. *M.*	McKay, 1874	328	41	
(See also Tokomaru.)				
Tom Bowline Bay, North Cape district, north Auckland . .	. .	. .	. .	73.
Coralline limestone, Tom Bowline Bay. *M.*	McKay, 1892	787	6	

—	Collector and Date.	Locality Number.	Number of Specimens.	Page in this Bulletin.
Torehine, Coromandel	..	..	..	72.
*Torlesse, Mount, central Canterbury	..	..	..	41, 71, 72.
Annelid beds, Mount Torlesse. *Carb.*	Hector, 1869	429	2	
Totara (Ototara). (See Oamaru)	..	..	..	9.
Totara Point, Auckland. (See Kawhia.)	..	..	..	40.
,, north Auckland. (See Whangaroa.)				
Totoro. (See Mokau.)				
*Trelissick Basin, Castle Hill, sixty-four miles north-west of Christchurch, Canterbury. (Also spelt "Tressilac," "Trelissic")	..	..	..	17, 46, 56, 59, 60, 64.
Saurian beds, Trelissick Basin. *Cret.*	Enys and Hector, 1872; McKay, 1874	67	42	
Upper Trelissick. *M.*	Enys and Hector, 1872	226	94	
Plant-beds, Christchurch – West Coast Road, at crossing of the Thomas River, Trelissick Basin. *M.* (?)	McKay, 1874	235	..	
Pareora beds, Thomas and Porter Rivers. *M.*	,, ,,	236	1	
Upper part of Mount Brown limestone, Trelissick Basin. *Up. E.*	,, 1879	237	59	
Mount Brown limestone, Coleridge Creek, Trelissick Basin. *Up. E.*	Enys 1866, 1879	238	13	
Fan coral beds, Porter and Thomas Rivers, Trelissick Basin. *C.-T.* or *T.*	McKay, 1879	239	240	
Below Weka Pass stone, Porter River, Trelissick Basin. *C.-T.*	,, ,,	240	23	
Tufaceous greensands, Whitewater Creek, Trelissick Basin. *C.-T.*	,, ,,	241	196	
Weka Pass stone, Trelissick Basin. *C.-T.*	Enys, 1866–79	242	10	
Fan coral bed, Trelissick Basin. *C.-T.* or *T.*	,, ,,	243	208	
Pareora beds, Trelissick Basin. *M.*	,, ,,	244	..	
Coal-beds, Broken River, Trelissick Basin. Plants. *C.-T.*	Hector, 1872..	425	2	
Lower beds, Trelissick Basin. *C.-T.*	Enys, 1880 ..	449	87	
Mount Brown beds, Coleridge Creek, Trelissick Basin. *Up. E.*	Enys ..	450A	..	
Pareora beds, Thomas and Porter Rivers, Trelissick Basin. *M.*	,, ..	451A	43	
Plant and shell beds, road-cutting, Thomas River, Trelissick Basin. *M.*	,, ..	452A	..	
Upper surface of Mount Brown limestone, Trelissick Basin. *Up. E.*	Hector and Enys	453A	6	
Chalk marls, Trelissick Basin	Hector ..	836	2	
Trooper's Range, east coast, Wellington	..	..	..	69.
Tukipo River. (See Ruataniwha Plain.)				
Tukituki River, south of Hawke's Bay.				
Tukituki River, near Kyber Pass, eastern base of the Ruahine Range. *P.*	Hill ..	772	20	
(See also Ruataniwha Plain.)				
Tumai. (See Pleasant River.)				
Tuparoa. (See Roparua.)				
Turanga-a-rere. (See Mataroa.)				
Turanganui River, Poverty Bay, east Auckland.				
Turanganui River. *Recent*	McKay, 1874	202	93	
Hill east of Turanganui River. *Recent*	,, ,,	203	104	
Turnagain, Cape, south coast, Hawke's Bay. *P.*	McKay, 1874	54	1	58, 64.
Urenui, twenty miles north-east of New Plymouth, Taranaki..	..	..	..	54.
White Cliffs, Urenui. *M.*	Hector, 1874	52	23	
Blue clays, Urenui. *P.*	Park, 1886 ..	582	36	
Urewera (Uriwera) country, east Auckland	..	..	..	68.
Utapu. (See Wanganui River.)				
*Vernon, Mount. (See Waipukurau.)				
Vincent County, Central Otago	..	..	..	61.
(See Bannockburn, Manuherikia.)				
Wade, twenty-four miles north of Auckland	..	..	..	65.
Waiapu River, East Cape district, Auckland.				
Upper Mata River, Waiapu Valley. *M.*	McKay, 1887	714	5	
Under Amuri limestone, Mata River. *C.-T.*	,, ,,	715	6	
Creek between Taitai and Aorangi, Mata River. *C.-T.* ..	,, ,,	716	1	
Waiau River, Southland	..	..	..	9, 52.
Waiau-ua River, south-east Nelson (Amuri district).				
Marble Point, Waiau-ua Gorge. *Up. E.*	Haast, 1869 ..	306	34	
Waiau-ua River. *C.-T.*	Buchanan, 1867	321	4	
Highfield Ridge, east of Waiau Township. *M.*	..	566	89	
(See also Isolated Hills, Lottery Creek, Lyndon, Mason River.)				

	Collector and Date.	Locality Number.	Number of Specimens.	Page in this Bulletin.
*Waihao River, south Canterbury	..	..	..	62, 64, 65.
Mount Harris, Waihao River. *M.*	McKay, 1880	475	638	
Marly greensands, Waihao River. *C.-T.*	" "	479	256	
Island sandstone or Saurian beds, Waihao River. *C.-T.*..	" "	480	646	
Waihao limestone, Waihao River. *C.-T.*	" "	482	174	
Grey marls, Waihao River. *C.-T.*	" "	485	284	
Waihao Bridge, one mile and a half below Waihao Forks. *C.-T.*	" "	642	70	
Waiherike. (See Kawhia.)				
*Waihola (Waihora), lake and gorge, east Otago	..	..	..	62, 64.
Tokomairiro limestone, Waihola Gorge. *C.-T.*	McKay, 1873	40	73	
Waihola township, marls below glacial breccia. *M.* ..	" 1886	629	6	
Waihora, Lake (Maori name for Lake Ellesmere), west of Banks Peninsula, Canterbury. (There is another lake of the same name, south-west of Dunedin)	..	..	..	51.
Waihou, Thames Valley, Auckland. *P.*	McKay, 1887	679	7	
Waihou River, Bay of Islands, north Auckland.				
East branch, Waihou River, near Okaihau. *C.-T.* ..	McKay, 1888	729	79	
Waikaka, Southland	..	..	..	67.
Waikaremoana, Lake, east Auckland.				
Outlet of Waikaremoana Lake. *Up. E.*	McKay, 1887	707	3	
Waikare Taheki River, six miles from Waikaremoana Lake. *M.*	Hamilton, 1885	722	..	
*Waikari, north Canterbury.				
Waikari Valley. *M.*	Hector, 1872..	233	54	
(See also Weka Pass.)				
Waikato district, south Auckland	..	..	..	54, 55, 57.
Leda marls, Whangape Lake, Lower Waikato (strata overlying brown coal of Taupiri). *C.-T.* (?)	Hector, 1867	39	33	
Whangape Lake. *C.-T.*	Hutton, 1866	273	8	
Taupiri Mine, Waikato River. *C.-T.*	Park, 1885 ..	529	18	
(See also Kupakupa, Mercer, Miranda.)				
*Waikato Heads, Waikato River, south-west Auckland ..	..	..	..	10, 15, 16, 21, 34, 39, 42–48, 57.
Marine beds, Waikato South Head. *J.*	Cox, 1876 ..	267	354	
Waikawau Creek, south of Waikato Head. *Up. E.* ..	" " ..	272	43	
Port Waikato, marine beds. *J.*	Old collections	289	142	
Coal-beds, Waikawau Creek. *Up. E.*	Cox, 1876 ..	301	444	
Below flaggy limestone, Waikato Heads. *C.-T.* ..	" 1877 ..	322	..	
Cardita beds, Waikawau. *Up. E.*	" " ..	323	126	
Waikato Heads. Plants. *J.*	Hector, 1866	409	14	
*Waikawa, Southland	..	..	..	15, 21, 42–48, 64, 65.
Waikawa. Plants	Hector, 1878	426	21	
Plant-beds, South Head, Waikawa. *J.*	Park, 1886 ..	677	211	
Waikawa. *J.*	Old collections	798	13	
Waikawau. (See Waikato Heads)	..	..	..	57.
Waikohu. (See Papakura.)				
Waikouaiti, thirty-two miles north of Dunedin. (See Pleasant River)	..	..	..	71.
Waimate. (See Waitangi.)				
Waimea Creek, Westland	..	..	..	56.
Waimea Plains, Southland. *Up. E.*	Hector, 1869	258	7	
Waimea River, Nelson. (See Wairoa River.)				
Waimirima, coast south of Cape Kidnappers, Hawke's Bay.				
Waimirima. *Cret.*	McKay, 1875	83	48	
Chalk marls. Waimirima. *C.-T.*	Enys, 1874; McKay, 1875	116	40	
Shell-beds, Waimirima. *Pl.*	McKay, 1875	122	4	
Waingaro, south-west Auckland.				
Putataka beds, Kohururu, Waingaro. *J.*	Park, 1885 ..	528	154	
Waingaroa. (See Whaingaroa.)				
Wainui, near Cape Turnagain, Hawke's Bay	..	..	..	68.
Waiomio. (See Kawakawa.)				
Waipa. (See Kawhia)	..	..	..	62, 63.
Waipahi. (See Landslip Hill.)				
Waipapa Boat-harbour. (See Clarence River.)				
*Waipara River, north Canterbury	..	..	..	10, 12, 16, 21, 52, 54–56, 58, 65, 67, 68, 74.
Mount Brown, Waipara River. *Up. E.*	Hector, 1867; McKay, 1874	66	2	
McKay's Creek, Middle Waipara. *C.-T.*	McKay, 1874	149	54	
Grey marls, Heathstock, Upper Waipara	" "	150	18	
Lower gorge of the Waipara. *M.*	Hector, 1867	228	283	
Boby's Creek, Waipara. *C.-T.*	" "	277	200	
Saurian beds, Heathstock, Upper Waipara. *C.-T.* ..	McKay, 1874	295	1	

—	Collector and Date.	Locality Number.	Number of Specimens.	Page in this Bulletin.
*Waipara River, north Canterbury—*continued.*				
The Deans, Waipara Valley. *Up. E.*	Hector, 1872	313	9	
Upper calcareous band, Mount Brown. *Up. E.*	Park, 1887	723	112	
Lower calcareous band, Mount Brown. *Up. E.*	" "	724	14	
Middle Waipara. *C.-T.*	McKay, 1891	761	520	
Junction between Weka Pass stone and Amuri limestone, Middle Waipara	McKay	821	2	
Saurian greensands, Upper Waipara	Haast	835	5	
(See also Weka Pass.)				
Waipawa River, south Hawke's Bay	..	..	..	59.
Waipawa River. *Cret.*	McKay, 1877	186	..	
Fossiliferous rocks, Waipawa Gorge. *C.-T.*	" 1886	692	58	
Waipiro, East Cape district, Auckland.				
Limestone, Waipiro Bay. *Cret.*	McKay, 1874	73	7	
Waipiro Creek. *M.*	" 1887	686	15	
(See also Akuaku.)				
*Waipukurau, south Hawke's Bay	..	..	..	59, 65.
South slopes of Mount Vernon, Waipukurau. *P.*	McKay, 1886	694	27	
Mount Vernon	Hill	769	53	
Wairarapa district, east Wellington	..	..	..	58, 59, 65, 74.
East Wairarapa	Charlton	847	1	
(See also Masterton, Ruamahanga, Woodville.)				
Wairau River, Marlborough	..	..	..	15, 59.
Waireka River, Kakanui River. (See Oamaru.)				
*Wairoa River, Waimea River, central Nelson	..	..	..	15, 16, 33, 34, 37, 40, 42–46, 48, 58.
Wairoa Gorge. *T.*	Hector, 1866	140	48	
" *T.*	McKay, 1874	141	44	
Wairoa River, below gorge. *M.*	" 1878	318	181	
Wairoa Gorge. *J.*	" 1875	382	2	
Mytilus problematicus beds, west side of Mount Heslington, Wairoa Gorge. *T.*	" 1878–9	383	32	
Halobia beds, east side of Mount Heslington, Wairoa Gorge. *T.*	" "	384	..	
Nautilus beds, east side of Mount Heslington, Wairoa Gorge. *Rh.*	" "	385	41	
Monotis beds, east slopes of Mount Heslington. *T.*	" "	386	3	
Mytilus problematicus beds, east slopes of Mount Heslington. *J.*	" "	387	4	
Limestone, Martin's Sawmill, upper end of Wairoa Gorge. *Carb.*	" "	388	18	
Limestone, upper end of Wairoa Gorge, at junction of Roding River. *Carb.*	" "	389	3	
Spirifer beds, upper part of Spring Grove Creek. *J.*	" 1878	390	140	
Monotis beds, Spring Grove Creek. *J.*	" "	391	3	
Top of the range at source of Spring Grove Creek. *J.*	" "	392	14	
Lowest beds, Sellen's section, Wairoa Gorge, to Eighty-eight Valley. *J.*	" "	393	125	
Spirigera beds, Sellen's section, Wairoa Gorge, to Eighty-eight Valley. *J.*	" "	394	348	
Mytilus problematicus beds, Sellen's section, Wairoa Gorge, to Eighty-eight Valley. *T.*	" "	395	11	
Great limestone, Sellen's section, Wairoa Gorge, to Eighty-eight Valley. *Carb.*	" "	396	1	
Productus limestone, Sellen's section, Wairoa Gorge, to Eighty-eight Valley. *Carb.*	" "	397	25	
Fossiliferous slates, Little Ben Nevis, Wairoa River. *Carb.*	" "	398	7	
Monotis beds, Mount Heslington, Wairoa Gorge. *T.*	" "	438	101	
Mytilus beds, Mount Heslington, Wairoa Gorge. *T.*	" "	439	28	
Psioidea beds, Mount Heslington, Wairoa Gorge. *T.*	" "	440	286	
Limestone, Martin's Mill, Wairoa Valley. *Carb.*	" "	441	182	
Mytilus beds, north side, Wairoa Gorge. *T.*	" "	442	13	
Psioidea beds, north side, Wairoa Gorge. *T.*	" "	443	8	
Pareora beds, Wairoa Gorge. *M.*	" "	468	123	
Wairoa Gorge, Nelson	Yule	775A	21	
Plant-beds, Mount Heslington, Wairoa Gorge. *Rh.*	McKay, 1878–9	803	13	
*Waitaki River, between north-east Otago and south Canterbury	..	..	..	58, 60, 61, 70, 75
Black Point, Waitaki River. *C.-T.*	McKay, 1876	176	338	
Maerewhenua gold-workings, Waitaki River. *C.-T.*	" "	177	50	
**Phorus* beds, Maerewhenua. *C.-T.*	" "	178	159	
Maerewhenua limestone. *C.-T.*	" "	179	175	
Waitaki River. *Up. E.*	Hector, 1865	242	10	
Otekaike, Waitahi Valley. *Up. E.*	Traill, 1874	252	70	
Kekenodon beds, Waitaki River. *Up. E.*	McKay, 1880	476	827	
Otekaike limestone, Station Peak, Waitaki Valley. *Up. E.*	" "	477	467	
Otekaike limestone, Otekaike. *Up. E.*	" "	481	38	

	Collector and Date.	Locality Number.	Number of Specimens.	Page in this Bulletin.
*Waitaki River, between north-east Otago and south Canterbury—*continued.*				
Maerewhenua limestone, Pigeon Rock, Waitaki Valley. *C.-T.*	McKay, 1880	484	970	
Triassic fossils, high-level river-terrace, Waitaki Valley. (*Cf.* St. Mary, Mount.)	,, 1881	552	67	
(See also Wharekauri.)				
Waitangi River, opposite Waimate, Bay of Islands, north Auckland. *C.-T.*	McKay ..	728	250	
Waitara, Taranaki	..	..	..	
Pareora beds, Onairo, Waitara. *M.*	Park, 1886 ..	583	82	
Waitemata County, Auckland	..	..	..	63.
*Waitotara, north-west Wellington	..	..	..	62.
Waitotara. *P.*	Hector, 1870..	209	..	
Waitotara, Puketapu. *P.*	,, 1866..	588	19	
Shell-beds at mouth of Butler's Creek, Waitotara. *P.* ..	Park, 1886 ..	634	191	
Rotella beds, Nukumaru Beach, Waitotara. *P.* ..	,, ,, ..	635	25	
Nukumaru limestone, Waitotara. *P.*	,, ,, ..	636	153	
Ostrea ingens bed, Waitotara. *P.*	,, ,, ..	639	88	
Blue clays on coast north of Waitotara. *P.*	,, ,, ..	640	50	
Blue clays, Wairoa Beach, Waitotara. *P.*	,, ,, ..	641	24	
Patea and Waitotara	Old collections	794	2	
*Wakatipu Lake, west Otago	..	..	..	59, 60, 68, 73.
Bob's Cove (The Twelve-mile), Lake Wakatipu. *C.-T.* ..	Hector, 1874..	63	25	
Bob's Cove. *C.-T.*	McKay, 1880	456	108	
Pareora beds, Bob's Cove. *M.*	,, ,,	457	2	
*Wanganui (town), north-west coas , Wellington	..	..	..	9, 16, 20, 53, 55, 56, 61, 63, 65, 69.
*Lower part of Shakespeare Cliff, Wanganui. *P.* ..	Buchanan, 1866	91	1	
Upper part of Shakespeare Cliff, Wanganui. *Pleistocene* ..	,, ,,	92	4	
Durie's Hill, Wanganui. *P.* or *Pleistocene*	Kirk, 1875 ..	205	157	
Shakespeare Cliff, Wanganui. *Pleistocene*	,, ,, ..	206	525	
Railway-cutting ten miles south (?) of Wanganui. *Pleistocene*	,, ,, ..	207	251	
Lower part of Shakespeare Cliff. *P.*	,, ,, ..	208	1395	
Blue clays at mouth of Kai-iwi River	Park, 1886 ..	633	199	
Shakespeare Cliff. *P.*	Buchanan, 1867	768	242	
*Wanganui River, north-west Wellington, Taranaki, and south Auckland	..	..	..	65.
Parikino and Upper Wanganui River. *M.* or *P.* ..	Crawford, 1862	259	60	
Kawaiki quarries, Wanganui River. *P.*	Park, 1886 ..	638	68	
Blue clays of Pipiriki, Wanganui River. *P.*	,, ,, ..	645	5	
Utapu, Upper Wanganui River. *M.*	,, 1887 ..	647	47	
Otapokiore, Upper Wanganui River. *M.*	,, ,, ..	648	84	
*Paparoa Rapids, Upper Wanganui River. *M.* ..	,, ,, ..	649	509	
Blue clays, rapids, Upper Wanganui River. *C.-T.* ..	,, ,, ..	650	39	
Heao Valley, Upper Wanganui River. *M.* (?)	,, ,, ..	653	22	
Limestone, Pipiriki, Wanganui River. *P.*	,, ,, ..	659	7	
Limestone at caves near Mangaio, Upper Wanganui. *P.*	,, ,, ..	660	19	
(See also King-country, Ongaruhe, Tangarakau.)				
Wanganui, West (West Haven), north-west Nelson	..	..	..	9.
Between West Wanganui and Mokihinui. *C.-T.* ..	Hector, 1866	637	33	
*Wangapeka River. (See Motueka River.)	..	..	..	59, 66.
Wangarei. (See Whangarei.)				
Wangaroa. (See Whangaroa.)	..	..	..	56.
Warkworth. (See Mahurangi.)				
*Weka Pass, between Waipara and Waikari, north Canterbury	..	..	..	56, 58, 62, 64, 66, 67, 67, 74.
Grey marls, Weka Pass. *C.-T.*	Hector, 1867; McKay, 1874	71	103	
Calcareous greensands, Weka Pass. *C.-T.*	Hector, 1867; Haast, 1869; McKay, 1874	74	92	
Weka Creek, Weka Pass *M.*	McKay, 1874	152	9	
Amuri limestone, Weka Pass. *C.-T*	,, 1886	643	..	
Waipara beds, Weka Creek. *C.-T.*	McKay ..	782	16	
Mount Donald, Weka Pass. *M.*	,, ..	786	34	
(See also Waipara.)				
Wellington, Mount. (See Wairoa Gorge.)				
WELLINGTON (province)	..	..	..	10.
*EAST. (See Akiteo River, Castlepoint, Dorset's, Glenburn, Korakonui, Mangapakeha River, Masterton, Pahua River, Ruamahanga, Taipos, Te Awaiti, Tiraumea, Trooper's Range, Wairarapa.)	..	..	..	69.
NORTH. (See Kaimanawa, King-country, Manawatu, Mataroa, Norsewood, Ongaruhe, Rangitikei.)				
NORTH-WEST COAST. (See Patea, Waitotara, Wanganui ..	..	..	..	64.
SOUTH. (See Palliser; Wellington, town.)				

	Collector and Date.	Locality Number.	Number of Specimens.	Page in this Bulletin.
Wellington (town and vicinity)	..	..	..	59.
Makara Valley, near Wellington. *Up. M.*	McKay, 1876	95	12	
Raised beach, Evans Bay, near Wellington. *Recent.* ..	,, ,,	200	3	
Excavation for gasworks, Te Aro, Wellington. *Recent.* ..	McKay ..	317	13	
Karori sandstones. *Carb.*	Hector, 1866	430	..	
Porirua Harbour and Sinclair Head. Plants. *Carb.* ..	McKay, 1879	810	3	
Annelid beds, Karori. *Carb.*	,, ,,	811	..	
(See also Miramar.)				
West Coast, South Island. (See also Westland and south-west Nelson.)	..	..	..	57.
WESTLAND PROVINCE	..	..	..	57, 59, 62, 67, 68.
Maitai formation (annelid beds), Westland. *Carb.* ..	McKay, 1875	291	10	
(See also Abbey Rocks, Callaghan's Hill, Greymouth, Kanieri River, Kaiata, Koiterangi, Kongahu, Mikonui, New River, Okarita, Omoeroa, Ross.)				
Westport, Buller River, south-west Nelson.				
Black marls, Mount Rochfort. *C.-T.*	McKay, 1874	124	1	
Buller Coalfield. Plants. *Cret.*	Hector, 1869	411	3	
Addison's Flat, Westport	..	822	3	
*Cape Foulwind, Westport. *Tertiary*	..	823	1	
*Whaingaroa Harbour. (See Raglan.)	..	..	..	42, 51, 54.
*Whakaati, near Napier	..	..	..	65.
Whakamarumaru. (See Gisborne.)				
*Whangape Lake. (See Waikato.)				
Whangara, coast thirteen miles north of Poverty Bay, east Auckland. *Cret.*	McKay, 1874	111	..	
*Whangarei, north Auckland	..	..	..	57, 61, 65, 75.
Morrison's, Waiau, south of Whangarei. *C.-T.* ..	Hector, 1874..	199	6	
Parua Bay, Whangarei. *C.-T.*	Cox, 1876 ..	270	14	
Walton's Coal-mine, Whangarei. *C.-T.*	Hector, 1865..	271	8	
Whangarei and Kawakawa. *C.-T.*	,, 1866..	279	5	
Whangarei. *C.-T.*	Cox, 1867 ..	282	21	
Tiger's Hill, Whangarei. *C.-T.*	Hector, 1867..	283	43	
Morrison's, Whangarei. *C.-T.*	,, 1874..	284	8	
Whangarei. Plants. *C.-T.*	,, 1866..	416	..	
Limestone Island, Whangarei. *C.-T.*	Cox, 1879 ..	464	2	
Hikurangi Coalfield. *C.-T.*	McKay, 1892	765	48	
Limestone Island, Whangarei. *C.-T.*	..	779	4	
Kawakawa (roof of coal, shells) and Whangarei (shells) ..	Old collection	783	14	
Whangaroa Harbour, north Auckland	..	..	..	53, 56, 67, 73.
Whangaroa Harbour. *Secondary*	McKay, 1884	76	4	
St. Peter's Mount, Whangaroa. Plants. *M.* or *P.* ..	Hector, 1866; McKay, 1875	105	2	
Whangaroa, north shore of harbour. *Cret.*	McKay, 1875	106	167	
Plant remains, St. Peter's Mount, north shore, Whangaroa Harbour. *Up. M.*	Hector, 1866..	418	10	
Cone-in-cone limestone, Totara Point, Whangaroa. *C.-T.*	McKay, 1890	750	53	
(See also Kaeo.)				
Whareharua. (See Castlepoint.)				
*Wharekauri, Waitaki River, above Kurow	..	..	..	61, 70.
Wharekauri. *Up. E.*	Traill, 1874 ..	251	73	
Otekaike limestone, Wharekauri. *Up. E.*	McKay, 1880	478	206	
Hutchinson's Quarry beds, Wharekauri. *Up. E.* ..	,, ,,	483	306	
Greensand, Wharekauri. *C.-T.*	,, ,,	486	133	
Coal-beds, Wharekauri. Plants. *M.*	,, 1881	550	..	
Wharfdale. (See Ashley River.)				
Whatatutu, Gisborne district	..	..	..	73.
Whenuakura, Taranaki (forty-five miles north-west of Wanganui)	..	..	..	62.
White Cliffs. (See Urenui)	..	..	..	54.
*White Rock Point. (See Mokihinui.)				
*White Rock Quarries. (See Okuku.)				
*White Rock River. (See Pareora.)				
Whitewater Creek. (See Trelissick Basin.)				
*Wilberforce River, tributary of Rakaia River, Canterbury ..	..	..	..	35.
Wiltshire Beach. (See Nugget Point.)				
Woodpecker Bay. (See Brighton, Nelson.)				
Woodville, south Hawke's Bay.				
Plant-impressions (indistinct), Maharahara, Woodville ..	McKay ..	820	1	
Wyndham River, Mataura River, Otago	..	..	..	33.
Dark mudstones, Wyndham River. *T.* or *L.*	Buchanan, 1866	132	10	
Lower part of Wyndham River, at junction with Mataura. *L.*	McKay, 1879	459	13	
(See also Mataura River). *L.*				

EXPLANATION OF PLATES.

(The plates are enclosed in an envelope on the inside of the under cover of the bulletin.)

THE plates issued with this bulletin were printed many years ago, and were designed to illustrate "Memoirs on the Palæontology of New Zealand," as has been explained above. Since they can serve no further purpose by remaining in stock, and may, moreover, be found useful in illustrating the species to which they refer, they are now issued.* Plates V and VI are reprints of pls. 22 and 23, T.N.Z.I., vol. 10, 1878, and, being printed on better paper, will be found clearer than the original plates. Plates I–IV are new. The figures, particularly in the case of the *Belemnites* from Amuri Bluff, are somewhat idealized, and some may be synthetographs,† but in those cases where the originals have been identified the figures are sufficiently true to serve as satisfactory illustrations. The names given by Hector are supplied on the authority of Mr. A. McKay, and the locality of the specimens is also supplied where it is known.

—		Locality.	Specimens in Dominion Museum.
	PLATE I.		
For explanation, see p. 50.			
	PLATE II.		
Fig. 1.	*Spiriferina* (*Trigonotreta alata*; *fide* McKay).	Loc. 380. *Spirifer* and Crinoid beds near Cowan's, Oreti Valley	1 plesiotype.
Figs. 2, 3, 4.	,, ,, ,,		
Figs. 5–9.	(See p. 50.)		
	PLATE III.		
Fig. 1, *a–c*.	*Spiriferina* sp. ind.	Loc. 300. As above	A specimen of same species, (?) the original of the figure.
Fig. 2, *a–c*.	*Spiriferina* sp. ind. (Fig. 40, No. 4, p. 72, Cat. Ind. Col. Exh.)	Loc. 359. Lower Cannon-ball sandstone, Taylor's Creek, Hokanui Hills.	1 figured specimen.
Fig. 3*a*.	*Spiriferina* sp. ind.	Loc. 380. As above ..	,,
Fig. 3*b*.	,, } *Cf. S. radiata*, fig. 36, No. 4, p. 70, Cat. Ind. Col. Exh.		
Fig. 4, *a–b*.	,,		
Fig. 5.	,,		
Fig. 6, *a–c*.	*Epithyris elongata*. (No. 6*b* is fig. 45, No. 5, p. 76, Cat. Ind. Col. Exh.)		
Fig. 7, *a*, *b*.	*Epithyris* sp. ind.		

* Duplicates of the plates illustrating Tenison-Woods's "Corals and *Bryozoa*, &c.," and Ettingshausen's "Contribution to the Knowledge of the Fossil Flora of New Zealand" (T.N.Z.I., vol. 23, p. 237), and the unpublished plates prepared to illustrate Hector's "Fossil Flora of New Zealand," are still in stock.

† A synthetograph is a figure based on more than one specimen.

		Locality.	Specimens in Dominion Museum.
	Plate IV.		
Fig. 8, *a–c.*	*Athyris* sp. ind.	? Loc. 380. As above.	A specimen possibly the original of the figure 8*a*.
Fig. 9*a*.	"	Loc. 434. *Mytilus* beds, Eighty-eight Valley, Nelson	A specimen with the beak broken.
Fig. 9*b*.	.. ..	Loc. 380. As above ..	2 specimens, from either of which the figure may have been made.
Fig. 10, *a. b.*	.. ..	Loc. 379. *Spirigera* beds overlying the big conglomerate, Oreti Valley	1 figured internal cast and also part of the external cast of the same specimen.
Fig. 11*a*.	"	Loc. 378. *Inoceramus* beds overlying the big conglomerate, Benmore Run, Hokanui Hills	1 specimen, probably the original of the figure.
Fig. 11*b*.	"		
Fig. 12, *a–c.*	*Spiriferina* (*cristata ?*). (Fig. 45, No. 6, p. 76, Cat. Ind. Col. Exh.)	Loc. 401. Mount Potts *Spiriferina* beds	1 specimen, from which the figures appear to have been idealized.
Fig. 13.	(See p. 50. Fig. 12*b* in the centre of the plate should be 13*b*.)		
	Plate V. (Reprint of pl. 22, T.N.Z.I., vol. 10, facing p. 486 ; 1878.)		
Fig. 1.	*Belemnites otapiriensis* Hector. (*Cf.* fig. 40, No. 5, p. 72, Cat. Ind. Col. Exh.)	Loc. 372. Oreti railway-cutting, Dipton	2 syntypes. (Figure probably a synthetograph.)
Fig. 2.	*Belemnites canaliculatus aucklandicus* Hauer : (*a*) ventral, (*b*) lateral aspect. (*Cf.* fig. 36, No. 3, p. 70, Cat. Ind. Col. Exh.)		
Fig. 3.	*Belemnites catlinensis* Hector : (*a*) lateral, (*b*) ventral aspect	Loc. 21. Pholadomya Point, Catlin's River	Holotype.
Fig. 4.	*Belemnites hochstetteri* Hector : (*a*) lateral, (*b*) ventral aspect. (*Cf.* fig. 33, No. 4, p. 68, Cat. Ind. Col. Exh., as *B. aucklandica*, Kawhia.)		
	Plate VI. (Reprint of pl. 23, T.N.Z.I., vol. 10, facing p. 488 ; 1878.)		
	Belemnites australis Phillips. (*Cf.* fig. 28, Nos. 1, 2, 3, p. 64, Cat. Ind. Col. Exh.)	Amuri Bluff ..	Numerous plesiotypes difficult to connect with given figures.
Var. *α*.	*a′* dorsal, *a″* lateral aspect, *a‴* longitudinal section, *s′* transverse section of phragmacone, *s″* transverse section of guard.		
Var. *β*.	*b′* lateral aspect, *b″* longitudinal section, *s′* transverse section of phragmacone, *s″* transverse section of guard.		
Var. *γ*.	*c′* ventral, *c″* lateral aspect, *c‴* longitudinal section of alveolus.		
Var. *δ*.	*d′* ventral aspect, *d″* longitudinal section, showing exfoliation of the central core, *d‴* lateral aspect, *s′* transverse section of guard, *s″* transverse section of phragmacone.		
Var. *ε*.	*e′* dorsal, *e″* lateral aspect ; *e‴* dorsal, *e⁗* lateral aspect (*juv.*) ; *s′* transverse section of guard, *s″* transverse section of phragmacone (*juv.*)		

INDEXES.

INDEX TO NAMES OF PERSONS.

GENERAL INDEX.

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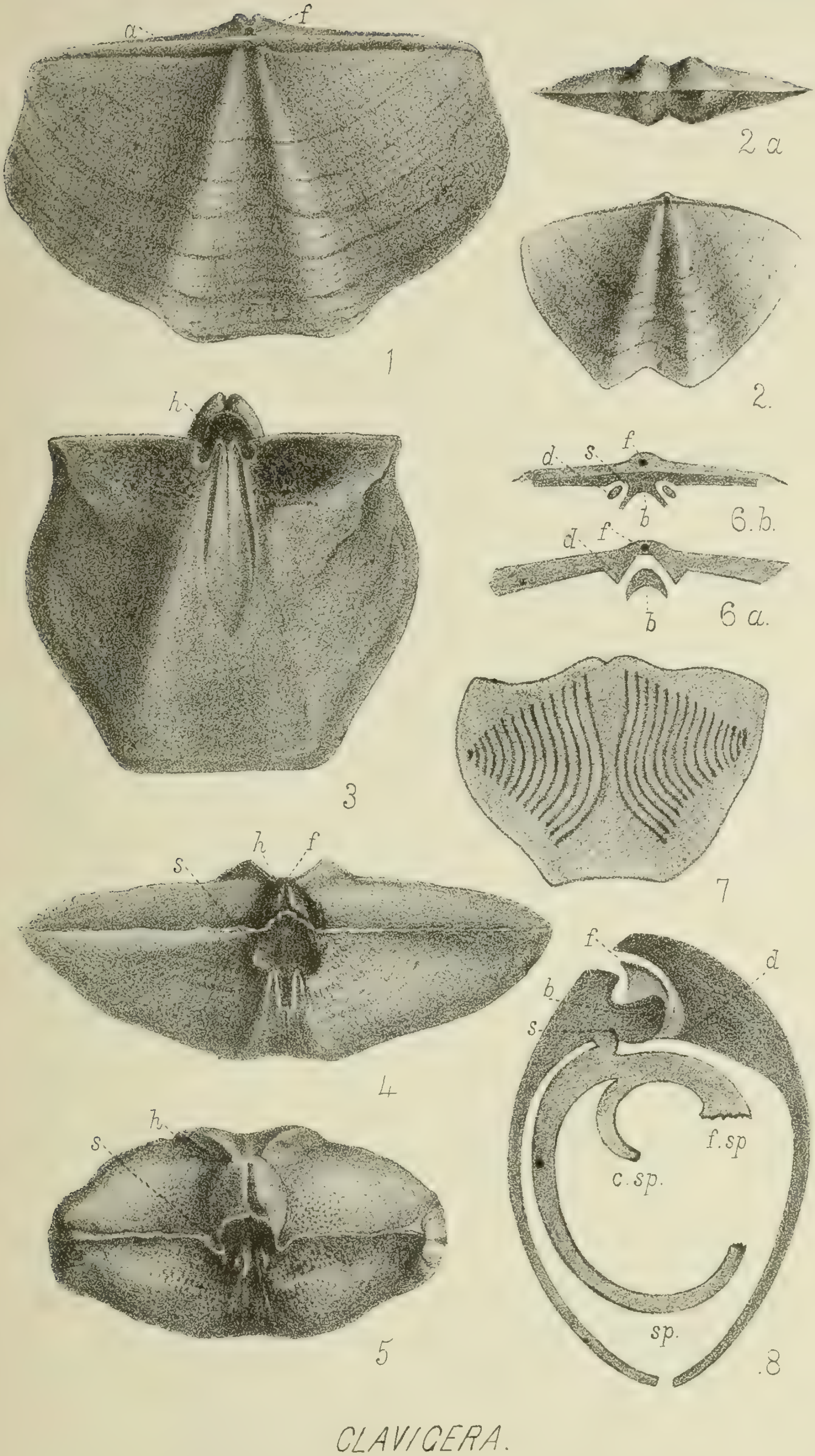
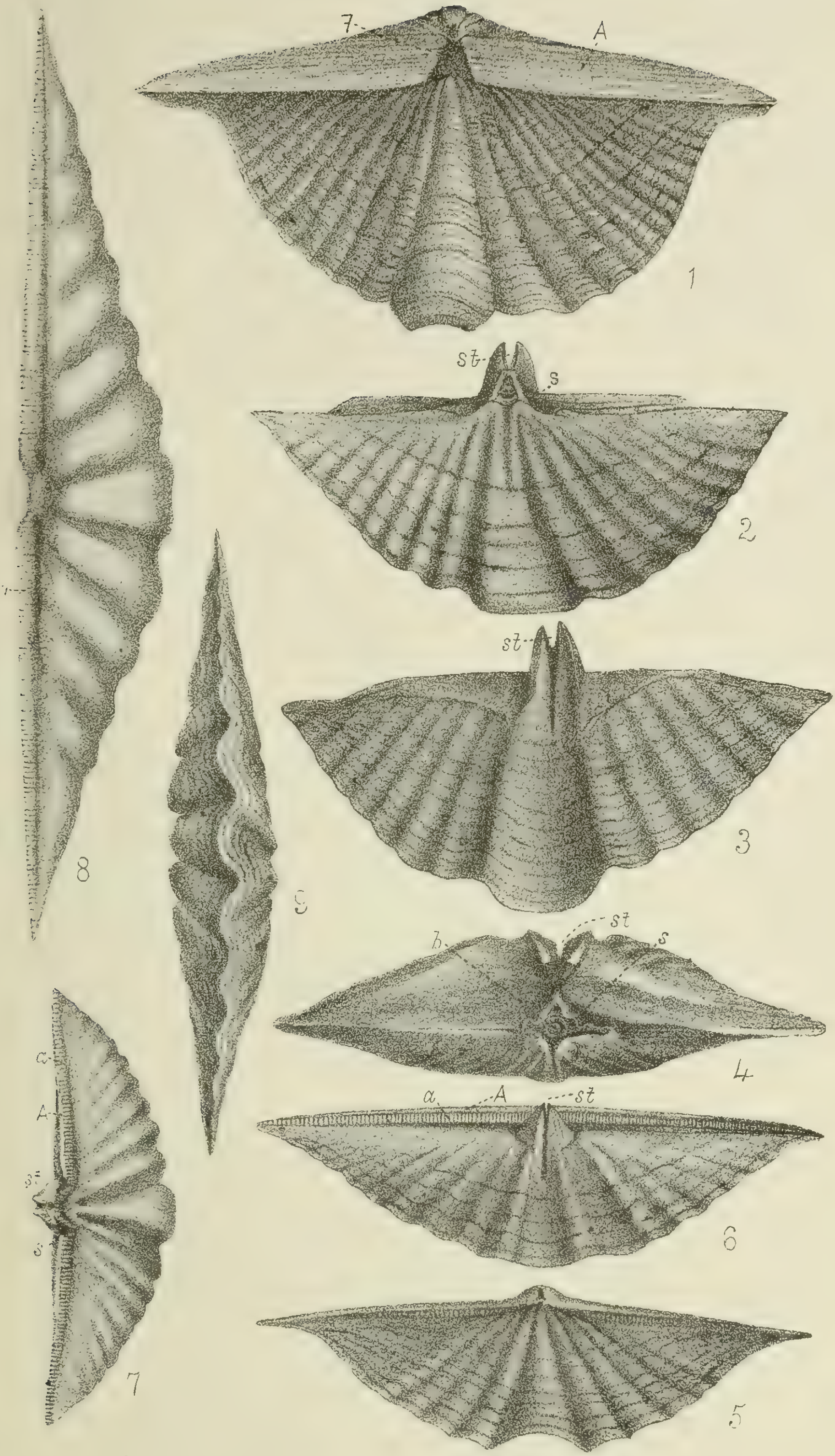


CLAVICERA.

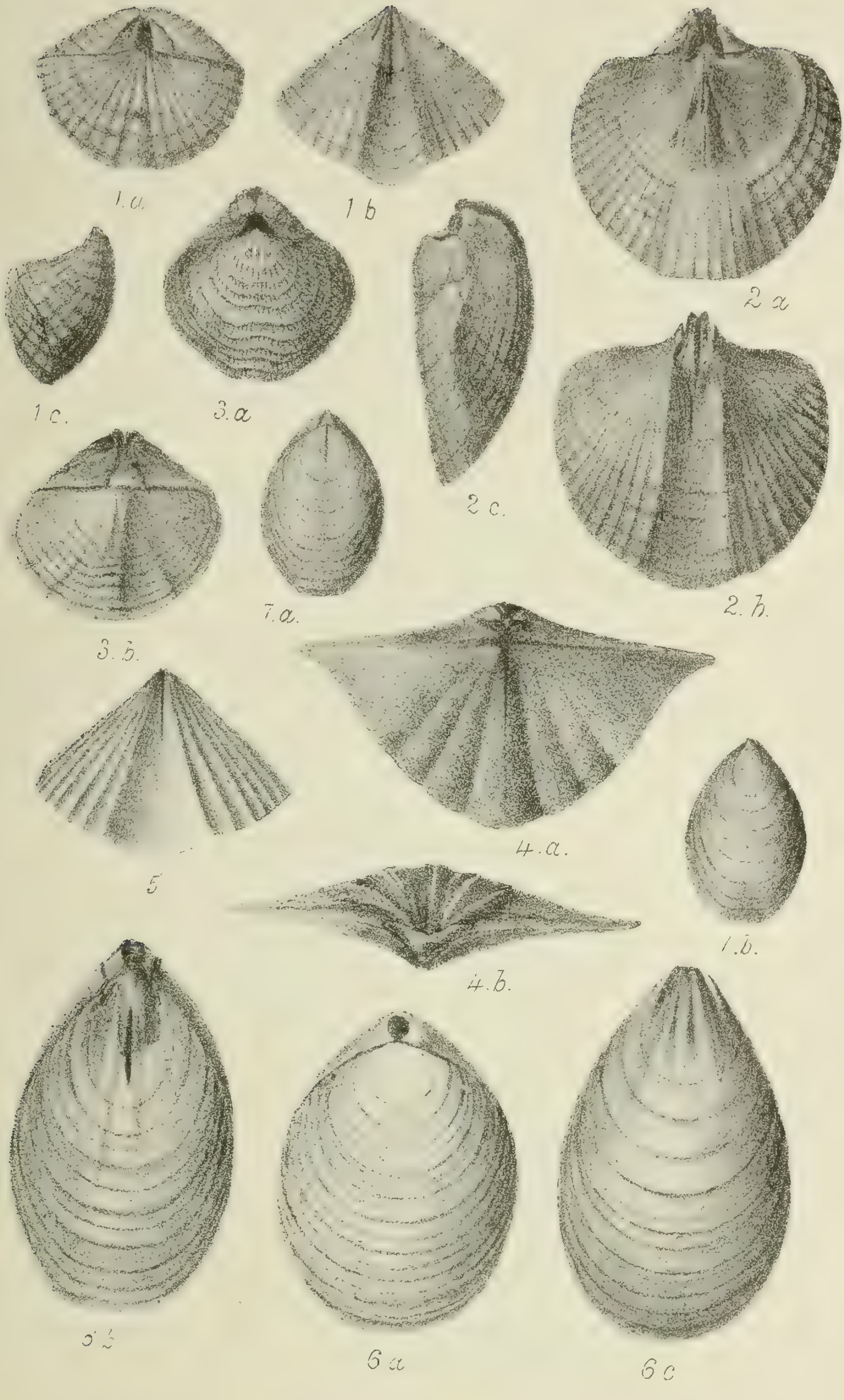
[*To accompany Palæontological Bulletin No. 1, New Zealand Geological Survey.*]



1-4. SPIRIFERINA. 5-9. RASTEILIGERA.

[*To accompany Palæontological Bulletin No. 1, New Zealand Geological Survey.*]

PLATE III.



1.-5. SPIRIFERINA. 6.-7. EPITHYRIS.

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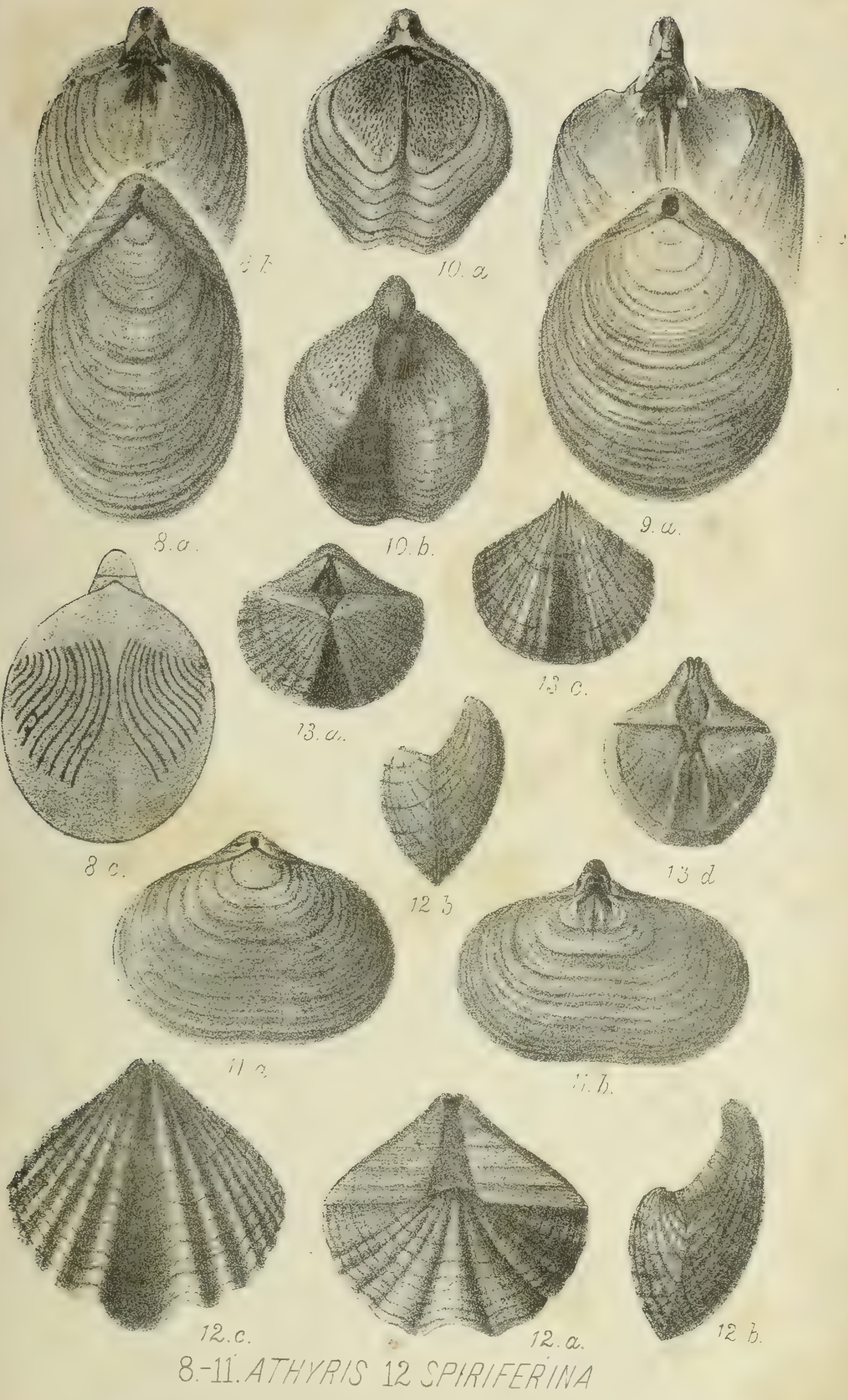

8.-11. ATHYRIS 12 SPIRIFERINA

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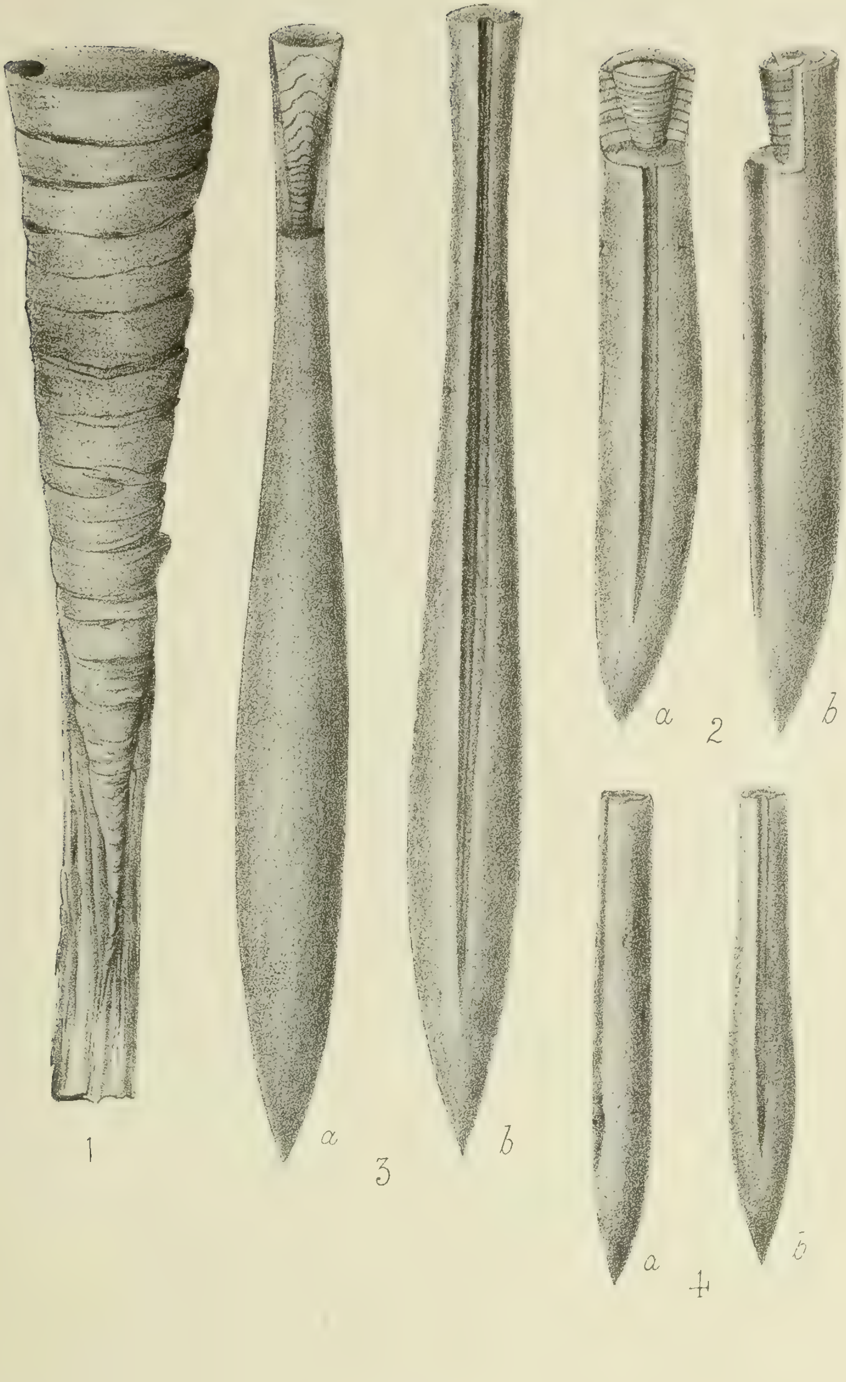


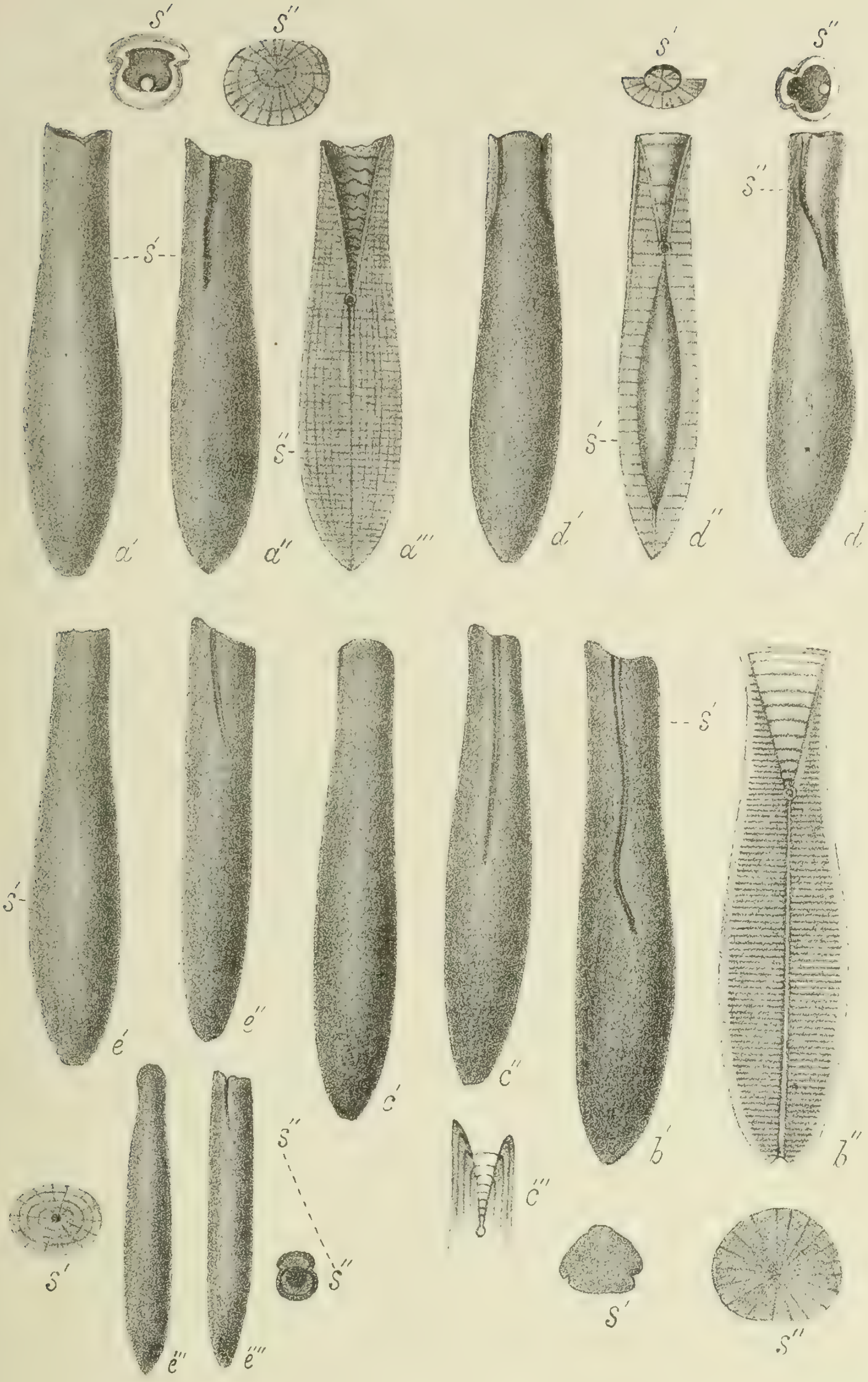
N. Z. BELEMNITES.

J. Hector. del.

J.B. lith.

[To accompany Palæontological Bulletin No. 1, New Zealand Geological Survey.]

PLATE VI.



J. Hector, del

N.Z. BELEMNITES.

J.B. lith.

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NEW ZEALAND.

Department of Mines.

NEW ZEALAND GEOLOGICAL SURVEY

(P. G. MORGAN, Director.)

PALÆONTOLOGICAL BULLETIN No. 2.

REVISION OF THE TERTIARY MOLLUSCA OF NEW ZEALAND,

BASED ON TYPE MATERIAL.

Part I.

BY

HENRY SUTER.

ISSUED UNDER THE AUTHORITY OF THE HON. WILLIAM FRASER, MINISTER OF MINES

WELLINGTON.
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1914.

LETTER OF TRANSMITTAL.

Geological Survey Office,
Wellington, 31st July, 1913.

Sir,—

I have the honour to transmit herewith Palæontological Bulletin No. 2, entitled "Revision of the Tertiary Mollusca of New Zealand, based on Type Material, Part I," and written by Mr. Henry Suter, of Christchurch. A preface by Dr. J. Allan Thomson, Palæontologist to this Survey, explains several matters connected with the preparation of this bulletin.

The bulletin contains sixty-four pages of letterpress, and is illustrated by a large number of plates, the majority of which have been prepared from drawings made many years ago by the late John Buchanan, under the direction of Sir James Hector.

I have the honour to be,
Sir,
Your obedient servant,

P. G. MORGAN,
Director, New Zealand Geological Survey.

The Hon. William Fraser, Minister of Mines, Wellington.

PREFACE.

From October, 1911, to March, 1912, Mr. Suter was engaged by the Geological Survey to assist in the determination of the large collections of *Tertiary Mollusca* in the possession of the Geological Survey. It was soon found that little progress could be made with these until the extinct species were revised in the light of modern knowledge of the *Recent Mollusca.* An instalment of this revision was begun by placing in Mr. Suter's hands the specimens in the Survey collections illustrating Captain F. W. Hutton's "Catalogue of the Tertiary *Mollusca* and *Echinodermata* of New Zealand in the Collection of the Colonial Museum," which was published by the Colonial Museum and Geological Survey Department in 1873. The present bulletin contains the result of Mr. Suter's examination of these specimens. During a subsequent engagement Mr. Suter has revised the types of the species established since 1873, and this revision will appear in a later bulletin.

Only a part of Hutton's primary types of 1873 could be sent to Mr. Suter. In 1885 Professor Tate, of Adelaide University, proposed to institute a comparison between the Tertiary *Mollusca* and *Echinodermata* of Australia and New Zealand, and at his request a large number of Hutton's primary types were lent to him. Owing to his death in 1895 the results of his comparison were never published, nor were the loaned specimens returned to New Zealand. Through the good offices of Mr. W. Howchin, Lecturer in Geology and Palæontology in the University of Adelaide, a few types have since been recovered, but, as indicated in Chapter I, there are still a large number in Adelaide that cannot be traced by Mr. Howchin.

It is obvious from a perusal of Hutton's Catalogue that in the case of most of the new species proposed several primary types were constituted, for a list of several localities accompanies the descriptions of most of the species. In the type collection as now preserved, however, there is rarely more than one specimen of each species, and Mr. Suter has therefore considered it as "the type"—*i.e.*, the holotype. Whether Hutton himself selected holotypes or not is uncertain, but it seems probable that he did, although there are certain anomalies difficult to explain on this assumption. For instance, the only specimen preserved of *Pecten chathamensis* is from Broken River, and not from the Chatham Islands; and again, the supposed holotype of *Pecten hutchinsoni*, a manuscript species of Hector's accepted by Hutton, comes from Kaipuki Cliffs, and not from Hutchinson's Quarry. Further, from the records of the collections sent to Professor Tate it appears that in a few cases syntypes were preserved, one of which in each case was sent to him. The final classification of the type specimens is, therefore, necessarily postponed until these lost syntypes have been recovered.

Hutton's Catalogues both of the Marine and of the Tertiary *Mollusca* were issued without figures, but it was evidently intended that a volume of plates should be subsequently issued, for pencil drawings suitable for lithography were made by J. Buchanan. These drawings were handed over to Mr. Suter along with the types, and have been extensively used in the preparation of the figures accompanying this bulletin—viz., in the first fifteen plates, with the exception of three drawings made by Mr. Suter. The remaining plates are from photographs taken by myself.

J. Allan Thomson,
Palæontologist.

TABLE OF CONTENTS.

REVISION

OF THE

TERTIARY MOLLUSCA OF NEW ZEALAND,

BASED ON TYPE MATERIAL.

PART I.

CHAPTER I.

COMPARATIVE LIST OF THE NAMES IN THE CATALOGUE OF TERTIARY *MOLLUSCA* AND *ECHINODERMATA* AND THE NAMES ADOPTED IN THIS BULLETIN.

THE classes, families, and genera are those used by Hutton in 1873. Hutton's original names are on the left side and the revised names on the right side of the page. The numbers opposite the species correspond to those in Hutton's Catalogue. Species marked with an asterisk are also found Recent, and have been fully treated in my "Mollusca of New Zealand." No specimens of those species marked † were preserved in the type collection.

Class PTEROPODA.

Fam. DENTALIIDÆ.

Dentalium.

*1.	*Dentalium pacificum* Hutt.† ..	.. *Dentalium zelandicum* Sow.
2.	,, *conicum* sp. nov. ..	.. ,, *solidum* Hutt.
*3.	,, *nanum* sp. nov. ..	.. *Dentalium nanum* Hutt.
4.	,, *tenuis* sp. nov. ..	.. ,, *mantelli* Zittel.
5.	,, *mantelli* Zittel ..	.. ,, *mantelli* Zittel.
6.	,, *irregularis* sp. nov.	.. ,, *mantelli* Zittel.
7.	,, *lævis* sp. nov. ..	.. *Dentalium pareorensis* Pilsbry and Sharp. 1897.
8.	,, *giganteum* Sow. ..	.. *Dentalium solidum* Hutt.
9.	,, *solidum* sp. nov. ..	.. ,, *solidum* Hutt.

Class GASTEROPODA.

Fam. MURICINÆ.

Murex.

*1. *Murex octogonus* Quoy ..	.. *Murex (Muricantha) octogonus* Q. & G.
*2. ,, *zealandicus* Quoy ..	.. ,, *(Poirieria) zelandicus* Q. & G.
*3. ,, *lyratus* Lamk. ..	.. *Trophon ambiguus* (Philippi).

Typhis.

*4. *Typhis zealandica* sp. nov. ..	.. *Murex (Alipurpura) angasi* (Crosse).

Fusus.

*5. *Fusus pensum* Hutt.† ..	.. *Fusinus spiralis* (A. Adams).
*6. ,, *australis* Quoy† ..	.. *Siphonalia (Austrofusus) mandarina* (Duclos).
*7. ,, *zealandicus* Quoy var. B	.. ,, ,, *mandarina* (Duclos).
*8. ,, *mandarinus* Duclos ..	.. ,, ,, *mandarina* (Duclos).
*9. ,, *dilatatus* Quoy† ..	.. ,, *(Penion) dilatata* (Q. & G.).
10. ,, *crawfordi* sp. nov. ..	.. *Murex* (s. str.) *crawfordi* (Hutt.).
11. ,, *plicatilis* sp. nov. ..	.. *Siphonalia plicatilis* (Hutt.).
*12. ,, *corticatus* Hutt.† ..	.. *Trophon (Kalydon) corticatus* (Hutt.).
*13. ,, *plebeius* Hutt.† ..	.. ,, ,, *plebeius* (Hutt.).
*14. ,, *linea* Martyn† ..	.. *Euthria linea* (Martyn).
*15. ,, *littorinoides* Reeve† ..	.. ,, *littorinoides* (Reeve).
*16. ,, *triton* Lesson† ..	.. *Siphonalia mandarina* (Duclos) (young shell)
*17. ,, *nodosus* Quoy ..	.. ,, *nodosa* (Martyn).
* ,, ,, ,, var. B Hutt. ..	,, *nodosa* (Martyn).
,, ,, ,, var. C var. nov. ..	,, *subnodosa* (Hutt.).
,, ,, ,, var. D var. nov. ..	,, *turrita* Suter, sp. nov.

Fam. PLEUROTOMIDÆ.

Pleurotoma.

*18. *Pleurotoma novæ zealandiæ* Reeve†	.. *Drillia novæ-zelandiæ* (Reeve).
*19. ,, *lævis* Hutt.† ..	.. ,, *(Crassispira) lævis* (Hutt.).
20. ,, *buchanani* sp. nov.	.. ,, *buchanani* (Hutt.).
21. ,, *trailli* sp. nov. ..	.. *Surcula huttoni* Suter, nom. mut.
22. ,, *awamoaensis* sp. nov.	.. *Drillia awamoaensis* (Hutt.).
23. ,, *wanganuiensis* sp. nov.	.. ,, *wanganuiensis* (Hutt.).
24. ,, *sulcata* sp. nov. ..	.. *Bathytoma sulcata* (Hutt.).
25. ,, *hebes* sp. nov.† ..	.. *Turris (?) hebes* (Hutt.).
26. ,, *latescens* sp. nov.†	.. ,, *(?) latescens* (Hutt.).
27. ,, *pagoda* sp. nov. ..	.. ,, *(Leucosyrinx) altus* (Harris).

Bela.

*28. *Bela striata* sp. nov.† ..	.. *Daphnella striata* (Hutt.).

Lachesis.

*29. *Lachesis sulcata* Hutt.† ..	.. *Alcira sulcata* (Hutt.).

Triton.

*30. *Triton spengleri* Chemnitz ..	.. *Cymatium spengleri* (Chemnitz).
31. ,, *minimus* sp. nov.† ..	.. ,, *minimum* (Hutt.).

Fam. Buccinidæ.

Buccinum.

*32.	*Buccinum zealandicum* Reeve† ..	.. *Cominella zealandica* (Reeve)
*33.	,, *costatum* Quoy ..	.. ,, *costata* (Q. & G.)
34.	,, *robinsoni* Zittel ..	.. *Siphonalia nodosa zitteli* Suter, subsp. nov.
35.	,, *inflatum* sp. nov.† ..	.. *Cominella inflata* (Hutt.)
36.	,, *carinatum* sp. nov.†	.. ,, *carinata* (Hutt.).

Fam. Purpuridæ.

Purpura.

*37.	*Purpura succincta* Lamk.† ..	.. *Thais (Stramonita) succincta* (Lamk.).
*38.	,, *textiliosa* Lamk.† ..	.. ,, *succincta* (Lamk.).
39.	,, *conoidea* Zittel ..	.. *Siphonalia conoidea* (Zittel).
40.	,, *excursa* sp. nov.† ..	.. *Galeodea senex* (Hutt.).

Fam. Olividæ.

Ancillaria.

*41.	*Ancillaria australis* Quoy ..	.. *Ancilla mucronata* (Sowerby).
42.	,, *hebera* sp. nov. ..	.. ,, *hebera* (Hutt.).
43.	,, *(Amalda ?) pomahaka* Hutt.†	.. *Melanopsis pomahaka* (Hutt.).

Fam. Volutidæ.

Voluta.

*44.	*Voluta pacifica* Lamk. ..	.. *Fulguraria (Alcithoe) arabica* (Martyn).
*	Var. B	.. Var. *elongata* (Swainson).
*	Var. V (should be C)	.. Var. *elongata* (Swains.) (juv.).
45.	,, *gracilicostata* Zittel ..	.. *Volutospina (Volutocorbis) gracilicostata* (Zittel).
46.	,, *kirki* Hutt.	.. *Volutospina (Athleta) huttoni* Suter, nom mut.
47.	,, *(Lyria) corrugata* sp. nov.	.. *Lapparia corrugata* (Hutt.).
	Var. B	.. *Lapparia ?*
48.	,, *elongata* sp. nov.† ..	.. *Fulguraria (Alcithoe) ? attenuata* (Hutt.).

Mitra.

49.	*Mitra enysi* sp. nov.† ..	.. *Mitra enysi* Hutt.
50.	,, *apicalis* sp. nov.† ..	.. *Vexillum apicale* (Hutt.).

Marginella.‡

*51.	*Marginella albescens* Hutt.† ..	.. *Marginella (Volvarina) albescens* Hutt.
52.	,, *dubia* sp. nov. ..	.. *Marginella dubia* Hutt.
53.	,, *ventricosa* sp. nov...	.. *Cryptospira ventricosa* (Hutt.).

Volvaria.

54.	*Volvaria ficoides* sp. nov.† ..	.. *Cypræa ficoides* (Hutt.).

‡ Omitted in the Catalogue, but inserted in the *Errata*.

Fam. CASSIDIDÆ.

Cassis.

*55. *Cassis pyrum* Lamk.	*Phalium (Cassidea) achatinum pyrum* (Lamk.).
*56. ,, *striatus* sp. nov.	*Phalium (Cassidea) achatinum pyrum* (Lamk.).

Cassidaria.

57. *Cassidaria sulcata* sp. nov.	*Galeodea sulcata* (Hutt.).

Fam. NATICIDÆ.

Natica.

*58. *Natica zealandica* Quoy	*Natica zelandica* Q. & G.
*59. ,, *vitrea* Hutt.†	*Polinices amphialus* (Watson).
60. ,, *solida* Sow.†	,, *huttoni* H. v. Ihering.
61. ,, *(Mamilla) ovata* sp. nov. ..	,, *(Mamma) ovatus* (Hutt.).
62. *Natica (?) callosa* sp. nov.†	,, *callosus* (Hutt.).

Sigaretus.

63. *Sigaretus subglobosus* Sow.	*Ampullina miocænica* Suter, sp. nov.

Fam. SCALARIDÆ.

Scalaria.

64. *Scalaria browni* Zittel†	*Epitonium browni* (Zittel).
65. ,, *lyrata* Zittel	*Epitonium (Cirsotrema) rugulosum* Sow. subsp. *lyratum* (Zittel).
*66. ,, *intermedia* sp. nov.	*Epitonium zelebori* (Dunker).
67. ,, *rotunda* sp. nov.† . ..	,, *rotundum* (Hutt.).

Fam. PYRAMIDELLIDÆ.

Odostomia.

*68. *Odostomia lactea* Angas†	*Odostomia bembix* Suter.

Fam. CONIDÆ.

Conus.

69. *Conus ornatus* sp. nov.	*Conus (Conospira) ornatus* Hutt.
70. ,, *trailli* sp. nov.	*Hemiconus trailli* (Hutt.).

Fam. STROMBIDÆ.

Struthiolaria.

*71. *Struthiolaria nodulosa* Lamk.	*Struthiolaria papulosa* (Martyn).
*72. ,, *vermis* Martyn	,, *vermis* (Martyn).
*73. ,, *scutulata* Deshayes† ..	,, *tricarinata* Lesson.
74. ,, *sulcata* nom. nov. ..	,, *canaliculata* Zittel.
75. ,, *cingulata* Zittel	,, *cingulata* Zittel.
Var. B	,, *cingulata monilifera* Suter, subsp. nov.
76. ,, *cincta* sp. nov.	,, *cincta* Hutt.
* Var. B	,, *papulosa* (Mart.).
Var. C	,, *calcar* Hutt.
77. ,, *tuberculata* sp. nov. ..	,, *tuberculata* Hutt.
Var. B	,, *spinosa* Hector.
78. ,, *senex* sp. nov.	*Galeodea senex* (Hutt.).

Fam. CANCELLARIIDÆ.

Trichotropis.

*79.	*Trichotropis inornata* Hutt.† ..	.. *Trichotropis clathrata* Sowerby.

Fam. CERITHIIDÆ.

Cerithium.

80.	*Cerithium rugatum* sp. nov. ..	.. *Batillaria pomahakensis* Harris.
81.	„ *cancellatum* sp. nov.†	.. *Bezanconia (Ataxocerithium) huttoni* (Cossmann).
82.	„ *nodulosum* sp. nov...	.. *Cerithium hectori* Harris.

Fam. RISSOIDÆ.

Rissoa.

83.	*Rissoa vana* sp. nov. ..	.. *Rissoina vana* (Hutt.).

Fam. TURRITELLIDÆ.

Turritella.

*84.	*Turritella rosea* Quoy ..	.. *Turritella rosea* Q. & G.
85.	„ *gigantea* sp. nov. ..	.. „ *cavershamensis* Harris.
*86.	„ *vittata* Hutt. ..	.. „ *carlottæ* Watson.
*87.	„ *pagoda* Reeve† ..	.. „ *pagoda* Reeve.
88.	„ *ambulacrum* Sow. ..	.. „ *ambulacrum* Sow.
*89.	„ *(Zaria) tricincta* sp. nov.	.. „ *symmetrica* Hutt.
	Var. B ..	.. „ *patagonica* Sowerby.
*90.	„ *fulminata* Hutton ..	.. „ *fulminata* Hutt.
91.	„ *bicincta* sp. nov. ..	.. „ *bicincta* Hutt.
92.	„ *ornata* sp. nov.† ..	.. „ *ornata* Hutt.

Fam. VERMETIDÆ.

Cladopoda.

*93.	*Cladopoda zealandica* Quoy. ..	.. *Serpulorbis zelandica* (Q. & G.).
*94.	„ *monilifera* sp. nov.†	.. „ *sipho* (Lamarck).

Phorus.

*95.	*Phorus onustus* Reeve† ..	.. *Xenophora corrugata* (Reeve) (?)

Fam. CALYPTRIDÆ.

Calyptræa.

*96.	*Calyptræa maculata* Quoy ..	.. *Calyptræa maculata* (Q. & G.).

Trochita.

*97.	*Trochita tenuis* Gray ..	.. *Calyptræa scutum* Lesson.
*98.	„ *dilatata* Zittel ..	.. „ *scutum* Lesson.

Crypta.

*99.	*Crypta costata* Deshayes ..	.. *Crepidula costata* Deshayes.
*100.	„ *contorta* Quoy ..	.. „ *crepidula* (L.).
101.	„ *incurva* Zittel ..	.. „ *gregaria* Sowerby.
102.	„ *striata* sp. nov.† ..	.. „ *striata* (Hutt.).
*103.	„ *profunda* sp. nov. ..	.. „ *crepidula* (L.).

Fam. PILÆOPSIDÆ.

Pilæopsis.

*104. *Pilæopsis uncinatus* sp. nov. ..	.. *Capulus australis* (Lamk.).
105. ,, *radiatus* sp. nov. ..	.. *Hipponix radiatus* (Hutt.)

Fam. NERITIDÆ.

Neritella.

106. *Neritella nitida* sp. nov. ..	.. *Nerita nitida* (Hutt.).

Fam. TROCHIDÆ.

Turbo.

*107. *Turbo rubicundus* Reeve† ..	.. *Turbo granosus* (Martyn).
*108. ,, *granosus* Lamarck ..	.. *Calliostoma punctulatum* (Martyn).
109. ,, *superbus* Zittel ...	.. *Turbo (Sarmaticus) superbus* Zittel.

Imperator.

*110. *Imperator imperalis* Lamarck ..	.. *Astræa heliotropium* (Martyn).

Rotella.

*111. *Rotella zealandica* Chenu ..	.. *Ethalia zelandica* (Homb. & Jaq.).

Trochus.

112. *Trochus stoliczkai* Zittel† ..	.. *Trochus stoliczkai* Zittel.
113. ,, *circinatus* sp. nov.† ..	.. ,, *circinatus* Hutt.

Polydonta.

*114. *Polydonta tiarata* Quoy ..	.. *Trochus (Coelotrochus) tiaratus* Q. & G.

Labio.

*115. *Labio hectori* Hutton	.. *Monodonta corrosa undulosa* (A. Ad.).

Monilea.

*116. *Monilea zealandica* Hutton† ..	.. *Monilea egena* (Gould).

Gibbula.

*117. *Gibbula sanguinea* Gray† ..	.. *Cantharidus sanguineus* (Gray).
*118. ,, *nitida* Adams† ..	.. ,, *tenebrosus huttoni* Smith.

Fam. HALIOTIDÆ.

Haliotis.

*119. *Haliotis iris* Lamarck (?)† ..	.. *Haliotis iris* Martyn (?)

Fam. FISSURELLIDÆ.

Emarginula.

*120. *Emarginula striatula* Quoy ..	.. *Emarginula striatula* Q. & G.

Tugali.

*121. *Tugali elegans* Gray	.. *Subemarginula (Tugalia) intermedia* (Reeve).

Fam. Tornatellidæ.

Buccinulus.

*122.	*Buccinulus kirki* Hutton† ..	.. *Pupa affinis* (A. Adams).
*123.	,, *albus* Hutton† ..	.. ,, *alba* (Hutt.).

Fam. Cylichnidæ.

Cylichna.

*124.	*Cylichna striata* Hutton† ..	.. *Cylichnella striata* (Hutt.).
125.	,, *enysi* sp. nov.† ..	.. ,, *enysi* (Hutt.).

Fam. Siphonariidæ.

Siphonaria.

126.	*Siphonaria denticulata* Quoy† ..	.. *Siphonaria* sp.

Fam. Ampullaceridæ.

Amphibola.

*127.	*Amphibola avellana* Gmelin ..	.. *Amphibola crenata* (Martyn).

Class LAMELLIBRANCHIATA.

Fam. Pholadidæ.

Pholadidea.

*1.	*Pholadidea tridens* Gray ..	.. *Pholadidea spathulata* (Sowerby).

Fam. Glycimeridæ.

Panopæa.

*2.	*Panopœa zealandica* Quoy† ..	.. *Panopea zelandica* Q. & G.
3.	,, *plicata* sp. nov.† ..	.. ,, *plicata* Hutt.
4.	,, *worthingtoni* sp. nov.†	.. ,, *worthingtoni* Hutt.

Saxicava.

*5.	*Saxicava arctica* L.†	.. *Saxicava arctica* (L.).

Fam. Corbulidæ.

Corbula.

*6.	*Corbula zealandica* Quoy† ..	.. *Corbula zelandica* Q. & G.
*7.	,, *macilenta* sp. nov. ..	.. ,, *macilenta* Hutt.
8.	,, *dubia* sp. nov. ..	.. *Mactra chrydœa* Suter.

Fam. Anatinidæ.

Neæra.

9.	*Neœra kirki* sp. nov. ..	.. *Cuspidaria kirki* (Hutt.).

Myodora.

*10.	*Myodora striata* Quoy ..	.. *Myodora striata* (Q. & G.).

Fam. MACTRIDÆ.

Mactra.

*11. *Mactra discors* Gray†	*Mactra discors* Gray.
*12. ,, *æquilatera* Reeve†	*Spisula æquilateralis* (Desh.).
*13. ,, *inflata* sp. nov.	*Mactra (Mactrotoma) ovata* (Gray).
14. ,, *attenuata* sp. nov.	,, *attenuata* Hutt.
*15. ,, *rudis* sp. nov.	,, *ovata* var. *rudis* Hutt.
*16. ,, *elegans* sp. nov.	*Spisula ordinaria* (E. A. Smith).

Thracia.

17. *Thracia granulosa* sp. nov.	*Thracia neozelanica* Suter, nom mut.

Mulinia.

*18. *Mulinia notata* Hutton	*Mactra (Mactrotoma) elongata* Q. & G.

Fam. LUTRARIINÆ.

Lutraria.

19. *Lutraria solida* sp. nov.†	*Lutraria solida* Hutt.
20. ,, *sulcata* sp. nov.†	,, *sulcata* Hutt.

Zenatia.

*21. *Zenatia acinaces* Quoy†	*Zenatia acinaces* (Q. & G.).

Darina.

*22. *Darina pusilla* Hutton†	*Mactra scalpellum* Reeve.

Fam. TELLINIDÆ.

Psammobia.

*23. *Psammobia stangeri* Gray	*Psammobia stangeri* Gray.
*24. ,, *lineolata* Gray†	,, *lineolata* Gray.

Hiatula.

*25. *Hiatula nitida* Gray†	*Soletellina nitida* (Gray).

Tellina.

*26. *Tellina albinella* Lamk.†	*Tellina alba* Q. & G.
*27. ,, *deltoidalis* Lamk.	,, *deltoidalis* Lamk.
*28. ,, *lintea* Hutton†	*Leptomya lintea* (Hutt.).

Mesodesma.

*29. *Mesodesma chemnitzii* Desh.	*Mesodesma australe* Gmel.
*30. ,, *cuneata* Lamk.†	,, *subtriangulatum* (Gray).
*31. ,, *grandis* sp. nov.†	,, *grande* Hutt.

Fam. VENERIDÆ.

Venus.

*32. *Venus zealandica* Gray	*Cytherea (Circomphalus) oblonga* (Hanley).
*33. ,, *oblonga* Gray†	,, ,, *oblonga* (Hanley).

Chione.

34. *Chione vellicata* sp. nov. .. .. *Chione meridionalis* (Sow.).
35. ,, *accuminata* sp. nov. .. .. ,, *acuminata* Hutt.
*36. ,, *stuchburyi* Gray . .. ,, *stutchburyi* (Gray).
*37. ,, *mesodesma* Quoy .. .. ,, *mesodesma* (Q. & G.).
*38. ,, *gibbosa* Hutton .. .. ,, *crassa* (Q. & G.).
39. ,, *assimilis* sp. nov.† .. .. *Macrocallista assimilis* (Hutt.).
*40. ,, *yatei* Gray .. .. .. *Chione yatei* (Gray).

Cytherea.

41. *Cytherea enysi* sp. nov. .. .. *Cytherea enysi* Hutt.

Callista.

*42. *Callista disrupta* Deshayes† .. .. *Macrocallista multistriata* (Sow.).
43. ,, *elegans* sp. nov.† .. .. *Chione elegans* (Hutt.).

Dosinia.

*44. *Dosinia subrosea* Gray .. .. *Dosinia (Austrodosinia) subrosea* (Gray).
45. ,, *magna* sp. nov. .. .. ,, ,, *magna* Hutt.
*46. ,, *grayi* Zittel .. .. .. ,, *(Dosinisca) greyi* Zittel.

Cyclina.

*47. *Cyclina kroyeri* Philippi .. .. *Dosinia* (s. str.) *lambata* (Gould).
*48. ,, *dispar* sp. nov. .. .. ,, *(Austrodosinia) subrosea* (Gray).

Tapes.

*49. *Tapes intermedia* Quoy .. .. *Paphia (Ruditapes) intermedia* (Q. & G.).
50. ,, *curta* sp. nov. .. .. .. ,, ,, *curta* (Hutt.).

Fam. CARDIIDÆ.

Cardium.

*51. *Cardium striatulum* Sowerby .. .. *Protocardia (Nemocardium) pulchella* (Gray).
52. ,, *spatiosum* sp. nov. .. .. *Cardium spatiosum* Hutt.
53. ,, *greyi* sp. nov.† .. .. ,, *greyi* Hutt.
54. ,, *patulum* sp. nov.† .. .. ,, *patulum* Hutt.

Protocardium.

55. *Protocardium serum* sp. nov. .. .. *Protocardia sera* Hutt.

Venericardia.

*56. *Venericardia australis* Quoy .. .. *Venericardia difficilis* (Deshayes).
*57. ,, *intermedia* sp. nov. .. ,, *australis* Lamk.
* Var. B .. .. ,, *australis* Lamk. (juv.).

Fam. LUCINIDÆ.

Lucina.

*58. *Lucina divaricata* Lamk. .. .. *Divaricella cumingi* (Ad. & Ang.).

Mysia.

*59. *Mysia zealandica* Gray .. .. *Diplodonta zelandica* (Gray).

Fam. Crassatellidæ.

Crassatella.

60. *Crassatella ampla* Zittel .. .. *Crassatellites amplus* (Zittel).

61. ,, *attenuata* sp. nov. .. .. ,, *attenuatus* (Hutt.).

*62. ,, *trailli* sp. nov. .. .. ,, *obesus* (A. Ad.).

Mytilicardia.

*63. *Mytilicardia excavata* Deshayes .. *Cardita calyculata* (L.).

Astarte.

64. *Astarte australis* sp. nov. .. .. *Astarte australis* Hutt.

Unio.

*65. *Unio aucklandica* Gray† .. .. *Diplodon menziesi aucklandicus* (Gray).

66. ,, *inflata* sp. nov.† .. .. ,, *inflatus* (Hutt.).

Fam. Myteliidæ.

Mytilus.

*67. *Mytilus magellanicus* Lamk. .. .. *Mytilus (Aulacomya) magellanicus* Lamk.

Crenella.

*68. *Crenella discors* Lamk.† .. .. *Modiolaria impacta* (Hermann).

69. ,, *elongata* sp. nov.† .. .. ,, *elongata* (Hutt.).

Modiola.

*70. *Modiola albicosta* Lamk. .. .. *Modiolus australis* Gray.

71. ,, sp. ind. .. .. .. ,, *huttoni* Suter, sp. nov.

Lithodomus.

72. *Lithodomus striatus* sp. nov. .. .. *Lithophaga striata* (Hutt.).

Fam. Aviculidæ.

Perna.

73. *Perna* sp. ind.† .. .. .. *Melina* sp.

Pinna.

74. *Pinna lata* sp. nov.† .. .. *Pinna (?) lata* Hutt.

*75. ,, *zealandica* Gray .. .. *Atrina zelandica* (Gray).

76. ,, *plicata* sp. nov.† .. .. A fan-shaped Fucoid (J. A. T.).

77. ,, *distans* sp. nov.† .. .. *Pinna (?) distans* Hutt.

Fam. Trigoniadæ.

Trigonia.

*78. *Trigonia pectinata* Lamk. .. .. Impossible to identify the specimen; inside of a valve only.

79. ,, *semiundulata* McCoy† .. *Trigonia subundulata* Jenkins.

Fam. Arcidæ.

Barbatia.

*80. *Barbatia sinuata* Lamk. .. .. *Arca (Barbatia) decussata* (Sow.).

Cucullæa.

81.	*Cucullæa ponderosa* sp. nov.	*Cucullæa ponderosa* Hutt.
	Var. B.	Var. B.
82.	,, *worthingtoni* sp. nov. ..	,, *worthingtoni* Hutt.
83.	,, *alta* Sowerby	,, *alta* Sowerby.
	Var. B	,, *alta* Sowerby, var. B.
84.	,, *attenuata* sp. nov.†	*Cucullæa attenuata* Hutt.

Pectunculus.

*85.	*Pectunculus striatularis* Lamk. ..	*Glycymeris modesta* (Angas).
*86.	,, *laticostatus* Quoy	,, *laticostata* (Q. & G.).
87.	,, *globosus* sp. nov.	,, *globosa* (Hutt.).
88.	,, *traversi* sp. nov.	,, *traversi* (Hutt.).
89.	*Pectunculus (?) cordatus* sp. nov.† ..	,, *cordata* (Hutt.).

Limopsis.

90.	*Limopsis insolita* Sowerby	*Limopsis zitteli* Ihering.
91.	,, *zealandica* sp. nov.†	,, *aurita* (Brocchi).

Fam. NUCULIDÆ.

Solenella.

*92.	*Solenella cumingi* Adams†	*Malletia australis* (Q. & G.).
*93.	,, *australis* Zittel	,, *australis* (Q. & G.).

Fam. PECTENIDÆ.

Pecten.

*94.	*Pecten zealandiæ* Gray	*Pecten (Chlamys) zelandiæ* Gray.
*95.	,, *radiatus* Hutton	,, ,, *radiatus* Hutt.
*96.	,, *gemmulatus* Reeve	,, ,, *zelandiæ* Gray, subsp. *gemmulatus* Reeve.
97.	,, *williamsoni* Zittel	,, ,, *williamsoni* Zittel.
98.	,, *chathamensis* sp. nov.	,, ,, *chathamensis* Hutt.
99.	,, *scandula* sp. nov.†	,, *scandula* Hutt.
100.	,, *fischeri* Zittel†	,, *fischeri* Zittel.
101.	,, *delicatula* sp. nov.	,, *(Patinopecten) delicatulus* Hutt.
102.	,, *semiplicata* sp. nov.†	,, *semiplicatus* Hutt.
103.	,, *secta* sp. nov.	,, *(Patinopecten) sectus* Hutt.
104.	,, *venosum* sp. nov.†	,, ,, *venosus* Hutt.
105.	,, *hochstetteri* Zittel†	,, *(Pseudamusium) hochstetteri* Zittel.
106.	,, *hectori* sp. nov.†	,, ,, *yahlensis* T.-Woods.
*107.	,, *laticostatus* Gray	,, *(Euvola) medius* Lamk.
108.	,, *triphooki* Zittel†	,, *(Patinopecten) triphooki* Zittel.
109.	,, *accrementa* sp. nov.	,, ,, *accrementus* Hutt.
110.	,, *diffluxa* sp. nov.	,, *delicatulus* Hutt.
111.	,, *hutchinsoni* sp. nov.	,, *(Patinopecten) hutchinsoni* Hutt.
112.	,, *beethami* sp. nov.	,, ,, *beethami* Hutt.
	Var. B	Var. B.
113.	,, *crawfordi* sp. nov.†	*Pecten (Patinopecten) crawfordi* Hutt.
114.	,, *athleta* Zittel†	,, (s. str.) *athleta* Zittel.
115.	,, *burnetti* Zittel	,, *(Pallium) burnetti* Zittel.
116.	,, *polymorphoides* Zittel	,, *(Pallium) polymorphoides* Zittel.
*117.	,, *(Dentipecten) vellicatus* Hutton ..	,, ,, *convexus* Q. & G.
118.	,, *zittelli* sp. nov.†	,, *(Amusium) zitteli* Hutt.

Hinnites.

119.	*Hinnites trailli* sp. nov.†	..	*Hinnites trailli* Hutt.

Lima.

120.	*Lima lævigata* sp. nov.†	..	*Lima lævigata* Hutt.
121.	,, *colorata* sp. nov.	..	,, *colorata* Hutt.
122.	,, *paucisulcata* sp. nov.	..	,, *paucisulcata* Hutt.
123.	,, *paleata* sp. nov.	..	,, *paleata* Hutt.
124.	,, *multiradiata* sp. nov.	..	,, *huttoni* Suter, nom. mut.
125.	,, *crassa* sp. nov.†	..	,, *crassa* Hutt.
*126.	,, *linguatula* var. B Lamk.	..	,, *angulata* Sow.
*127.	,, *bullata* Born	..	,, *bullata* (Born).

Fam. Anomiidæ.

Placunanomia.

*128.	*Placunanomia* sp. ind.	..	*Anomia huttoni* Suter.
129.	,, *incisura* sp. nov.	..	*Placunanomia incisura* Hutt.

Fam. Ostreidæ.

Ostrea.

*130.	*Ostrea purpurea* Hanley†	..	*Ostrea angasi* Sow.
*131.	,, *virginica* Lamk.	..	.. *angasi* Sow.
*132.	,, *lutaria* Hutton	..	,, *angasi* Sow.
133.	,, *nelsoniana* Zittel†	..	*Ostrea nelsoniana* Zittel.
134.	,, *wullerstorfii* Zittel†	..	,, *wuellerstorfii* Zittel.
135.	,, *ingens* Zittel	..	, *ingens* Zittel.
136.	,, *subdentata* sp. nov.	..	,, *(Eostrea) subdentata* Hutt.
137.	,, *incurva* sp. nov.†	..	,, *incurva* Hutt.
*138.	,, *corrugata* sp. nov.	..	,, *corrugata* Hutt.

Gryphæa.

139.	*Gryphæa tarda* sp. nov.	..	*Gryphæa tarda* Hutt.

CHAPTER II.

DESCRIPTION OF THE SPECIES.

Class GASTEROPODA.

Fam. NERITIDÆ.

Nerita nitida (Hutton).

1873. *Neritella nitida* Hutton, Cat. Tert. Moll., p. 14.

Shell very small, globose, transverse, quite smooth. *Spire* eroded, flat. *Colour* whitish, with numerous narrow zigzag radiate black bands. *Aperture* subovate. *Outer lip* simple internally. *Inner lip* smooth, arcuate.

Height, 6 mm.; diameter, 9 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Pomahaka, Otago. Miocene.

Remarks.—The type specimen is unfortunately broken into several pieces and stuck together on a tablet, so that a figure of the species cannot be made, and I can only reproduce Hutton's diagnosis. *Neritella* is a synonym of *Neritina*, but it seems to me more correct to class the species under *Nerita*, as it occurs together with marine shells.

Fam. RISSOIDÆ.

Rissoina vana (Hutton). Plate I, fig. 1; Plate XVII, fig. 3.

1873. *Rissoa vana* Hutton, Cat. Tert. Moll., p. 12.

Shell small, ovato-conic, smooth, with continuous peristome. *Sculpture* none, except for some incremental lines on the body-whorl. *Spire* conical, with straight outlines, slightly higher than the aperture. *Protoconch* papillate, of 1 convex and smooth whorl. *Whorls* 5, lightly convex, narrowly and faintly shouldered, the last somewhat ventricose; base flatly convex. *Suture* much impressed. *Aperture* oblique, oval, pointed above. *Peristome* slightly callous, continuous.

Height, 4·7 mm.; diameter, 3·2 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Awamoa, South Island. Miocene.

Remark.—Amongst the Recent forms *Rissoina (Eatoniella) olivacea* Hutton stands nearest, but it is smaller and less ventricose.

Fam. CERITHIIDÆ.

Cerithium hectori Harris. Plate I, fig. 2.

1873. *Cerithium nodulosum* Hutton, Cat. Tert. Moll., p. 12; not of Bruguière.
1887. „ *nodosum* Hutton, P.L.S. N.S.W. (2), vol. i, p. 216.
1897. „ *hectori* Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 227.

Shell turreted, many-whorled, strongly nodulous, with 2 keels upon the base. *Sculpture* consisting of a spiral row of large dentate subspinose tubercles, about 8 on a whorl, near the anterior suture on the spire-whorls, but medially on the body-whorl; the latter with 2 spiral ridges below the tubercles. *Spire* high, angle 20°. *Whorls* 10 to 11, flattened, concave between the rows of tubercles, regularly increasing. *Suture* linear. *Aperture* quadrate, with a short, slightly oblique canal. *Outer lip* thin. *Columella* excavated.

Height, 54 mm.; diameter, 18 mm. (type, imperfect). Height, 46 mm.; diameter, 15 mm. (British Museum specimen).

Type in the collection of the New Zealand Geological Survey.

Loc.—Broken River, South Island. Miocene.

Remarks.—Hutton had, as will be observed, already changed the specific name ot *nodulosum* to *nodosum*, but I accept the quite distinct name of Harris. I follow the latter in the diagnosis, as he had a specimen with perfect aperture.

Batillaria pomahakensis Harris. Plate XVII, fig. 4.

1873. *Cerithium rugatum* Hutton, Cat. Tert. Moll., p. 11; not of Deshayes.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 216.
1897. *Batillaria pomahakensis* Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 229, pl. vii, fig. 4.

Shell turreted, plicate and nodose, with a short and almost straight anterior canal. *Sculpture* consisting of 12 to 14 axial plications on a whorl, nodose at the periphery, spirally striated, with 2 prominent keels in front of the median row of tubercles on the body-whorl, lines of growth well marked leading to rugosities, sinuous and deeply cut in towards the middle. *Spire* high, angle 32°. *Whorls* 9 to 10, regularly increasing, keeled at or a little below the middle. *Suture* margined, not much impressed. *Aperture* suborbicular, angled above, produced below into an open, short, very little recurved canal. *Outer lip* sharp, slightly channelled above. *Columella* straight, slightly arched. *Inner lip* reflected, covered by a thin plate of enamel.

Height, 45 mm.; breadth, 17·5 mm.; length of aperture, 13 mm. (Harris).

Type in the collection of the New Zealand Geological Survey.

Loc.—Pomahaka, Otago. Miocene.

Remarks.—The type specimen being in a bad condition, the diagnosis was compiled from those published by Hutton and Harris. The figure is copied from that in the Cat. Brit. Mus.

Bezanconia (Ataxocerithium) huttoni (Cossmann). Plate I, fig 3.

1873. *Cerithium cancellatum* Hutton, Cat. Tert. Moll., p. 12; not of Lamarck, &c.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 216.
1893. „ „ Hutton, Macleay Mem. Vol., Plioc. Moll., p. 59, pl. vii, fig. 55.
1895. *Colina huttoni* Cossmann, Feuille Jeunes Nat., No. 299, p. 174.
1897. „ „ Cossmann: Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 227.
1906. *Bezanconia (Ataxocerithium) huttoni* Cossmann, Essais Paléoconch. Comp., livr. 7, p. 92.

Type seems to be lost.

Loc.—Shakespeare Cliff; Pliocene: Hampden; Miocene.

Remark.—A figure taken after the type is here given. Harris has given a comprehensive diagnosis of the species.

Fam. Turritellidæ.

Turritella ambulacrum Sowerby. Plate I, fig. 4.

1846. *Turritella ambulacrum* Sowerby, Darwin's Geol. Obs. on S. America, p. 257, pl. iii, fig. 49.
1846. „ *suturalis* Sowerby, *id.*, p. 257, pl. iii, fig. 50.
1873. „ *ambulacrum* Sowerby: Hutton, Cat. Tert. Moll., p. 12.
1887. „ „ Sowerby: Hutton, P.L.S. N.S.W. (2), vol. i, p. 219.
1887. *Turritella sowerbyana* (= *suturalis* Sow.) R. A. Philippi, Los Fósiles, &c., p. 71, pl. ix, fig. 2 (copy after Sowerby).
1897. *Turritella ambulacrum* Sowerby: von Ihering, Revista Mus. Paul., vol. ii, p. 286.
1902. *Turritella ambulacrum* Sowerby: Ortmann, Princ. Exped. Patagonia, p. 192, pl. xxxi, fig. 13*a*.

Dr. von Ihering gives the following diagnosis (*l.c.*): Turritella elongata turrita anfractibus 10–11 spiraliter tricostatis, posterioribus costis æqualibus, anteriorum costa antica postica majoribus, media minore, costis minoribus interpositis; sutura in sulco profundo posita.

Long., 45 mm.; diam., 13 mm.

With this description the specimens from Awatere perfectly agree, and I have no doubt that Hutton quite correctly assigned them to Sowerby's species.

In P.L.S. N.S.W. Hutton classes his *T. bicincta* as a synonym of *T. ambulacrum*, which is a mistake.

T. ambulacrum occurs in the Miocene of New Zealand, and also in the Tertiary of Patagonia and Chile.

Turritella (Colpospira) cavershamensis Harris. Plate I, fig. 5.

1873. *Turritella gigantea* Hutton, Cat. Tert. Moll., p. 12; not of Bellardi and Michelotti.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 218.
1897. „ *cavershamensis* Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 242.

Shell very large, long, attenuated, whorls concave, with numerous unequal spiral striæ over the whole surface. *Sculpture* consisting of spiral cords of unequal strength; on the upper whorls the 3 liræ below the suture and one a little distance above it are more conspicuous than the others; on the lower whorls the fourth cord below and the third above the suture are somewhat stronger, the total number being about 16; the whole crossed by deeply sinuous incremental lines. *Spire* very high, turreted, angle 15°. *Protoconch* broken off. *Whorls* 11 in the imperfect specimen, regularly increasing, the upper half convex, the lower concave with a swelling towards the suture; base flatly convex. *Suture* on the upper whorls linear, narrow and deep between the lower whorls. *Aperture* vertical, subquadrate. *Outer lip* sharp, concave at the middle, with a deep, broadly concave sinus. *Columella* vertical, slightly excavated.

Height, 117 mm.; diameter, 30 mm. (imperfect specimen).

Type in the collection of the New Zealand Geological Survey.

Loc.—Oamaru. Oligocene ?

Remark.—The figure does not show the sinuated incremental lines, and the sculpture is not quite correct.

Turritella bicincta Hutton. Plate I, fig. 6.

1873. *Turritella bicincta* Hutton, Cat. Tert. Moll., p. 13.

Shell small, elongate, turreted, with 2 spiral ribs, and a margined suture. *Sculpture* consisting of 2 sharply raised, submoniliform spiral ribs, the interstices a little excavated, and a fine spiral thread margining the suture below; radial sculpture represented by somewhat irregular angular riblets, which may be the remnants of slightly thickened former outer lips. In one place only there are a few wavy fine spiral lines. *Spire* high, its angle 15°. *Protoconch* lost. *Whorls* 8, regularly increasing. *Suture* well impressed, margined below. *Aperture* rounded. *Outer lip* with a rather shallow, angular sinus, the angle corresponding with the lower spiral. *Columella* regularly concave.

Height, 13 mm.; diameter, 4 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Kanieri, South Island. Miocene.

Remarks.—In P.L.S. N.S.W. (2), vol. i, p. 219, this species is classed by Hutton as a synonym of *T. ambulacrum* Sowerby, which is not correct. The *bicincta* of the Pliocene, Macleay Mem. Vol., p. 63, pl. viii, fig. 60, is most certainly not this species, but, in my opinion, *T. fulminata* Hutton. The type specimen of *T. bicincta* is not adult.

In the Cat. Tert. Moll. *T. fulminata* Hutton is mentioned as occurring at Shakespeare Cliff, but omitted, and *T. bicincta* substituted in its place, in Hutton's Pliocene Mollusca in the Macleay Mem. Vol.

Turritella (Colpospira) patagonica Sowerby. Plate XVI, fig. 5.

1846. *Turritella patagonica* Sowerby, Darwin's Geol. Obs. on S. America, p. 256, pl. iii, fig. 48.

1873. „ *tricincta* var. B Hutton, Cat. Tert. Moll., p. 13.

1887. „ *patagonica* Sowerby: Hutton, P.L.S. N.S.W. (2), vol. i, p. 219.

1902. *Turritella patagonica* Sowerby: Ortmann, Princ. Exped. Patagonia, p. 196, pl. xxxi, fig. 15.

1907. *Turritella patagonica* Sowerby: von Ihering, Anales Museo Nac. Buenos Aires, vol. xiv, p. 163.

Shell rather small, turreted, whorls with 3 principal cinguli, the two lower ones close together, outer lip with a deep sinus. *Sculpture:* The whorls below the protoconch with 3 fine spiral riblets, one at the middle and two close together at the base of the whorls; farther down the upper strong spiral rib is situate at the upper third, and the lower two spirals, close together, are placed higher up, but the interspace between the first and second principal spiral is always about twice the width of the interstices between the second and third cinguli; the interstices have one or several fine spiral threads, and the whole surface is crossed by very distinct arcuate growth-lines. *Spire* high and narrow, its angle 20°. *Protoconch* lost in the specimen before me. *Whorls* about 12 or more, rapidly increasing, flat on the shoulder, excavated between the main spirals. *Suture* inconspicuous. *Outer lip* with a deep, rounded sinus.

Height, 37 mm.; diameter, 10 mm. (imperfect specimen).

Type in the British Museum ?

Loc.—Kanieri, South Island. Miocene.

The type is from Port Desire, Patagonia.

Remarks.—Dr. von Ihering is somewhat doubtful about the identity of our form with Sowerby's species. I have not yet seen a South American specimen, but the new Zealand shell agrees with Sowerby's diagnosis and figure. The species appears in the Eocene of Patagonia, and in the Miocene of New Zealand.

Fam. Struthiolariidæ.

Struthiolaria cincta Hutton. Plate I, fig. 7.

1873. *Struthiolaria cincta* Hutton, Cat. Tert. Moll., p. 11.

1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 216.

1897. „ „ Hutton: Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 221.

Shell rather small, ovate, turreted, carinated. *Sculpture* consisting of a conspicuous, rounded, slightly nodulous spiral rib on the carina of the spire-whorls, and a second equally strong rib on the body-whorl, arising from the upper end of the aperture, thus rendering the body-whorl bicarinate. Between these two ribs there are 4 to 6 fine spiral striæ, about 7 on the shoulder, and a number of more distant spiral liræ are ornamenting the base. The spire-whorls bear a number of unequal and inequidistant spiral riblets, the median one below the carina more prominent. *Spire* acute, very little higher than the aperture. *Protoconch* lost. *Whorls* 6, keeled, straight above and below the carina; body-whorl with 2 keels, the shoulder and the interspace between the keels slightly concave, base flatly convex. *Suture* not impressed, linear. *Aperture* typical.

Height, 41 mm.; diameter, 25 mm. (imperfect specimen).

Type in the collection of the New Zealand Geological Survey.

Loc.—Awatere. Miocene.

Struthiolaria papulosa (Martyn).

1784. *Buccinum papulosum* Martyn, Univ. Conch., pl. xliv.
1873. *Struthiolaria cincta* var. B Hutton, Cat. Tert. Moll., p. 11.

The type specimen of Hutton's var. B, which has the initial whorls and the outer lip of aperture wanting, cannot be separated from *S. papulosa* with only traces of nodules upon the carina of the whorls, forms which are often found Recent in New Zealand waters. The absence of the outer lip may have misled Captain Hutton.

Type in the collection of the New Zealand Geological Survey. (*S. cincta* var. B.)

Loc.—Kanieri, South Island. Miocene.

Struthiolaria calcar Hutton. Plate I, fig. 8.

1873. *Struthiolaria cincta* var. C Hutton, Cat. Tert. Moll., p. 11.
1886. „ *calcar* Hutton, Trans. N.Z. Inst., vol. xviii, 1885, p. 335.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 216.

Shell small, ovate and turreted, keeled, body-whorl bicarinate, the upper keel produced into a claw at the outer lip. *Sculpture :* The upper two whorls with fine spiral striæ, the following two whorls with a prominent, slightly nodulous keel slightly below the middle, with fine spiral liræ above and below it; the body-whorl bicarinate, the lower, less nodulous, keel arising from the upper part of the peristome, the spaces above, between, and below the keels with numerous spiral threads, usually a stronger and a finer thread alternating. *Spire* acute, of the same height as the aperture. *Protoconch* and all the whorls covered by a white calcareous layer obscuring the sculpture; the pullus seems to be papillate. *Whorls* 6, regularly increasing, the shoulder and interstice between the keels of the body-whorl concave, base flattish. *Suture* inconspicuous. *Aperture* vertical, oval, angled above, with a small and narrow canal below. *Outer lip* thickened, produced into a hollow claw of 5 mm. length, slightly turned upwards, at the intersection of the upper keel, and giving the shell the appearance of certain forms of *Aporrhais*. *Columella* vertical, concave. *Inner lip* callous, spreading a short distance over the body-whorl.

Height, 35 mm.; diameter, 25 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Oamaru. Oligocene ?

Struthiolaria canaliculata Zittel. Plate XVII, fig. 8, *a*, *b*.

1865. *Struthiolaria canaliculata* Zittel, Voy. "Novara," Palæ., p. 34, pl. xv, fig. 1.
1873. „ *sulcata* Hutton, Cat. Tert. Moll., p. 10.
1886. „ „ Hector, Outline Geol. N.Z. p. 50, figs. 6, 7.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 217.

Shell rather small, ovato-oblong, slightly ventricose, turreted, with strong distant spiral ribs. *Sculpture :* The last whorl of an adult specimen has 9 strong spiral ribs, which are flat or broadly convex, decreasing in strength towards the base, the interstices of the same width or broader, smooth or with growth-lines; the penultimate whorl has 3 cinguli, the uppermost getting lost in the whorls above. *Spire* turreted, of the same height as the aperture. *Protoconch* papillate. *Whorls* 6, gradually increasing, faintly convex in outline, base flattish. *Suture* linear, canaliculated. *Aperture* rotundly ovate, vertical, rounded above, with a rudimentary canal below. *Outer lip* thickened, slightly sinuate, convex. *Columella* vertical, concave. *Inner lip* spreading as a moderate callus over the body-whorl, connected with the outer lip.

Height, 45 mm.; diameter, 35 mm. (type).

Type in the K.K. Hofmuseum, Vienna.

Loc.—Awatere Valley, South Island. Miocene.

Remarks.—Hutton proposed the name *S. sulcata*, because he thought Zittel's name was preoccupied by Spengler, who, however, was not a binomial writer, and Zittel's name has therefore to be accepted.

The specimen in the collection of Hutton's types of 1873 is from the east coast Wellington, and has the outer lip broken off.

Struthiolaria cingulata Zittel. Plate I, fig. 9.

1865. *Struthiolaria cingulata* Zittel, Voy. "Novara," Palæ., p. 35, pl. xv, fig. 2.
1873. ,, ,, Zittel: Hutton, Cat. Tert. Moll., p. 11.
1886. ,, ,, Zittel: Hector Outline Geol. N.Z., p. 51, figs. 9, 17.
1887. ,, ,, Zittel: Hutton, P.L.S. N.S.W. (2), vol. i, p. 217.
1893. ,, ,, Zittel: Hutton, Macleay Mem. Vol., Plioc. Moll., p. 61.

Whorls with spiral ribs, 15 to 20 on the body-whorl, crossed by strong growth-lines.

Height, 45 mm.; diameter, 28 mm. (type).

Type in the K.K. Hofmuseum Vienna.

Loc.—Awatere. Miocene.

Remark.—A specimen from the Pliocene of Patea is in the collection of the Geological Survey, and agrees with Zittel's description and figures, but the incremental lines are much more pronounced, thus approaching the following subspecies.

Struthiolaria cingulata nov. subsp. *monilifera.* Plate I, fig. 10.

1873. *Struthiolaria cingulata* Zittel var. B Hutton, Cat. Tert. Moll., p. 11.

The shell is more elevated than the species, but chiefly distinguished from it by the very distinctly moniliform spiral ribs, of which there are 4 on the penultimate whorl, the upper two interstices with a fine, slightly nodulous spiral riblet. This sculpture is continued over the body-whorl, the ribs getting stronger and the instices broader; the base with about 11 finer, less nodulous, equidistant spiral liræ, which are getting finer on approching the neck.

Height, 48 mm.; diameter, 29 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Awatere. Miocene.

Struthiolaria spinosa Hector. Plate I, fig. 11.

1873. *Struthiolaria tuberculata* var. B Hutton, Cat. Tert. Moll., p. 11.
1886. ,, ,, Hutton, Trans. N.Z. Inst., vol. xviii, 1885, p. 335.
1886. ,, *spinosa* Hector, Outline Geol. N.Z., p. 51, figs. 9, 13.
1887. ,, *tuberculata* Hutton, P.L.S. N.S.W. (2), vol. i, p. 216.

Shell moderately large, ovate, turreted, solid, with a row of tubercles on the carina of the two lower whorls, the body-whorl subbicarinate. *Sculpture:* The protoconch is smooth, the succeeding whorls with subequal spiral cords, 6 on the shoulder and 6 below it, the interstices of about the same width as the cinguli; on the carina of the third whorl low distant tubercles appear, which are gradually getting stronger as growth proceeds, their number being about 12 on a whorl; the lower, rounded angle on the body-whorl has only traces of tubercles; growth-lines sinuous. *Spire* conical, turreted, very little higher than the aperture. *Protoconch* planorbiform, rather large. *Whorls* 6, the lower two distinctly shouldered, shoulder and surface below it straight, interval between the two angles of the body-whorl slightly excavated; base contracted, somewhat concave. *Suture* linear, not impressed. *Aperture* slightly oblique, ovate, broadly angled above, produced into a rudimentary open canal below. *Outer lip* thick, broadly and flatly recurved, with a prominent tubercle at the angle of the shoulder, sinuous, much advancing in front of the lower angle, then excavated before reaching the canal.

Columella broadly concave. *Inner lip* spreading very broadly over the body-whorl, and extending above as far as the carina of the penultimate whorl.

Height, 53 mm.; diameter, 37 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Waikari. Miocene.

Remarks.—Not only the sculpture but the flat protoconch and the broadly expanding inner lip separate this species from *S. spinosa* Hutt. = *S. tuberculata* Hutt.

Struthiolaria tuberculata Hutton. Plate I, fig. 12.

1873. *Struthiolaria tuberculata* Hutton, Cat. Tert. Moll., p. 11.
1886. „ *spinosa* Hutton, Trans. N.Z. Inst., vol. xviii, 1885, p. 335.
1886. „ *tuberculata* Hutton: Hector, Outline Geol. N.Z., p. 51, figs. 4, 9.
1887. „ *spinosa* Hutton, P.L.S. N.S.W. (2), vol. i, p. 217.

Shell small, ovate, turreted, with a sharp apex, with concentric rows of sharp spines. *Sculpture* consisting of a row of tubercular spines on the angle of the shoulder upon the two lower spire-whorls; body-whorl bicarinated, bearing a row of spines on each keel, 10 to 12 on a row, the spines upon the lower carina slightly smaller. Spiral fine liræ seem to be present in well-preserved specimens. *Spire* acute, conical, turreted, its height equal to that of the aperture. *Protoconch* pointed, conical. *Whorls* 6, the last very large in proportion, shouldered, slightly concave above, straight below; base flattish. *Suture* strongly impressed. *Aperture* vertical, oval, angled above, with a broad rudimentary canal below. *Outer lip* much thickened, recurved, sinuous, with a distinct narrow sinus above the upper keel. *Columella* slightly excavated. *Inner lip* very thick and callous, flattened, but rounded on the outside, connecting with the outer lip, but not extending higher than midway between the two rows of spines.

Height, 38 mm.; diameter, 26 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Broken River. Miocene.

Remark.—The measurement given in the Cat. Tert. Moll. (2 in. by 1·4 in.) is that of *S. tuberculata* var. B.

Fam. Capulidæ.

Capulus australis (Lamarck). Plate I, fig. 13, *a*, *b*.

1819. *Patella australis* Lamarck, Anim. s. Vert., vol. vi, p. 335.
1873. *Pilœopsis uncinatus* Hutton, Cat. Tert. Moll., p. 14.
1886. „ „ Hutton: Hector, Outline Geol. N.Z., p. 48, figs. 2, 5.
1893. *Hipponyx uncinatus* Hutton, Macleay Mem. Vol., Plioc. Moll., p. 62.

Shell rather large, irregularly conical, with posterior spiral nucleus, fine irregular radiate riblets, and horseshoe-shaped muscular impression. *Sculpture* consisting of somewhat irregularly spaced close radial riblets, obsolete on some parts of the surface, crossed by distinct growth-lines; at the posterior margin, and especially on the left side of it, well-marked plications. *Apex* posterior, either level with the margin or extending beyond it. *Protoconch* small, of 1 volution, planorboid, smooth, marked off from the succeeding large irregularly conical whorl by a small groove. *Aperture* large, irregularly round or oval. *Peristome* sharp, smooth, sometimes sinuous, the left side usually more advancing than the right. *Inside* smooth, polished.

Height, 20 mm.; length, 33 mm.; breadth, 29 mm.

Type of *P. uncinatus* Hutt. in the collection of the New Zealand Geological Survey.

Loc.—Wanganui. Pliocene.

Remarks.—Hutton's species agrees with Recent specimens of *Capulus australis* Lamarck from South Australia in every particular, except that the former is about twice the size of the latter. It is not *Hipponix australis* Q. & G., which is usually, but erroneously, considered a synonym of *Capulus australis* Lamarck.

Fam. Hipponicidæ.

Hipponix radiatus (Hutton). Plate I, fig. 14.

1873. *Pilæopsis radiatus* Hutton, Cat. Tert. Moll., p. 14.
1887. *Hipponyx radiatus* Hutton, P.L.S. N.S.W. (2), vol. i, p. 218.

The type specimen is half-embedded in matrix, and not much can be added to Hutton's diagnosis. The shell is very high and the apex much incurved; the longitudinal riblets are somewhat unequally spaced, slightly undulating and nodulous, their number being about 24; the interstices are much broader than the riblets, with concentric incremental lines.

The species has some affinity with *H. australis* Q. & G., but the latter is not so high, the apex less incurved, and the riblets are more numerous and therefore closer together.

Height, 20 mm.; diameter of aperture, 17 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Awatere, South Island. Miocene.

Fam. Calyptræidæ.

Calyptræa scutum Lesson.

1830. *Calyptræa scutum* Lesson, Voy. "Coquille," Zool., vol. ii, p. 395.
1865. *Trochita dilatata* Sowerby: Zittel, Voy. "Novara," Palæ., p. 43, pl. xv, fig. 8; not of Sowerby.
1873. *Trochita tenuis* Gray: Hutton, Cat. Tert. Moll., p. 13.
1873. ,, *dilatata* Sowerby: Hutton, Cat. Tert. Moll., p. 14.
1887. ,, ,, Sowerby: Hutton, P.L.S. N.S.W. (2), vol. i, p. 217.

The fig. 8*a* in Zittel's work, and the specimen from Awatere (98 of Hutton's catalogue), have the apex subcentral, and Zittel was certainly mistaken when he assigned his specimen to *maculata* Q. & G., a fact already pointed out by Hutton. Why Zittel thought it also to be identical with *Trochita dilatata* Sowerby I do not know; the latter is a synonym of *Trochita trochiformis* Gmelin, ranging from Panama to Valparaiso, Chile. Zittel's figures and the specimen before me very well agree with Lesson's species. *Trochita alta* Hutton, which has also a subcentral apex, is out of the question.

Crepidula gregaria Sowerby. Plate I, fig. 15, *a*, *b*.

1846. *Crepidula gregaria* Sowerby, Darwin's Geol. Obs. on S. America, p. 254, pl. iii, fig. 34.
1865. ,, *incurva* Zittel, Voy. "Novara," Palæ., p. 44, pl. xv, fig. 9.
1873. *Crypta incurva* Zittel: Hutton, Cat. Tert. Moll., p. 14.
1887. *Crepidula incurva* Zittel: Hutton, P.L.S. N.S.W. (2), vol. i, p. 218.
1887. *Haliotis imperforata* Philippi, Los Fósiles, &c., p. 97, pl. xii, fig. 2.
1897. *Crepidula gregaria* Sowerby: von Ihering, Revista Mus. Paul., vol. ii, p. 278.
1897. ,, *incurva* Zittel: Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 248.
1902. ,, *gregaria* Sowerby: Ortmann, Princ. Exped. Patagonia, p. 184, pl. xxxii, fig. 10.
1907. ,, ,, Sowerby: von Ihering, Anales Museo Nac. Buenos Aires, vol. xiv, p. 147.

The type of *C. gregaria* is from Santa Cruz, Patagonia, and the type of *C. incurva* from Awatere Valley.

Ihering and Ortmann are of opinion that Sowerby's and Zittel's species are conspecific.

The species occurs in the Tertiary of Patagonia and Chile, and in the Miocene and Pliocene of New Zealand.

Fam. NATICIDÆ.

Polinices (Mamma) ovatus (Hutton). Plate XVII, fig. 1, *a*, *b*.

1873. *Natica (Mamilla) ovata* Hutton, Cat. Tert. Moll., p. 9.

1887. „ *ovata* Hutton, P.L.S. N.S.W. (2), vol. i, p. 215.

1893. „ *(Mamma) ovata* Hutton, Macleay Mem. Vol., Plioc. Moll., p. 55, pl. vii, fig. 40.

Shell of moderate size, ovate, smooth, umbilicated. *Sculpture* consisting of fine oblique growth-lines only. *Spire* short, conical, the outlines convex, its height a little more than one-third the height of the aperture. *Protoconch* small, broadly conoidal. *Whorls* 5, the first four slowly increasing, but the last large, inflated, and rapidly descending. *Suture* covered, leaving a linear impression. *Aperture* subvertical, ovate, angled above, narrowly rounded below. *Outer lip* sharp, broadly convex. *Columella* slightly excavated. *Inner lip* forming a thick callus above and over the greater part of the columella, but gradually attenuated below. *Umbilicus* large, with a slight funicle, about half of the opening closed by the inner lip.

Height, 37 mm. ; diameter, 29 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Shakespeare Cliff. Pliocene.

Remarks.—The shell figured in the Macleay Mem. Vol. is much more rounded, and the umbilicus is closed up so far as to leave only an oblique slit. The type specimen has the umbilicus much less closed, leaving a conspicuous vertical opening.

Ampullina miocænica sp. nov. Plate II, fig. 2.

1873. *Sigaretus subglobosus* Sowerby : Hutton, Cat. Tert. Moll., p. 9 ; not of Sowerby.

1887. „ „ Sowerby : Hutton, P.L.S. N.S.W. (2), vol. i, p. 215.

Shell small, globose, spirally very finely and irregularly striated, narrowly umbilicated. *Sculpture* : The protoconch of 2 whorls is smooth, the succeeding volutions have fine spiral threads, sometimes finer and more crowded just below the suture, 10 to 15 on the penultimate whorl ; sometimes part of the cinguli is produced into minute tubercles by the intersection of oblique growth-lines ; on the body-whorl the spirals are getting very unequal, broader cinguli appear now and again, leaving between them rather wide interstices which contain 1 to 4 very fine spiral threads. Obliquely retrocurrent growth-lines are crossing the spiral ornamentation. *Spire* short, broadly conoidal, with a blunt apex, its height about one-third of that of the aperture. *Protoconch* of 2 flatly convex whorls, convexly conoidal. *Whorls* 4, first rather slowly increasing, the last large in proportion, globose ; base lightly convex. *Suture* impressed. *Aperture* subvertical, ovate, angled above, attenuated below. *Outer lip* regularly convex, sharp, smooth within. *Columella* oblique, straight, but concave below. *Inner lip* forming a prominent callus, spreading above narrowly over the body, slightly excavated over the umbilicus, and drawn out to a narrow margin at the base of the aperture. *Umbilicus* narrow, deep, half-covered by the inner lip.

Height, 12 mm. ; diameter, 10 mm. (type).

Type in the collection of the New Zealand Geological Survey.

Loc.—Awamoa, South Island. Miocene.

Remarks.—As pointed out by von Ihering, this species is not the same as *Sigaretus subglobosus* Sowerby, from Chile. The latter is twice as large, and has a much coarser spiral sculpture. The figure shows the cinguli too fine, numerous and regular.

The diagnosis was emended after a perfect specimen from Oamaru in my collection.

Fam. Cassididæ.

Phalium (Cassidea) achatinum pyrum (Lamarck).

1822. *Cassis pyrum* Lamarck, Anim. s. Vert., vol. vii, p. 226.
1872. ,, *nivea* Brazier, Proc. Zool. Soc., p. 616, pl. xliv, fig. 1.
1873. ,, *striatus* Hutton, Cat. Tert. Moll., p. 8.

Cassis tumida Petterd is an immature shell.

The type specimen of Hutton's *C. striatus* is a very small but perfect form of the subspecies, having the spiral ribs of the base more pronounced than is usually the case in Recent specimens; otherwise there is no difference.

Height, 33 mm.; diameter, 24 mm.

Type of *C. striatus* in the collection of the New Zealand Geological Survey.

Loc.—Shakespeare Cliff. Pliocene.

Galeodea sulcata (Hutton). Plate II, fig. 1.

1873. *Cassidaria sulcata* Hutton, Cat. Tert. Moll., p. 8.
1887. ,, ,, Hutton, P.L.S. N.S.W. (2), vol. i, p. 214.

Shell ovato-ventricose, with moderately elevated spire, prominent spiral sculpture, and broad inner lip. *Sculpture:* The smooth protoconch followed by spire-whorls with strong, unequal spiral ribs, 4 of them are stronger than the others, the lowest furrowed, and all of these more prominent cinguli are rendered moniliform by indistinct axial costæ, the two lowest cinguli being distinctly nodulous; of the three interstitial ribs, the two upper ones are thin and sharply rounded, the third is considerably stronger; interspaces broader than the ribs, concave; this sculpture is getting much more conspicuous on the body-whorl, and is continued down to the base by sharp, smooth, occasionally unequally spaced spiral ribs; in some places the axial riblets are faintly extended over the base. *Spire* conoidal, about half the height of the aperture. *Protoconch* small, with the nucleus slightly lateral. *Whorls* 5, convex, the last large and ventricose; base but slightly contracted. *Suture* well impressed. *Aperture* oblique, produced into a canal below, which in the type specimen is broken off. *Outer lip* convex, reflected, but the greater part of it also lost. *Inner lip* a broad callus over the body, slightly free below, lirate the whole height.

Height, 46 mm.; diameter, 37 mm.; angle of spire, 90°.

Type in the collection of the New Zealand Geological Survey.

Loc.—Kanieri, South Island. Miocene.

Galeodea senex (Hutton).

1873. *Struthiolaria senex* Hutton, Cat. Tert. Moll., p. 11.
1873. *Purpura excursa* Hutton, Cat. Tert. Moll., p. 6.
1887. *Cassidaria senex* Hutton, P.L.S. N.S.W. (2), vol. i, p. 214.

Shell moderately large, ovate, turreted, spirally striated, keel of the spire-whorls nodulous, 3 keels on the body-whorl with nodules. *Sculpture:* The protoconch is smooth, the following whorls are finely, somewhat irregularly spirally striated, usually a stronger cord alternating with 1 to 3 finer threads; the angle of the shoulder bears distant, pointed tubercles; on the body-whorl there are 5 more prominent keels, 3 of which bear tubercles, 18 on the type specimen (from Oamaru), but only 12 on a much larger specimen (from Pareora); the keels are closer together as they approach the base, which bears 5 additional flat cinguli, ornamented with spiral lines. *Spire* short, scalariform, shorter than the aperture. *Protoconch* conic, with flatly convex whorls, of which there are 3. *Whorls* 6, regularly increasing, the last very large and ventricose; spire-whorls with a broad, slightly excavated shoulder, straight below it; body-whorl with the shoulder straight, the interspaces between the keels concave. *Suture* not impressed, margined below. The *aperture* high, ovate, the canal broken off. *Inner lip* spread broadly over the body as a thick callus.

Height, 3·2 in.; diameter, 2·4 in. ?

Type in the collection of the New Zealand Geological Survey.

Loc.—Oamaru. Oligocene ?

Remarks.—The type specimen consists only of 2 whorls, and is in a bad condition; its height is 1·3 in. Hutton's measurements must have been taken from another specimen. The diagnosis has been emended from a nearly perfect specimen from Pareora which is in the Canterbury Museum, and was kindly lent to me for the purpose. Its dimensions are—height, 61 mm.; diameter, 45 mm.

Fam. CHRYSODOMIDÆ.

Siphonalia nodosa Martyn, n. subsp. zitteli.

1865. *Buccinum* sp. indet. Zittel, Voy. "Novara," Palæ., p. 36, pl. xiii, figs. 5*a*, 5*b*.
1873. ,, *robinsoni* Zittel: Hutton, Cat. Tert. Moll., p. 5; not of Zittel.
1887. *Cominella robinsoni* Zittel: Hutton, P.L.S. N.S.W. (2), vol. i, p. 210.

The subspecies is distinguished from the species by its smaller size and the much stronger spiral ornamentation. On the penultimate whorl 2 strong spiral cords appear below the suture, followed by a few fine spiral threads; on the body-whorl from the angle of the shoulder down to the base regular spiral riblets are present, which are considerably stronger than in *S. nodosa*, the interstices broader than the riblets; all these cinguli are crossed by axial ribs, produced into nodules upon the spirals, but not marked in the interspaces.

Height, 25 mm.; diameter, 16 mm.

Type in the K.K. Hofmuseum, Vienna.

Loc.—The cliffs near Nelson (type). White Cliffs, Taranaki (specimen in the collection of the New Zealand Geological Survey).

Remarks.—The specimen labelled "34. *Buccinum robinsoni* Zittel" amongst Hutton's type specimens is certainly not that species, but it agrees very well with Zittel's fig. 5 on pl. xiii. The diagnostic characters are taken from this specimen.

I have not seen *Buccinum robinsoni* Zittel, but it is no doubt a subspecies of *Siphonalia nodosa* Martyn. It is figured by Zittel on pl. xiii, figs. 4*a*, 4*b*.

Siphonalia plicatilis (Hutton). Plate II, fig. 9.

1873. *Fusus plicatilis* Hutton, Cat. Tert. Moll., p. 3.
1887. *Siphonalia plicatilis* Hutton, P.L.S. N.S.W. (2), vol. i, p. 208.

Shell very small, thin, fusiform, with radial broad ribs on the spire-whorls. *Sculpture* consisting of 8 to 9 oblique, broadly rounded, smooth radial ribs, the interstices of about the same width and smooth; on the body-whorl they are reduced to rounded tubercles upon the angle of the shoulder, followed farther down by broad, flat cinguli, separated by linear grooves, and getting narrower towards the base. *Spire* short, slightly turreted. *Whorls* 4 or 5, the last large and somewhat inflated, shouldered; the base concave. *Suture* linear, impressed. *Aperture* slightly oblique, ovate, narrowly channelled above, produced below into a moderate, open, slightly recurved canal. *Outer lip* convex, sharp, smooth within. *Columella* vertical, very little excavated. *Inner lip* smooth, narrow, stretched out over the left margin of the canal.

Height, 14 mm.; diameter, 9 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Pomahaka, Otago. Miocene.

Remarks.—The specimen before me consists of the body-whorl, with front part of it broken off, and of a small part of the penultimate whorl. From Hutton's diagnosis, the drawing of the perfect specimen by Buchanan, and the remains of the type I have been able to compile the above description. The specimen is most likely not adult.

Siphonalia subnodosa (Hutton). Plate XVI, fig. 6; Plate XVII, fig, 6, *a*, *b*.

1873. *Fusus nodosus* Quoy var. C Hutton, Cat. Tert. Moll., p. 3.
1877. *Cominella subnodosa* Hutton, Trans. N.Z. Inst., vol. ix, 1876, p. 596, pl. xvi, fig. 7.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 209.

Shell ovate with depressed spire, thin, turriculate, with axial ribs and spiral threads; short, oblique, and recurved canal. *Sculpture:* Protoconch with a smooth pullus, the second whorl axially ribbed, the following whorls with close, rounded radial ribs, beginning at the angle of the shoulder, and reaching to the suture below on the spire-whorls, but only to the middle on the body-whorl, where they are raised to low tubercles, as is also the case close to the suture on the spire-whorls; the whole surface is ornamented with subequal spiral riblets, the interspaces being slightly broader than the riblets; the axial ribs number about 15 on a whorl. *Spire* low, conoidal, its height about two-thirds of that of the aperture without canal. *Protoconch* very small, of 2 whorls, conic. *Whorls* 7, regularly increasing, the last large, with a concave shoulder, slightly convex below it; base contracted. *Suture* not much impressed, margined below by a tubercular plait. *Aperture* ovate, channelled above, with a short, widely open canal below, which is turned to the left and strongly recurved. *Outer lip* sharp, angled above, slightly sinuate below. *Columella* vertical, a little excavated, forming an angle below towards the canal. *Inner lip* extending over the columella and part of the body as a thin glaze.

Height 30 mm.; diameter, 20 mm. (*nodosa* var. C). Height, 33 mm.; diameter, 25 mm. (*C. subnodosa*).

Type of var. C in the collection of the New Zealand Geological Survey; of *C. subnodosa*, in the Otago Museum.

Loc.—Var. C, Shakespeare Cliff; Pliocene. *C. subnodosa*, White Rock River; Miocene.

Remarks.—Hutton already pointed out in the Catalogue that this shell is "approaching *Cassis* in shape." It really has a resemblance to *Galeodea*, but the small, sharply pointed protoconch, the sharp outer lip, and the but very slightly callous inner lip remove it from that genus.

Siphonalia turrita sp. nov. Plate XVI, fig. 2.

1873. *Fusus nodosus* Quoy var. D Hutton, Cat. Tert. Moll., p. 3.

Shell moderately large, fusiform, with elevated scalar spire, numerous nodulous radial ribs, and strong spiral riblets; short, open, and recurved canal. *Sculpture:* Protoconch smooth; the succeeding whorls with low, rounded, radial ribs, produced into sharp nodules on the carina of the whorls, and smaller ones on the intersection with the stronger spiral cords, 16 on the last whorl; towards the base the ribs vanish, and strong incremental striæ are the only axial sculpture. Spiral sculpture consisting of 2 spiral cords close together below the suture, followed by 3 distant and strong cinguli upon the shoulder, with a fine thread in the interstices; a strong spiral cord upon the angle of the shoulder, and 2 fine threads above it; 4 unequal cinguli below the carina, usually with a very fine thread between them; the lowest spiral rib of the penultimate whorl, continued over the body, is distinctly nodulous; below it follow 7 distant, prominent, slightly moniliform spiral ribs, most of the interstices ornamented by a fine spiral thread. *Spire* turreted, high, about the same height as the aperture with canal. *Protoconch* conic, small, of 2 convex whorls. *Whorls* 8, rather rapidly increasing, the last slightly ventricose; the shoulder broad, steep, straight; below the angle the whorls are slightly contracted and concave. *Suture* not much impressed, wavy. *Aperture* oblique, oval, angled above and on the carina, contracted below and produced into a short, oblique, open canal, turned to the left and recurved, notched at the base. *Outer lip* sharp, straight above the carina, convex below it, contracted towards the canal. *Columella* vertical, slightly arcuate, turned to the left below to form the inner margin of the canal. *Inner lip* spreading narrowly over the body as a rather thin callosity.

Height, 55 mm.; diameter, 29 mm.; angle of spire, 45°.

Type in the collection of the New Zealand Geological Survey.

Loc.—Kanieri, South Island. Miocene.

Remarks.—In the manuscript left by the late Captain Hutton he put this species as a synonym of *Purpura conoidea* Zittel, which no doubt is a *Siphonalia*, and in my opinion much nearer allied to *S. nodosa* than *S. turrita*. The elongated form and prominent spiral sculpture are characteristic of the latter species.

The angle of the spire in *S. nodosa* and *S. conoidea* is 58°.

Fam. Buccinidæ.

Cominella inflata (Hutton). Plate II, fig. 6.

1873. *Buccinum inflatum* Hutton, Cat. Tert. Moll., p. 6.

1887. *Cominella inflata* Hutton, P.L.S. N.S.W. (2), vol. i, p. 209.

Shell large, ovato-fusiform, with a large, inflated body-whorl, spire axially plicated, most whorls spirally grooved. The *sculpture* consists of broadly rounded axial ribs on the spire-whorls, continued over the body-whorl as irregular, flexuous incremental plications; the spiral grooves are evidently variable in strength and width, in one specimen (from Mount Horrible) there are distinct spiral flat ribs, the interstices about twice as broad. *Spire* conoidal, lower than the aperture. *Whorls* 7, lightly convex, in well-preserved specimens distinctly shouldered; the body-whorl, however, with a rounded pad below the suture, and contracted below it. *Suture* well impressed. *Aperture* oval, broadly angled above, produced below into a short and open canal. *Outer lip* concave at the periphery. *Columella* straight, truncated below. *Inner lip* forming a broad and thick callosity over the body-whorl. *Fasciole* distinct.

Height, 33 mm.; breadth, 22 mm.; angle of spire, 65° (type). Height, 74 mm.; breadth, 44 mm. (Porter River specimen).

Type seems to be lost.

Loc.—Kanieri River. Miocene.

Remarks.—The diagnosis was emended after specimens from the Canterbury Museum, and sketches of those were also made (here reproduced). The specimen showing the aperture is from Mount Horrible, the other from Porter River. I am greatly indebted to Mr. Edgar R. Waite, Curator of the Canterbury Museum, for the loan of the specimens.

Fam. Muricidæ.

Murex (s. str.) crawfordi (Hutton). Plate II, fig. 5; Plate XVII, fig. 5.

1873. *Fusus crawfordi* Hutton, Cat. Tert. Moll., p. 3.

1887. *Siphonalia dilatata* Q. & G. var. *crawfordi* Hutton, P.L.S. N.S.W. (2), vol. i, p. 208.

Shell ovato-fusiform, with depressed spire, spirally striated, with spinous varices. *Sculpture* consisting of numerous spiral cords below the carina, which are, as is visible on a small part of the second whorl, crossed by radial cords of equal strength. Most of this sculpture is lost in the specimen before me. Spire-whorls with a row of tubercles above the suture, body-whorl with a row of 9 hollow spines on the carina, all of which are broken off, and a second row of tubercles below, which is connected with the upper row by rounded varices. Growth-lines distinct, retrocurrent towards the carina, continued, obliquely advancing, towards the base. *Spire* depressed, conical, with straight outlines, of the same height as the aperture without the canal. *Protoconch* apparently smooth, but the greater part of it is missing. *Whorls* 5, regularly increasing, flattened, the body-whorl somewhat inflated, broadly shouldered. *Suture* undulating, not deep. *Aperture* oval, higher than broad, somewhat oblique; the canal broken off, but apparently directed slightly to the left. *Outer lip* worn off, regularly convex. *Columella* vertical, lightly excavated. *Inner lip* forming a broad callus on the body, its lower part evidently with a free outer edge, but this has been worn off.

Height, without canal, 74 mm.; diameter, 66 mm.; angle of spire, 75°.

Type in the collection of the New Zealand Geological Survey.

Loc.—Te Awaite, east coast, Wellington. Miocene.

Remarks.—This shell is, in my opinion, neither a *Fusus* nor a *Siphonalia*, but has, though imperfect, most of the characters of *Murex*.

Fam. Volutidæ.

Volutospina (Athleta) huttoni nom. mut. Plate XVI, fig. 3, *a*, *b*.

1873. *Voluta (Cymbiola) kirki* Hutton, Cat. Mar. Moll., p. 18.
1873. „ *kirki* Hutton, Cat. Tert. Moll., p. 7.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 211.
Not *V. kirki* var. *kirki* Hutton, Trans. N.Z. Inst., vol. xvii, p. 325.

Shell moderately large, ventricose, ovoid-conical, with the last whorl large, forming nearly the whole of the shell, a short conical spire, and distant ribs produced into spines at the upper third of the last whorl. Columella with 4 plaits. *Sculpture* consisting of 8 to 9 rounded ribs on the last whorl; they are produced into tubercular spines at the upper third of the whorl, but getting flat and effaced towards the base; in some places there are indications of narrow, distant sulci on the dorsal side of the shell. *Spire* short, conical, with straight outlines. *Protoconch* of a few whorls, turbinate, the nucleus lost. *Whorls* 6, slowly increasing, but the last whorl suddenly grows very large; it is convex above the carina, almost straight below. *Suture* not much impressed, margined below. *Aperture* oblique, moderately large, narrowly channelled above, notched at the base, but slightly narrowed below, broadest at the lower third. *Outer lip* slightly thickened, not expanded, smooth inside, extended above as a strong varix to the suture. *Inner lip* very broadly expanded over the body-whorl, extending up to the suture, narrowed below. *Columella* slightly excavated, with 4 strong, oblique plaits, which are equidistant, the uppermost more feeble than the others.

Height, 96 mm.; diameter, 54 mm.; height of aperture, 78 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Broken River, South Island. Miocene.

Remarks.—Hutton's diagnosis of *Voluta kirki* was based on a Recent shell in the Auckland Museum, supposed to have been found in New Zealand. This, however, turned out to be a mistake, the shell having been identified as *Heteroaulica flavicans* Gmel., from north Australia.

In typical *Athleta* the aperture is attenuated towards the base, and the columella bears 3 plaits and 1 or 2 plicæ above.

It is interesting to see *Athleta* turning up in New Zealand, as this subgenus has hitherto only been known from the Eocene of England and the United States of America, and from the Oligocene and Miocene of Europe.

The name of *Volutospina* was proposed by Bullen Newton (Proc. Mal. Soc. London, vol. vii, p. 102, 1906) to take the place of *Volutilithes* Swainson, 1840.

Subgenus *Athleta* Conrad, 1853. Type: *Voluta rarispina* Lamarck. Miocene. (= *Margovoluta* Sacco, 1890.)

The species is named after the late Captain F. W. Hutton, F.R.S.

Lapparia corrugata (Hutton). Plate II, fig. 4, *a. b.*

1873. *Voluta (Lyria) corrugata* Hutton, Cat. Tert. Moll., p. 7.
1887. „ *corrugata* Hutton, P.L.S. N.S.W. (2), vol. i, p. 212.
1907. *Lapparia parki* Suter, Proc. Mal. Soc. London, vol. vii, p. 207, pl. xviii, figs. 1, 2 (juv.).

Shell of moderate size, fusiform, with large caricelloid protoconch, radially costate lower whorls, and 5 oblique plaits on the pillar. *Sculpture:* The last whorl of the protoconch usually shows distinct marks of spiral striation, and on the succeeding whorls all spiral striæ are either absent, or they are exceedingly fine and dense, as in a specimen from Goldsborough in the Canterbury Museum, or there are distant linear grooves, as can be made out on the type specimen; the radial sculpture consists of rather distant, sharp, slightly flexuous ribs, 14 to 16 on a whorl, extending to the anterior end; the interstices broader than the ribs, with fine incremental lines. *Spire* high, conical, a little higher than the aperture. *Protoconch* consisting of 2½ to 3 whorls with impressed suture, the apex lateral, raised and pointed, the first two whorls convex, slightly higher than the last whorl, which is also less rounded. *Whorls* about 8, somewhat straightened below the suture, thence flatly convex; body-whorl slightly inflated. *Suture* superficial, undulated by the axial costation. *Aperture* long and narrow, the margins subparallel, angled above, with a short anterior canal. *Columella* nearly straight, with 5 subequal oblique and slender plaits, the uppermost more feeble than the others. *Inner lip* spreading as a thin callus over the pillar and on to part of the body.

Height, 49 mm.; diameter, 23 mm. (imperfect specimen).

Type in the collection of the New Zealand Geological Survey.

Loc.—Maunga-pakeha Taipo, east coast of Wellington. Miocene.

Remarks.—The type specimen being devoid of the protoconch, I was allowed to examine a specimen from Goldsborough in the Canterbury Museum, which has the protoconch perfect, but the body-whorl imperfect. I was surprised to see a very distinctly caricelloid protoconch, which at once reminded me of the immature shells I had described and figured in 1907 under the name *Lapparia parki;* these I found to be absolutely identical with Hutton's species, and my name therefore falls into synonymy.

Lapparia corrugata var. B (Hutton). Plate II, fig. 3.

1873. *Voluta (Lyria) corrugata* var. B Hutton, Cat. Tert. Moll., p. 7.

Shell less inflated, the ribs nearer together, becoming obsolete towards the anterior end; axial ribs about 25 on a whorl.

Type in the collection of the New Zealand Geological Survey.

Loc.—Waikari.

Remarks.—The type specimen consists of the body-whorl and part of the penultimate whorl; therefore nothing can be ascertained about the protoconch and the plaits of the columella, the aperture being filled with matrix. No trace of spiral sculpture can be discovered.

Fam. OLIVIDÆ.

Ancilla hebera (Hutton). Plate II, fig. 7.

1873. *Ancillaria hebera* Hutton, Cat. Tert. Moll., p. 6.
1880. „ *mucronata* Johnston, Geol. Tasmania, pl. xxxi, fig. 12; not of Sowerby.
1887. „ *hebera* Hutton, P.L.S. N.S.W. (2), vol. i, p. 210.
1889. *Ancillaria hebera* Hutton: Tate, Trans. Roy. Soc. South Aust., vol. xi, p, 147, pl. vii, fig. 5.
1897. *Ancilla hebera* Hutton: Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 76.

Shell rather small, thin, cylindrical, but slightly narrowed on the lower half, with short spire, entirely covered with enamel. *Sculpture:* A spiral depression beneath the spire, and 2 sulci at the base below the smooth zone, the latter with distinct vertical growth-lines. *Spire* short, thick, bluntly rounded at the apex, the enamel coarsely granulose.

Aperture long and narrow. *Columella* twisted and plicated anteriorly. *Inner lip* spread as a thick callus over the spire and below along the base beneath the two spiral sulci, elevated to a low rib which is produced into a small denticle at the lower end of the outer lip.

Height, 18 mm.; diameter, 7 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Awamoa, South Island. Miocene.

Remarks.—The species also occurs in the Eocene of Tasmania and Victoria.

Fam. TURRITIDÆ.

Turris (Leucosyrinx) altus (Harris). Plate II, fig. 12.

1873. *Pleurotoma pagoda* Hutton, Cat. Tert. Moll., p. 5; not of Reeve.
1887. ,, ,, Hutton, P.L.S. N.S.W. (2), vol. i, p. 212.
1893. ,, ,, Hutton, Macleay Mem. Vol., Plioc. Moll., p. 48, pl. vi, fig. 21.
1897. ,, *alta* Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 45.

Shell small, elongate-fusiform, thin and fragile, strongly keeled whorls without prominent sculpture, and a long canal. *Sculpture* consisting of a strong and acute keel below the middle of the whorls, absent on the protoconch; between the keel and the suture above there is a very faint spiral lineation, and between it and the keel the deep, rounded sinus is indicated by incremental lines; body-whorl with a low obtuse spiral rib below the keel, emanating from the angle of the aperture; growth-lines are well marked upon the base. *Spire* produced, scalariform, of the same length as the aperture with canal. *Protoconch* composed of 2 elevated, smooth, and convex whorls. *Whorls* 6, regularly increasing, almost straight above and below the carina, base contracted towards the canal. *Suture* linear. *Aperture* ovate, contracted below, and terminating in a rather long and open canal, rounded below. *Outer lip* sharp and thin, with a deep, rounded sinus above the keel. *Columella* nearly straight. *Inner lip* spreading rather broadly as a thin enamel over the body.

Height, 18 mm.; diameter, 6·5 mm.; angle of spire, 30°.

Type in the collection of the New Zealand Geological Survey.

Loc.—Awamoa, South Island. Miocene.

Remarks.—Specimens from the Pliocene of Petane and Waikopiro in my collection are much smaller, with more or less distinct spiral sculpture and margined suture. One specimen is beautifully reticulated by axial lines. They form certainly a valid subspecies.

Surcula huttoni nom. mut. Plate II, fig. 10.

1873 (June). *Pleurotoma trailli* Hutton, Cat. Tert. Moll. (June), p. 4; not of Cat. Mar. Moll. (May), 1873, p. 11.

Shell of medium size, fusiform, with costulate whorls and spiral ornamentation, turriculate sharp spire, and the sinus on the shoulder of the whorls. *Sculpture:* The protoconch smooth, the following whorls with slightly oblique, radial, rounded, axial ribs below the shoulder, vanishing towards the base on the body-whorl, 12 on a whorl; the spiral sculpture consists of very fine and close threads on the shoulder, but they grow suddenly thicker farther down, passing over the costæ; the interstices are somewhat broader than the cinguli, and usually contain 1 or 2 fine lines. The spiral threads extend over the whole of the base, becoming of equal strength, and lying close together. *Spire* turriculate, sharply pointed, of about the same length as the aperture with canal, angle 45° (not 38°, as stated by Hutton). *Protoconch* minute, of 2 concentric whorls, the nucleus slightly lateral. *Whorls* 8, regularly descending, distinctly shouldered, convex below the slightly excavated shoulder; base contracted. *Suture* a little impressed, margined below by a somewhat indistinct, narrow, and smooth band. *Aperture* pyriform, angled above, produced below into a long, open, almost straight canal. *Outer lip* sharp, with a narrow and deep sinus at the shoulder. *Columella* slightly sinuate. *Inner lip* spreading narrowly as a rather thin callosity over the pillar, and ending in a point at the margin of the canal.

Height, 17 mm.; diameter, 9 mm. (type, imperfect). Height, 24 mm.; diameter, 10 mm. (perfect specimen).

Type in the collection of the New Zealand Geological Survey.

Loc.—Awamoa, South Island. Miocene.

Remarks.—The species occurs also in the Pliocene of Petane. Hutton unfortunately used the name *Pleurotoma trailli* twice, first for the Recent shell, which is a *Drillia* and not found fossil, and then for the above species.

Drillia wanganuiensis (Hutton). Plate II, fig. 13.

1873. *Pleurotoma wanganuiensis* Hutton, Cat. Tert. Moll., p. 4.
1887. *Drillia wanganuiensis* Hutton, P.L.S. N.S.W. (2), vol. i, p. 214.
1893. *Pleurotoma wanganuiensis* Hutton, Macleay Mem. Vol., Plioc. Moll., p. 50, pl. vi, fig. 28.
1897. „ „ Hutton: Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 46.

Shell small, fusiform, spirally striated and axially obliquely ribbed, the suture strongly margined, canal short. *Sculpture:* The protoconch smooth, the succeeding whorls spirally finely striated, the striæ close together upon the shoulder, but wider apart below, on the body-whorl stronger and finer threads are alternating; a strong cord below the suture, sometimes bearing a narrow groove; axial, oblique, rounded ribs are present on all whorls below the protoconch, extending from the margin of the suture or very little below it to the suture below, but getting obsolete towards the base on the body-whorl; 16 to 20 ribs on a whorl. *Spire* high and narrowly conic, angle 30°, twice the height of the aperture without canal. *Protoconch* consisting of a globular pullus. *Whorls* 7 to 8, regularly and rather slowly increasing, lightly shouldered, angularly convex, base contracted. *Suture* not much impressed, prominently margined below. *Aperture* oval, angled above, with a short, open canal below, truncated at the base. *Outer lip* thin and sharp, with a narrow, deep sinus upon the shoulder. *Columella* straight, slightly bent to the left below. *Inner lip* thin and narrow.

Height, 12 mm.; diameter, 5 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Shakespeare Cliff. Pliocene.

Drillia buchanani (Hutton).

1873. *Pleurotoma buchanani* Hutton, Cat. Tert. Moll., p. 4.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 213.
1893. „ „ Hutton, Macleay Mem. Vol., Plioc. Moll., p. 50, pl. vi, fig. 26.
1897. „ „ Hutton: Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 47.

Shell of medium size, elongato-fusiform, spirally striated and with oblique axial costæ, whorls shouldered, canal short, sinus close to the suture. *Sculpture* consisting of fine spiral cords below the shoulder, 6 on the penultimate whorl, 20 and more on the body, crossed by equidistant oblique axial ribs, absent on the shoulder, and disappearing towards the base; they number from 12 to 16 on a whorl; a narrow smooth cord margining the suture below; shoulder with arcuate growth-lines. *Spire* high and narrow, scalar, about the same height as the aperture with canal; angle 30°. *Protoconch* small, conic, of 2 smooth convex whorls. *Whorls* about 8, slowly increasing, the shoulder concave, lightly convex below it; body-whorl convex, contracted below.

Suture not much impressed, margined below. *Aperture* vertical, oval, angled above, produced below into a short canal. *Outer lip* sharp, with a narrow, not very deep sinus at the shoulder, straightened below the angle. *Columella* long, vertical, straight. *Inner lip* thin, spreading narrowly over the body, and drawn out to a fine point towards the canal.

Height, 22 mm.; diameter, 7 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Shakespeare Cliff. Pliocene.

Drillia awamoaensis (Hutton). Plate II, fig. 11.

1873. *Pleurotoma awamoaensis* Hutton, Cat. Tert. Moll., p. 4.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 213.

Shell elongato-fusiform, rather small, with a slightly scalariform, sharply pointed spire; whorls radially plicate and spirally striated. *Sculpture:* The two embryonic whorls are smooth, the succeeding whorls are radially obliquely ribbed, the ribs broadly rounded, 10 to 12 on a whorl, the interstices narrower than the ribs, the ribs on the body-whorl are becoming obsolete towards the anterior end; spiral liræ ornament the surface, passing over the ribs, about 10 on a whorl; the suture is margined below by a prominent cord, followed by a very fine spiral thread. *Spire* high, pointed, much higher than the aperture, its angle being 22°. *Protoconch* conoid, of 2½ convex whorls. *Whorls* 10, convex, but slightly shouldered, regularly increasing; the base contracted. *Suture* not impressed, margined. *Aperture* narrow, the posterior canal moderate, the anterior rather produced.

Height, 25 mm.; diameter, 7 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Awamoa. Miocene.

Remarks.—This species is very nearly allied to *Drillia buchanani* Hutton, but is distinguished from it by the more acuminate spire, the inconspicuous shoulder of the whorls, the less numerous axial ribs which are broader convex, and the fine thread below the cord margining the suture. The type specimen has the greater part of the body-whorl destroyed.

Bathytoma sulcata (Hutton). Plate XVI, fig. 4.

1873. *Pleurotoma sulcata* Hutton, Cat. Tert. Moll., p. 4.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 213.

Shell rather large, biconic, spirally ribbed and lightly axially costate, with prominently shouldered whorls. *Sculpture* consisting of close spiral ribs, 6 from the shoulder down to the suture on the penultimate whorl, about 16 on the body-whorl; they are crossed by narrow, vertical, not much raised axial ribs, about 20 on a whorl, which are getting more or less obsolete on the body-whorl; the points of intersection are raised into ovate nodules; the shoulder bears very fine spiral threads, crossed by oblique growth-lines only; a narrow ridge below the suture is roughened by incremental ridges. *Spire* conical, of about the same height as the aperture, angle 40°. *Protoconch* smooth, conic. *Whorls* about 6, first slowly, then more rapidly increasing, flattened, the shoulder concave, body-whorl lightly convex, contracted towards the base. *Suture* not impressed, margined below by a narrow oblique ridge. *Aperture* narrow, oblique, channelled above, produced below into a short canal which is slightly excavated below where the fasciole begins. *Outer lip* angled above and with a rather deep, broadly rounded sinus at the shoulder. *Columella* straight at the middle, turned to the left below. *Inner lip* thin, rather broad above, narrowed towards the base, smooth.

Height, 45 mm.; diameter, 20 mm. (type). Height, 34 mm.; diameter, 16 mm. (specimen from Oamaru).

Type in the collection of the New Zealand Geological Survey.

Loc.—Broken River, South Island. Miocene.

Remarks.—The type specimen shows only on the base a little sculpture. I have been able to emend Hutton's diagnosis from a well-preserved specimen in my collection, from the Lower Miocene of Oamaru.

Fam. Conidæ.

Conus (Conospira) ornatus Hutton. Plate II, fig. 14; Plate XVII, fig. 7.

1873. *Conus ornatus* Hutton, Cat. Tert. Moll., p. 10.

1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 212.

Shell small, biconic, spire elevated, with small nodules on the keels, the greater part of the body-whorl smooth. *Sculpture:* Protoconch smooth, the following whorls with a broad shoulder, the keel below the middle of the whorl, ornamented with numerous small nodules, crossed by a few spiral linear grooves; body-whorl with about 8 oblique cinguli. *Spire* conical, about half the length of the aperture, angle about 65°. *Protoconch* subulate, consisting of 3 convex whorls. *Whorls* 8 to 9, slowly increasing, the shoulder slightly concave; body-whorl an inverted cone. *Suture* but little impressed. *Aperture* high and narrow, oblique, the margins parallel, truncated at the base. *Outer lip* almost straight, sharp, angled above. *Columella* oblique, very slightly convex, with a distinct spiral groove above.

Height, 20 mm.; diameter, 8 mm. (type).

Type in the collection of the New Zealand Geological Survey.

Loc.—Awamoa, South Island. Miocene.

Remarks.—There is a *Conus ornatus* Michelotti, which, however, belongs to the genus *Hemiconus* Cossmann, 1889.

Hemiconus trailli (Hutton). Plate II, fig. 15, *a, b*.

1873. *Conus trailli* Hutton, Cat. Tert. Moll., p. 10.

1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 212.

Shell small, biconic, with raised scalar spire, subnodose keels, and irregular spiral grooves on the body-whorl. *Sculpture:* Protoconch smooth, succeeding whorls with curved retrocurrent growth-lines upon the shoulder, which are obliquely slightly antecurrent on the body-whorl; the keels are subnodulous, there are a few spiral lines below, and the suture is plicated below; body-whorl with distant, irregular, and but slightly impressed spiral grooves, deeper and closer together upon the base. *Spire* conoidal, outlines scalar, straight, its height a little more than one-third the height of the aperture, angle about 65°. *Protoconch* small, obtuse. *Whorls* about 8, regularly and slowly increasing, the body-whorl large, inverted conical; spire-whorls with a broad shoulder, which is but very little concave, and the distinct keel is at the lower third of the whorls. *Suture* but little impressed. *Aperture* long and narrow, the margins subparallel, angled above. *Outer lip* lightly convex, angled above, with a shallow sinus at the shoulder, sharp. *Columella* oblique, straight above, slightly twisted below; there is no distinct groove below the suture.

Height, 21 mm.; diameter, 11 mm. (imperfect type specimen). Height, 41 mm.; diameter, 17 mm. (perfect specimen).

Type in the collection of the New Zealand Geological Survey.

Loc.—Awamoa, South Island. Miocene.

Fam. Scaphandridæ.

Cylichnella enysi (Hutton). Plate II, fig. 8.

1873. *Cylichna enysi* Hutton, Cat. Tert. Moll., p. 16.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 207.

Shell subcylindrical, narrower above, spire deeply sunk at the summit, spirally striated, narrowly umbilicated. *Sculpture* consisting of fine spiral striæ, which are slightly more distant on the upper part of the whorl. *Spire* deeply sunk, leaving a perforation of about one-fourth of the minor diameter. *Aperture* narrow, vertical, widened below. *Outer lip* extending beyond the axis of the shell above, lightly convex, sharp. *Columella* short, lightly concave, a little twisted below and forming a small plication. *Inner lip* thinly spread over the convex body-wall. *Umbilicus* narrow, not deep, defined exteriorly by a distinct narrow groove, extending to the base of the shell, and keeled on the outer side.

Height, 16 mm.; diameter, 8 mm.

Type seems to be lost.

Loc.—Broken River, South Island. Miocene.

Remarks.—The figure here published was drawn after the type by the late Mr. Buchanan. The diagnosis has been emended with the help of a specimen in my collection.

Fam. Dentaliidæ.

Dentalium mantelli Zittel. Plate III, fig. 1, *a*, *c*.

1850. *Dentalium* sp. nov. Mantell, Quart. Journ. Geol. Soc., vol. vi, p. 331, pl. xxviii, fig. 15.
1865. „ *mantelli* Zittel, Voy. "Novara," Palæ., p. 45, pl. xiii, fig. 7.
1873. „ „ Zittel: Hutton, Cat. Tert. Moll., pt. 1.
1873. „ *tenuis* Hutton, Cat. Tert. Moll., p. 1.
1873. „ *irregularis* Hutton, Cat. Tert. Moll., p. 1; not of Risso, 1826.
1876. „ *kirksii* Tenison-Woods, Pap. Roy. Soc. Tasmania, 1875, p. 15; not of Nyst, 1843.
1887. *Entalis mantelli* Zittel: Tate, Trans. Roy. Soc. South Aust., vol. ix, p. 190.
1897. *Dentalium mantelli* Zittel: Pilsbry and Sharp, Man. Conch. (1), vol. xvii, p. 208.
1897. „ „ Zittel: Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 293.

Shell from nearly straight to subarcuate, thick, round, gradually tapering, with a variable number of longitudinal ribs (from about 20 to 50), more numerous towards the base, when they become almost obsolete. The ribs are mostly equal, but sometimes they are alternately slightly broad and narrow. The interstices are usually broader than the ribs. The whole surface crossed by annular threads and grooves, often crenulating the ribs.

Length, 40–60 mm.; greatest diameter, 7 mm.

Type in the K.K. Hofmuseum, Vienna. The types of Hutton's two species are in the collection of the New Zealand Geological Survey.

Loc.—The cliffs near Nelson, Awatere Valley, Onekakara (Mantell).

Remarks.—Found also in the older Tertiary strata of Australia. Tate mentions a long and narrow apical slit, but none of the New Zealand specimens I have seen had the apex preserved. *Entalis texturatus* Tate is most likely a synonym.

Dentalium pareorensis Pilsbry and Sharp. Plate III, fig. 4.

1873. *Dentalium lævis* Hutton, Cat. Tert. Moll., p. 2; not of Schlotheim, 1820.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 222.
1897. „ „ Hutton: Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 297.
1897. „ *pareorensis* Pilsbry and Sharp, Man. Conch. (1), vol. xvii, p. 211.

Shell small, smooth, slowly tapering, slightly curved, with circular mouth. There are distant, fine, annular growth-lines, and a strong lens reveals rather distant, fine, longitudinal lines. There is no fissure, but part of the apex is lost.

Length, 28 mm.; breadth at mouth, 3·5 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Kanieri, South Island. Miocene.

Dentalium solidum Hutton. Plate III, figs. 1, *a*, *b*, 3.

1873. *Dentalium solidum* Hutton, Cat. Tert. Moll., p. 2.
1873. „ *conicum* Hutton, Cat. Tert. Moll., p. 1.
1873. „ *giganteum* Sowerby: Hutton, *id.*, p. 2; not of Sowerby.
1887. „ „ Sowerby: Hutton, P.L.S. N.S.W. (2), vol. i, p. 222.
1897. „ „ Sowerby: Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 294.
1897. „ *solidum* Hutton: Pilsbry and Sharp, Man. Conch. (1), vol. xvii, p. 215.
1897. „ *subgiganteum* d'Orbigny, *id.*, p. 217; not of d'Orbigny.

Shell very large, circular in cross-section, nearly straight, the curve in about the earlier third. *Sculpture* consisting in the typical form of about 60 low longitudinal riblets at the middle of the shell; they are of equal strength, with rather shallow interstices of half the width of the riblets. The specimen assigned to *Dent. giganteum* by Hutton has about 50 riblets of varying strength, sometimes narrow and broader riblets alternating, but now and again 2 to 7 broader riblets close together, the interstices linear and well impressed throughout. A specimen from the East Cape has about 60 riblets, which are more elevated, rounded, the interstices rounded, a fine longitudinal riblet being sometimes intercalated between the larger ones. Near the apex the number of riblets is reduced to 35 or 40. Annular growth-lines are present, but getting distinct only towards the anterior end.

The length of a full-grown shell may be about 160 mm.; anterior diameter, 22 mm.; diameter near apex, 3·5 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Waikari, South Island; Miocene. Waitaki, South Island, for *D. giganteum* Hutton, non Sowerby.

Remarks.—The specimen on which *D. conicum* Hutt. is based appears to be only the posterior part of the long *D. solidum* Hutt.; it has a distinct slit at the apex, and this is also present in specimens from Oamaru and Pareora, which cannot be separated from Hutton's type of *D. solidum*. The length of the type specimen of *D. conicum* is 43 mm. Dr. von Ihering, the greatest authority on the Tertiary *Mollusca* of South America, who has also a good knowledge of the New Zealand Tertiary shells, says (Anales Museo Nac. Buenos Aires, vol. xiv, p. 223) with regard to the species of *Dentalium*, "Les espèces tertiaires de la Nouvelle-Zélande sont différentes de celles du Chili et de la Patagonie." In consequence I dropped the name *D. giganteum*, or *subgiganteum*, and adopted Hutton's name *D. solidum*, as suggested by von Ihering.

CHAPTER III.

DESCRIPTION OF THE SPECIES—*continued.*

Class PELECYPODA.

Fam. Anomiidæ.

Anomia huttoni Suter. Plate VI, fig. 3.

1873. *Anomia alectus* Gray: Hutton, Cat. Mar. Moll., p. 83; not of Gray.
1873. *Placunanomia* sp. ind. Hutton, Cat. Tert. Moll., p. 34.
1885. *Anomia undata* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 324 (wrong identification).
1913. „ *huttoni* Suter, Manual N.Z. Mollusca, p. 843, pl. lvii, fig. 8.

Left valve ovate, transverse, very thin, inflated, waved, smooth, with distant concentric, imbricating lamellæ, no radiate sculpture. *Beak* inconspicuous, rounded, near the middle. *Anterior and posterior end* convex, angled above on meeting the very little descending and almost straight dorsal margins; *basal margin* broadly rounded, slightly sinuated. *Inside* slightly pearly; the *ligamental scar* inside under the beak, triangular; the tongue-shaped *triangular area* distinctly limited, but the byssus and adductor scars obliterated.

Type (Recent) in the Dominion Museum, Wellington.

Loc.—Napier. Miocene.

Remarks.—As far as can be judged by the left valve before me, the specimen may be assigned to *A. huttoni*, a Recent species devoid of radiate sculpture. It certainly is not *A. undata* Hutton.

Placunanomia incisura Hutton. Plate VI, fig. 2.

1873. *Placunanomia incisura* Hutton, Cat. Tert. Moll., p. 34.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 237.

Shell suborbicular, much compressed, broadly plicated, both valves impressed and plicated in the same direction—viz., what is convex on one valve is concave on the opposite valve; concentrically ridged and laminate toward the basal margin; both valves radially striated. *Beaks* flat, near the median vertical line. *Anterior end* slightly produced and truncated; *posterior end* somewhat irregularly rounded; *basal part* with a broad anterior and several narrower posterior plications, the margin straightened. *Sculpture* consisting on both valves of numerous interrupted, scaly, and slightly knotty radiate riblets, the upper part of the valves with distant concentric growth-lines, which, on the lower part, are laminate. The part of the right valve with the perforation broken off.

Height, 50 mm.; length, 51 mm.; diameter, 10 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Pareora Beds, Rangitata, South Island. Miocene.

Remarks.—A specimen in my collection from the Miocene of Motutara Bluff, Kawhia, has both valves nearly flat, but the same radial sculpture on both valves. The perforation of the right valve is large, oval. *P. sella* Tate, 1886, from the Lower Tertiary of South Australia, Victoria, and Tasmania, is very likely the same species. Tate remarks that 2 left valves from Oamaru Creek, Otago, are comparable with the triangular-ovate form of *P. sella*.

Fam. ARCIDÆ.

Glycymeris globosa (Hutton). Plate IV, fig. 1, *a*, *b*, *c*.

1873. *Pectunculus globosus* Hutton, Cat. Tert. Moll., p. 28.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 231.
1897. „ „ Hutton: Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 343.

Shell fairly large, solid, subequilateral, ventricose, with a distinct posterior dorsal area, radially ribbed, the umbones raised considerably above the dorsal margins. Left valve: *Beak* elevated, convex, incurved, slightly opisthogyrate, not far back from the hinge-margin. *Anterior end* convex, the dorsal margin horizontal, straight; *posterior end* sinuated at the dorsal area below the straight and but little descending dorsal margin, but lightly convex below; *basal margin* broadly rounded. *Sculpture* consisting of very flat, rather narrow radial ribs, about 35, with linear interstices, a small area in front and the much broader area behind without any radial ribs; fine growth-lines cross the ribs and the areas, but they are distantly raised into very distinct concentric ridges towards the base. Margins deeply crenate inside. *Hinge-plate* strong and long, slightly curved, with about 10 strong, oblique, curved or hooked teeth on each side. *Ligamental area* not high, broadly triangular, with a few divergent grooves. *Anterior adductor-scar* large, trapezoidal, the *posterior scar* smaller, round, forming with the pallial line a small triangular sinus.

Height, 64 mm.; length, 69 mm.; diameter, 28 mm. (× 2).

Type in the collection of the New Zealand Geological Survey.

Loc.—Kanieri, South Island. Miocene.

Remarks.—The dimensions indicated by Hutton, 4 in. by 4 in., if taken from the type specimen, are not correct; they are 2·5 in. by 2·7 in. The smooth dorsal areas are characteristic for this species.

Glycymeris traversi (Hutton). Plate IV, fig. 2, *a*, *b*.

1873. *Pectunculus traversi* Hutton, Cat. Tert. Moll., p. 28.

Shell moderately large, suborbicular, subequilateral, rather compressed, with elevated rounded radial ribs. Right valve: *Beak* small and slightly directed backward, not far back from the hinge-plate. *Anterior end* slightly shorter, regularly convex, the dorsal margin also convex and very slowly descending. *Posterior end* rounded, but obtusely angled below, the dorsal and the basal margin convex; there is a smaller anterior and a broader posterior dorsal area marked off by much finer radial ribs. *Sculpture* consisting of about 37 rounded radial ribs, separated by slightly narrower, deep, and rounded interstices; in front and behind the ribs and interstices are broader than in the middle; the riblets on the dorsal anterior area are much finer, with broad interspaces, the lower two ribs bifurcated; those on the posterior dorsal area are more numerous, and also very narrow, with wider interstices; the lower half of the disc crossed by numerous slightly lamellar growth-lines. *Margin* crenate inside. *Hinge-plate* with a narrow cardinal border, which is semicircular and without teeth in the middle, about 8 hooked teeth on each side. *Ligamental area* with about 5 diverging grooves. *Adductor-scars* subequal, the posterior scar more oval.

Height, 67 mm.; length, 67 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Chatham Islands. Miocene?

Remarks.—The species has the same number of ribs as *G. laticostata* Q. & G., but they are much more rounded, and separated by broader interstices; the valve is far more compressed and less solid.

Fam. Parallelodontidæ.

Cucullæa alta Sowerby. Plate V, fig. 1, *a*, *b*.

1846. *Cucullæa alta* Sowerby, Darwin's Geol. Obs. on S. America, p. 252, pl. ii, figs. 22, 23.
1873. „ „ Sowerby: Hutton, Cat. Tert. Moll., p. 27.
1885. „ „ Sowerby: Hutton, Quart. Journ. Geol. Soc., vol. xli, p. 551.
1897. „ *multicostata* Ihering, Revista Mus. Paul., vol. ii, p. 240, pl. v, fig. 29.
1897. „ *dalli* Ihering, *id.*, p. 241, pl. vii, fig. 47; pl. viii, fig. 51.
1899. „ „ Ihering, N. Jahrb. Mineral., vol. ii, p. 12.
1899. „ *alta* Sowerby: Ihering, N. Jahrb. Mineral., vol. ii, p. 13.
1900. „ „ Sowerby: Ortmann, Amer. Journ. Sci., vol. x, p. 389.
1902. „ „ Sowerby: Ortmann, Princ. Exped. Patagonia, p. 86, pl. xxv. fig. 4.

Shell variable in outline, elongated rhomboidal, shorter or longer, thick, and inflated. Surface finely radially striated, and with fine, undulating, concentric lines of growth. *Anterior end* short, rounded; *posterior* narrowed, and a little produced to an obtuse angle. *Apex* high and incurved, a very indistinct and rounded angulation running down from the apex to the posterior end. *Area* large; according to age, with 1 to 9 rhombiform sulci. (Ortmann.)

Length 22–88 mm.; height, 18–73 mm.

The specimen which served Hutton for determination has—height, 61 mm.; length, 71 mm.; diameter, 51 mm.

Loc.—East coast, Wellington.

Cucullæa alta var. B Hutton. Plate V, fig. 2, *a*, *b*.

1873. *Cucullæa alta* Low var. B Hutton, Cat. Tert. Moll., pl. 27.

More elongated than the typical form, in outline near *C. ponderosa* Hutt.

Height, 87 mm.; length, 102 mm.

Loc.—Callaghan's Hill, east side.

Remarks.—The only distinction I can find between the New Zealand specimen before me and the figures published by von Ihering and Ortmann are the sharp angles between the dorsal and the anterior and posterior margins in the former, and its slightly greater obliquity. I have seen no specimens from the Patagonian formation.

Cucullæa ponderosa Hutton.

1873. *Cucullæa ponderosa* Hutton, Cat. Tert. Moll., p. 27.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 230.

Shell large, ventricose, nearly as high as long, radially costate, the costæ flat and having nearly always a very narrow rib intercalated between the broader ribs. *Beaks* distant, convex, incurved, slightly in front of the middle. *Anterior end* slightly shorter, somewhat concave above, the margin rounded and forming with the nearly horizontal dorsal margin a slight angle, but sometimes it is narrowly convex; *posterior end* somewhat flattened, with convex margin, the dorsal margin longer than the anterior, straight, slowly descending and forming a distinct angle on meeting with the posterior margin; *basal margin* regularly convex. *Sculpture* consisting of rather broad, flat, radiate ribs, a very narrow rib usually filling the interstice; the concentric sculpture is represented by conspicuous dense striæ, slightly arched over the broad ribs. *Ligamental area* long and rather narrow, with divergent grooves.

Height, 102 mm.; length, 109 mm.; diameter, 80 mm.

Type seems to be lost, but in the collection of the New Zealand Geological Survey there is a specimen which answers very well to the figure of the species and the short diagnosis.

Loc.—Korakonui, east coast, Wellington. Miocene.

III 5

Cucullæa ponderosa var. B Hutton. Plate V, fig. 4, *a*, *b*.

1873. *Cucullæa ponderosa* var. B Hutton, Cat. Tert. Moll., p. 27.

This variety differs in having the posterior end produced and narrowly angled below. The beaks are more distant, and from their posterior part an angulation extends to the lower part of the margin, forming a triangular area on which concentric fine lines are crossed by indistinct narrow radial riblets.

Height, 94 mm.; length, 115 mm.; diameter, 77 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Waikari, South Island. Miocene.

Cucullæa worthingtoni Hutton. Plate VI, fig. 1, *a*, *b*.

1873. *Cucullæa worthingtoni* Hutton, Cat. Tert. Moll., p. 27.
1887. ,, ,, Hutton, P.L.S. N.S.W. (2), vol. i, p. 231.
1897. ,, ,, Hutton: Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 339.

Shell rather large, solid, elongated, ventricose, equivalve, inequilateral, finely radially costate, posterior end produced, the anterior, basal, and posterior margins in the adult contracted, turned partly inside on the anterior half of the shell, but the edges meeting each other nearly vertically on the posterior half of the shell, a feature characteristic of the section *Pallium* of the subgenus *Chlamys*. *Beaks* in front of the middle, broken off in the specimen before me. *Anterior end* shorter, broadly convex, forming a sharp angle with the horizontal dorsal margin; *posterior end* produced, its upper margin forming an angle with the straight horizontal dorsal margin, then descending obliquely and but faintly convex, narrowly convex towards the *basal margin*, which is nearly straight posteriorly. *Area* long, with 7 rhombiform sulci in the adult. *Sculpture* slightly different on the two valves, the radial ribs on the right valve broader anteriorly and posteriorly than on the left; the ribs are rather narrow (2–3 mm.), often unequal in width, with linear interstices on the left valve, but with occasional intercostal narrow riblets on the right valve, the whole crossed by fine and close concentric ridges, straight on the left valve, but lightly convex on each rib of the right valve. The area formed on the valves posteriorly by a rounded ridge descending from the umbones towards lower posterior end has very fine radial riblets.

Height, 72 mm.; length, 102 mm.; diameter, 79 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Waitaki, South Island. Miocene.

Fam. Limopsidæ.

Limopsis aurita (Brocchi). Plate IV, fig. 3, *a*, *b*.

1814. *Arca aurita* Brocchi, Conch. Foss. Subappen., p. 485, pl. xi, fig. 9.
1873. *Limopsis zealandica* Hutton, Cat. Tert. Moll., p. 28.
1875. ,, *aurita* Brocchi: McCoy, Prod. Palæ. Vict., dec. 2, p. 23, pl. xix, figs. 5–7.
1887. ,, ,, Brocchi: Hutton, P.L.S. N.S.W. (2), vol. i, p. 232.
1897. ,, ,, Brocchi: Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 346

Shell obliquely ovate when old, more orbicular when young; beaks small, moderately tumid, rounded, slightly projecting beyond the hinge-line; valves moderately convex, most so at about the middle of the length; *cartilage-pit* large, an equilateral triangle with 4 or 5 teeth much smaller than the lateral ones under it in large specimens, but few or no teeth under it in small specimens, 5 (or sometimes 6) larger ones on each side of the cartilage-pit; *ligamental area* flattened, slightly concave, faintly striated transversely, increasing in width with age, and forming obtuse-angled, undefined, very short ears on each side; *anterior muscular impression* with a prominent posterior edge; *inner margin* of the valves with a broad, flat, smooth, bevel-like space round the thin, sharp edge. *External surface* with numerous close, irregular, imbricating, concentric laminar ridges. Well-preserved specimens show under the lens close, obtuse, radiating striæ, about twice their thickness apart on the flat portion of the concentric laminæ, each seeming to widen and dichotomize towards the edge, which it does not pass. (McCoy.)

Height, 21 mm.; length, 22·5 mm.

Loc.—Awamoa, South Island. Miocene.

Found also fossil in Victoria, Tasmania, and in European Miocene and Pliocene. Recent in the Arctic and Southern Oceans.

Limopsis zitteli Ihering. Plate IV, fig. 4.

1865. *Limopsis insolita* Sowerby: Zittel, Voy. "Novara," Palæ., p. 48, pl. xiii, fig 1; not of Sowerby.

1873. *Limopsis insolita* Sowerby: Hutton, Cat. Tert. Moll., p. 28.

1907. „ *zitteli* Ihering, Anales Museo Nac. Buenos Aires, vol. xiv, p. 235.

Shell large for the genus, suboval, oblique, thick, convex, concentrically striated and with interrupted radial threads, equivalve, inequilateral. *Beaks* small, approximate, incurved. *Anterior end* shorter, convex, the dorsal margin descending nearly straight; *posterior end* obliquely produced, convex, the dorsal margin very lightly convex; *basal margin* broadly rounded. *Sculpture* consisting of fine concentric growth-lines, crossed by radial striæ, which are mostly interrupted by the concentric grooves. *Hinge-plate* well developed, with a triangular ligamental area, the teeth increasing in size from the middle towards the outside; they are oblique, semilunar, about 7 on each side of the ligament; length of the hinge, 11 mm.

Height, 24 mm.; length, 28 mm.; diameter, 15 mm. (specimen from Kanieri). Zittel gives the dimensions as 30 mm. by 30 mm., but his figure shows a much more elongated shell—height, 24 mm.; length, 32 mm.

Type in the K.K. Hofmuseum, Vienna.

Loc.—Blind Bay, Nelson. Miocene.

Remarks.—Dr. von Ihering remarks that the New Zealand specimens differ from those of Patagonia and Chile in the predominating length of the valves, whilst in the South American shells the height is greater than the length. The length of the hinge is equal or less than half the length of the valve in New Zealand shells, but more than half the length in South American examples. He further says that it is impossible to confound the two species when one has authentic specimens at his disposal. The figure shows the dorsal posterior margin too high, and the outline of the valve is not oblique enough.

Fam. TRIGONIIDÆ.

Trigonia pectinata Lamarck.

A valve of a shell embedded in sandstone, the inside only visible and the hinge missing, is what Hutton considered to be the above species when writing his "Catalogue of the New Zealand Tertiary Mollusca." In the list of the *Mollusca* of the Pareora and Oamaru systems he omitted it, and rightly so. It may be a *Trigonia*, but I would not undertake to say whether it is a still-living species or not.

The best thing to do is to omit it from our list until better specimens are available. The specimen is from Hampden, South Island. Upper Miocene.

Trigonia subundulata Jenkins. Plate IV, fig. 5.

1865. *Trigonia subundulata* H. M. Jenkins, Quart. Journ. Sci., vol. ii, p. 362, pl. viii, fig. 6.
1866. „ *semiundulata* H. M. Jenkins, Geol. Mag., vol. iii, p. 201.
1873. „ „ McCoy: Hutton, Cat. Tert. Moll., p. 27.
1875. *Trigonia semiundulata* H. M. Jenkins: McCoy, Prod. Palæ. Vict., dec. 2, p. 22, pl. xix, figs. 4, 5.
1897. *Trigonia subundulata* (McCoy MS.) Jenkins: Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 352.

Rotundato-oblong, little longer than deep, moderately convex; *anterior* and *ventral margins* broadly rounded; *posterior margin* nearly straight, abruptly truncated, forming an angle of 120° with the hinge-line; *posterior slope* flattened and radiated with about 10 or 11 strong obtusely rounded ridges, separated by rather wider flatter spaces, and crossed by lines of growth near the margin, closer and spinulose near the beak, and followed on the lunule close to the hinge-line by 6 or 7 much smaller spinulose ridges; *middle* and *anterior* portion of the valve covered with rounded, narrow, slightly undulating ridges, nearly parallel with the ventral margin, crossed, except on the anterior portion, by rather faint impressed sulci radiating from the beak to the ventral margin, nearly the same distance apart as the ridges of the posterior slope. (McCoy.)

Length, 51·5 mm.; height, 21 mm.; diameter, 13 mm.

Type in the National Museum, Melbourne.

Loc.—Awamoa, South Island; Miocene. Tasmania and Victoria; Eocene.

Remark.—The specimen which served Hutton for identification seems to be lost.

Fam. Mytilidæ.

Modiolus huttoni sp. nov. Plate V, fig. 3.

1873. *Modiola* sp. ind. Hutton, Cat. Tert. Moll., p. 26.

Shell moderately large, elongato-oblong, with broadly rounded anterior and posterior margins, very prominently angled from beak to lower part of the posterior end. *Beaks* at about the anterior seventh of the length, convex. *Anterior end* rather broad, convex, the dorsal margin straightened; *posterior end* much longer, angled, the margin convex posteriorly, the dorsal margin slightly ascending from the beak, thence flatly convex; *basal margin* straight. *Sculpture* consisting of distinct concentric lines of growth, more pronounced along the base.

Height, 30 mm.; length, 58 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Lower Gorge of the Waipara, South Island. Oligocene?

Remark.—The beak is more posterior in the figure than in the specimen.

Lithophaga striata (Hutton). Plate V, fig. 4.

1873. *Lithodomus striatus* Hutton, Cat. Tert. Moll., p. 26.
1886. „ „ Hutton: Hector, Outline Geol. N.Z., p. 48, fig. 4.
1893. „ „ Hutton, Macleay Mem. Vol., Plioc. Moll, p. 87.

Shell rather large, elongato-oblong, distinctly angled medially, with distant fine radial lines, and much finer ones between them, on the posterior end. *Beaks* terminal, rounded, and somewhat inflated. *Anterior end* narrowly convex; *posterior* end compressed, the dorsal margin long and but faintly convex, posterior margin rather narrow, broadly rounded; *basal margin* long, very faintly concave. *Sculpture* consisting of fine concentric growth-lines, and fine radial lines on the posterior end of the valves.

Height, 20 mm.; length, 66 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Shakespeare Cliff. Pliocene.

Fam. Pectinidæ.

Pecten (s. str.) athleta Zittel.

1865. *Pecten athleta* Zittel, Voy. "Novara," Palæ., p. 49, pl. x, fig. 1.
1873. „ „ Zittel: Hutton, Cat. Tert. Moll., p. 32.
1887. „ „ Zittel: Hutton, P.L.S. N.S.W. (2), vol. i, p. 233.

The very large shell is suborbicular, slightly longer than high, equilateral, inequivalve. Each valve bears about 10 principal ribs, extending from the beak to the margin, with 1 to 2 secondary ribs in the broad interstices attaining only about two-thirds of the height of the valve. Ribs rounded, without ornamentation. The left valve is but little convex, the secondary ribs extend here higher up than on the other valve, which is distinctly convex, and whose beak does not reach beyond the hinge-margin. Ears large, equal. (Zittel.)

Height, 175 mm.; length, 185 mm.

Type in the K.K. Hofmuseum, Vienna.

Loc.—Motupipi, Massacre Bay, South Island. Oligocene ?

Remark.—I have not seen this species, and therefore offer here a translation of Zittel's diagnosis.

Pecten (Chlamys) chathamensis Hutton. Plate VI, fig. 6.

1873. *Pecten chathamensis* Hutton, Cat. Tert. Moll., p. 29.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 235.

Shell rather small, ovato-trigonal, higher than long, equivalve, subequilateral, regularly radiately ribbed. *Ears* unequal, the anterior no doubt larger, but broken off in the type specimen, which is a left valve; the posterior ears broadly triangular. *Anterior end* narrowly convex, the rapidly descending dorsal margin slightly excavated; *posterior end* convex, the dorsal margin straight; *basal margin* regularly convex. *Sculpture* consisting of 23 radiate scaly ribs, which are rounded and of equal breadth with the smooth grooves; the posterior ear with a few radiate riblets and distinct growth-periods.

Height, 33 mm.; length, 28 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Broken River, South Island. Miocene.

Remarks.—The Recent *P. dichrous* Suter is very near this species, as was pointed out by me (Proc. Mal. Soc. London, vol. viii, p. 264).

Pecten (Patinopecten) beethami Hutton. Plate VII, fig. 1.

1873. *Pecten beethami* Hutton, Cat. Tert. Moll., p. 31.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 234.
1897. „ „ Hutton: Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 319.

Shell large, inequivalve, equilateral, longer than high, radially ribbed, the ribs unequal on the two valves. *Beaks* median. *Ears* large, subequal. *Anterior* and *posterior ends* convex, the dorsal margins nearly straight; *basal margin* regularly convex. *Sculpture* of the right (more convex) valve: There are about 50 low radiating ribs, which in the middle are small and much narrower than the grooves, but get broader towards each end, and have a steep slope on the outer side, but on the inner gradually sloping; towards the margin they are crossed by undulating, imbricating, concentric striæ. Left (more flattened) valve, with about 100 fine, narrow, imbricate ribs, somewhat irregularly arranged, the interstices usually twice the thickness of the rib. The ears with fine transverse lines of growth, and three fine imbricate radial riblets on the lower half.

Height, 117 mm.; length, 140 mm.; diameter of right valve, 25 mm.; left valve, 15 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Upoko Ngaruru, east coast, Wellington. Miocene.

Pecten beethami var. B Hutton. Plate VIII, fig. 1, *a*, *b*.

1873. *Pecten beethami* var. B Hutton, Cat. Tert. Moll., p. 32.

The imbricating striæ taking the form of pointed scales on the ribs only; middle ribs larger. (Hutton.)

Type specimen seems to be lost.

Loc.—Oamaru; Caversham. Oligocene ?

Pecten (Patinopecten) hutchinsoni Hutton. Plate X, fig. 1.

1873. *Pecten hutchinsoni* Hutton, Cat. Tert. Moll., p. 31.
1887. ,, ,, Hutton, P.L.S. N.S.W. (2), vol. i, p. 234.

Shell large, suborbicular, inequivalve, equilateral, with imbricate narrow radial ribs, the interstices with a threadlike riblet. *Ears* subequal, large. *Margins* regularly convex, the dorsal margins almost straight. *Sculpture* of the more convex right valve: 35 to 40 radiating rounded ribs ornamented with pointed scales, about equal to the interstices; the latter with an elevated scaly line down the centre. Left valve flattened near the umbo, with from 70 to 80 fine scaly radiating narrow ribs, usually grooved towards the base, no intercostal riblets. Ears radiately ribbed, those of the left valve and the inner upper margin of the right anterior ear transversely striated.

Height, 115 mm.; length, 115 mm.; diameter of the right valve, 28 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Kaipuki Cliffs, South Island. Oligocene ?

Pecten (Patinopecten) sectus Hutton. Plate IX, fig. 1.

1873. *Pecten secta* Hutton, Cat. Tert. Moll., p. 30.
1886. ,, ,, Hutton: Hector, Outline Geol. N.Z., p. 51, figs. 9, 12.
1887. ,, *sectus* Hutton, P.L.S. N.S.W. (2), vol. i, p. 234.

Shell large, solid, suborbicular, slightly longer than high, equilateral, inequivalve, with broad, strongly raised dichotomous radial ribs. *Ears* subequal, divided from the shell by a deep sulcus; the anterior ear of the right valve with a byssal sinus. *Margins* convex, the posterior end a little more produced and its dorsal margin slightly longer than the anterior. *Sculpture* of right valve: There are 9 sharp, flat plications, which are simple at the umbo, but each divided into 4 or 5 ribs towards the margin; the first anterior rib, however, is narrow and simple; the second somewhat broader and dichotomous; the last posterior rib is narrow and not much raised, with a finer trichotomous rib in front and behind; depression between the plicæ with a single raised rib. Left valve with 8 plicæ, narrower than on the right valve, splitting into 2 to 4 rounded ribs; the interstices with 2 raised, sharply ridged ribs. The surface of both valves has exceedingly fine, regular, wavy concentric striæ, passing over the ribs on the left valve, but not on the right, where very fine radial striæ, crossed by incremental lines, ornament the plicæ. Ears with four distant radial riblets and fine growth-lines.

Height, 105 mm.; length, 115 mm.; diameter of right valve 18 mm., of left valve 17 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Callaghan's Creek, Stafford Town, South Island. Miocene.

Remark.—Hutton confounded the valves in his diagnosis.

Pecten (Patinopecten) accrementus Hutton. Plate IX, fig. 2.

1873. *Pecten accrementa* Hutton, Cat. Tert. Moll., p. 31.
1886. ,, ,, Hutton: Hector, Outline Geol. N.Z., p. 48, figs. 5, 6.
1897. ,, ,, Hutton: Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 320.

Shell fairly large, suborbicular, inequivalve, subequilateral. Posterior *ear* of left valve moderately large. *Margins* rounded. *Sculpture* of left valve: There are 17 principal radiate ribs, elevated, rounded, most of them dichotomous, but sometimes with a well-impressed sulcus only; the bifurcations of the ribs are occasionally adorned with a furrow on the lower half of the valve; the interstices with a small central rib extending nearly to the umbo; fine, regular, and close concentric striæ are present on the whole surface. Right valve not seen. Ear with a few fine radiating riblets and growth-lines.

Height, 94 mm.; length, 97 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Napier.

Remarks.—The type specimen before me is what I take to be a left valve of the species. Hutton states that the shell is inequivalve, but he does not say in what the difference consists. Harris had most likely some right valves before him, as he gives the number of radiating costæ as 23 to 25, whilst Hutton counted 30 to 33 ribs (in both cases the intercostal riblet counted as a rib). Harris further says that the costæ are broad, flat, rounded. It is not clear to me how they can be flat if they are rounded, but I suppose the former to be the case on the right valve.

Pecten (Patinopecten) delicatulus Hutton. Plate VI, fig. 4; Plate IX, fig. 4.

1873. *Pecten delicatula* Hutton, Cat. Tert. Moll., p. 30.

1873. „ *diffluxa* Hutton, *id.*, p. 31.

1887. „ *diffluxus* Hutton, P.L.S. N.S.W. (2), vol. i, p. 234.

Shell fairly large, suborbicular, subequilateral, radially ribbed, the sculpture different on the two valves. *Ears* subequal, the anterior of the right valve with a byssal notch and ctenolium. *Anterior* and *posterior ends* rounded, the dorsal margins slightly excavated; *basal margin* broadly convex. *Sculpture* of right valve: 25 radiating ribs; ribs broad, flat, simple near the umbo, but grooved near the margin, and occasionally dichotomous; covered with sharp scales; grooves round, narrower than the ribs, finely concentrically striated, without any central raised line. Left valve with about 27 narrow distant smooth ribs, the interstices with 2 to 5 thin raised scaly riblets. Ears with radiating scaly riblets.

Height, 50 mm.; length, 50 mm. (*P. delicatula*). Height, 76 mm.; length, 76 mm. (*P. diffluxa*).

Types in the collection of the New Zealand Geological Survey.

Loc.—Castle Point (*P. delicatula*); Weka Pass (*P. diffluxa*). Miocene.

Remarks.—The type specimens consist of a left valve of *P. delicatula* and a right valve of *P. diffluxa*. In 1887 Hutton classed the former as a synonym of the latter, as he no doubt had then seen a specimen with the unequally sculptured valves *in situ*.

Pecten (Pallium) burnetti Zittel. Plate IX, fig. 3; Plate XVI, fig. 1, *a*, *b*.

1865. *Pecten burnetti* Zittel Voy. "Novara," Palæ., p. 51, pl. x, fig. 2.

1873. „ „ Zittel: Hutton, Cat. Tert. Moll., p. 32.

1887. „ „ Zittel: Hutton, P.L.S. N.S.W. (2), vol. i, p. 236.

Shell of moderate size, suborbicular, subequilateral, inequivalve, the left valve less convex, with 6 to 7 plicæ, and numerous radiating ribs. *Ears* unequal, the anterior larger and on the right valve with a byssal sinus, the ctenolium absent. *Anterior end* with the dorsal margin short and straight; *posterior end* with a longer and slightly concave dorsal margin; *basal margin* convex. *Sculpture* of the right valve with 4 to 7 plicæ, which are less conspicuous towards the ends, each bearing from 2 to 4 radial rounded ribs, the deep interstices between the plicæ with 1 to 3 smaller ribs; left valve usually with more irregular plicæ and broader interstices, containing 1 or 2 smaller ribs. The whole surface with dense, fine concentric striæ. Anterior ears with

5 radial, slightly scaly radial riblets; posterior ears with 4 to 5 riblets, the two upper ones much stronger. *Margins* of the valves lirate inside, corresponding to the exterior ribs.

Height, 30 mm.; length, 30 mm. (type).

Type in the K.K. Hofmuseum, Vienna.

Loc.—Motupipi, Province of Nelson (type). Oligocene?

Remark.—The specimen used for this emended description, two perfect valves, is from Castle Point (Miocene), and is in the collection of the New Zealand Geological Survey.

Pecten (Pseudamusium) hochstetteri Zittel.

1865. *Pecten hochstetteri* Zittel, Voy. "Novara," Palæ., p. 50, pl. xi, fig. 5*b*.

Shell suborbicular, equilateral, thin, compressed. Right valve smooth, with fine concentric growth-lines; left valve nearly smooth, with 55 to 60 radial, hardly raised flat ribs. *Ears* subequal, obtuse, smooth or with fine incremental lines.

Height, 50 mm.; length, 52 mm.

Type in the K.K. Hofmuseum, Vienna.

Loc.—Whaingaroa and Aotea, Province of Auckland; Cape Farewell. Oligocene? Miocene.

Pecten (Pseudamusium) yahlensis Tenison-Woods. Plate VII, fig. 3.

1865. *Pecten yahlensis* Tenison-Woods, Trans. Phil. Soc. Adelaide, pl. i, fig. 4.
1873. „ *hectori* Hutton, Cat. Tert. Moll., p. 30.
1876. „ *yahlensis semilævis* McCoy, Prod. Palæ. Vict., dec. 4, p. 13, pl. xxxiv.
1886. „ „ Tenison-Woods: Tate, Trans. Roy. Soc. South Aust., vol. viii, p. 110.
1887. „ „ Tenison-Woods: Hutton, P.L.S. N.S.W. (2), vol. i, p. 235.
1896. „ „ Tenison-Woods: Pritchard, Proc. Roy. Soc. Vict. (n.s.), vol. viii, p. 127.
1897. *Pseudamussium yahlensis* Tenison-Woods: Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 322.

Shell suborbicular, thin, equilateral; valves unequal, and with dissimilar sculpture. *Right valve* deeper than the left, moderately convex, polished; surface radiated with numerous (60–70) subequal, nearly straight, narrow, flatly rounded ridges, separated by shallow concavities, rather less than the width of the ridges, crossed by distant concentric lines of growth; ears with the posterior one a little larger than the anterior; both slightly obtuse-angled, radially ridged, and marked with concentric lines of growth, which rise on the dorsal margin as projecting angular scales; anterior ear slightly sinuated for passage of byssus. *Left valve* nearly flat; surface radiated with nearly straight, narrow, rounded ridges, about one-third of their width apart, crossed by sharp, erect, crowded, concentric lamellæ. *Ears* about equal, slightly obtuse-angled, radially ridged, crossed by concentric lamellæ, which form a serrated fringe on the dorsal margin.

In the var. *sublævis* the right valve is quite smooth, whilst another variety has the rostral portion smooth and the marginal portion radiately ridged. (Tate.)

Height, 104 mm.; length, 116 mm. (*P. hectori*).

Type of *P. hectori* apparently lost.

Loc.—Chatham Islands; Brighton, &c. Oligocene?

Remark.—The figure is that of *P. hectori*, after the type.

Pecten (Camptonectes) huttoni (Park). Plate VII, fig. 2.

1865. *Pecten hochstetteri* Zittel, Voy. "Novara," Palæ., p. xi, fig. 5*a*.
1873. „ „ Zittel: Hutton, Cat. Tert. Moll., p. 30.
1886. „ „ Zittel: Tate, Trans. Roy. Soc. South Aust., vol. viii, p. 114.
1897. *Pecten hochstetteri* Zittel: Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 323; not of Zittel, except fig. 5*a*.
1905. *Pseudamussium (Pecten) huttoni* Park, Trans. N.Z. Inst., vol. xxxvii, 1904, p. 485.
1906. *Pseudamusium huttoni* Park: Boult, Trans. N.Z. Inst., vol. xxxviii, 1905, p. 432, pl. ix, fig. 1.

Shell moderately large, compressed, thin, equivalve, equilateral, smooth, suborbicular. *Ears* subequal, obtuse, smooth. *Anterior and posterior margins* regularly convex, the dorsal margins rather short and somewhat straightened. *Sculpture* on both valves consisting of a few concentric grooves near the margin.

Height, 73 mm.; length, 75 mm.

Plesiotype in the collection of the New Zealand Geological Survey.

Loc.—Maerewhenua. Miocene or Oligocene.

Found also in the older Tertiary of southern Australia.

Pecten (Amusium) zitteli Hutton. Plate VI, fig. 5, *a*, *b*.

1865. *Pecten* sp. Zittel, Voy. "Novara," Palæ., p. 53, pl. ix, figs. 1, 3.
1873. „ *zittelli* Hutton, Cat. Tert. Moll., p. 32.
1880. *Amussium atkinsoni* Johnston, Pap. Roy. Soc. Tasmania, p. 41.
1886. *Pecten zittelli* Hutton: Hector, Outline Geol. N.Z., p. 56, figs. 6, 19.
1886. „ *zitteli* Hutton: Tate, Trans. Roy. Soc. South Aust., vol. viii, p. 115, pl. vii, figs. 3, *a–c*.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 236.
1897. *Amussium zitteli* Hutton: Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 324.

Shell suborbicular, compressed, smooth, with 11 internal ribs, which do not reach to the margin of the valves, the two upper ones very short; *ears* equal, obtuse, smooth. (Hutton.)

Shell small, suborbicular, compressed, equilateral, equivalve. Interior of both valves concave, shining, with 9 or 11 ribs which terminate truncatedly near the margin. *Right valve* reticulatedly striated or ridged; *left valve* concentrically striated; *ears* unequal. The exterior ornament of the right valve varies very much in respect of the number and thickness of the radial and concentric threads; usually the radial threads are stouter than the raised concentric lines, but this form merges on the one hand into a fenestrated ornament, and on the other to one in which the radial ridges are very prominent and minutely scaly. Ears of right valve unequal, the posterior larger and triangular, cancellate; anterior triangular, with concentric scaly lamellæ. The left valve is invariably concentrically striated, the interior ribs showing as faint dark lines, but may present a smoothed surface from exfoliation of the external shell-layer. *Ears* very unequal, posterior the larger, aliiform, distantly arcuate-ridged, and faintly rayed; anterior triangular, concentrically striated. (Tate.)

Height, 22 mm.; length, 20 mm. (type).

Type in the collection of the New Zealand Geological Survey.

Loc.—Whangape Lake, Waikato. Oligocene?

Found also in the older Tertiary of southern Australia and Tasmania.

Fam. Limidæ.

Lima colorata Hutton. Plate X, fig. 5.

1873. *Lima colorata* Hutton, Cat. Tert. Moll., p. 33.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 233.
1897. „ „ Hutton: Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 309.

Shell moderately large, solid, inequilateral, radially costate, straight in front, rounded behind. Right valve: *Beak* acute, bent inwards. Posterior *ear* high and narrow, triangular; no anterior auricle. *Anterior end* straight, rapidly descending, curved off below towards the base; *posterior end* slightly produced, the rather short dorsal margin straight, oblique, the lower part of the posterior margin convex; *basal margin* rounded. *Submargin* much immersed, concave, long and rather broad. *Sculpture* consisting of 20 strong, rounded, radiating ribs, crossed by imbricating concentric striæ, which on the two ribs below the submargin are produced into sharp denticles; submargin with 3 radial costæ and rough, dense growth-lines; auricle with numerous vertical flat riblets. *Colour* yellowish-brown, with concentric rosy-brown markings; interor white. *Resilifer* triangular, large, visible from the outside.

Height, 62 mm.; length, 58 mm.; diameter, 17 mm. (× 2).

Type in the collection of the New Zealand Geological Survey.

Loc.—Awamoa, South Island. Miocene.

Lima huttoni nom. mut. Plate X, fig. 2.

1873. *Lima multiradiata* Hutton, Cat. Tert. Moll., p. 33; not of Gabb, 1868.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 233.

Shell rather large, ovato-triangular, valves flatly convex, with numerous rounded radial ribs, inequilateral, the anterior side shorter. *Beak* broken off. *Anterior end* with the dorsal margin straight, rapidly descending, forming an angle at the middle of the height with the convex lower part; *posterior end* broadly rounded, the dorsal margin short, straight, slowly descending; *basal margin* regularly convex; *submargin* long, narrow, with fine radial riblets. *Sculpture* consisting of about 30 radiating rounded ribs, crossed by rather distant scaly concentric lines; interstices of the same width as the ribs, deep and smooth.

Height, 43 mm.; length, 40 mm.; diameter, 10 mm. (× 2).

Type in the collection of the New Zealand Geological Survey.

Loc.—Curiosity Shop. Miocene.

Remarks.—The type specimen is a left valve, whose inside is filled with matrix. There are traces of a small anterior ear. The species is somewhat allied to *L. bassi* T.-Woods, but the latter is a shorter form with less ribs, occurring in the Eocene of Victoria.

Lima paucisulcata Hutton. Plate X, fig. 4.

1873. *Lima paucisulcata* Hutton, Cat. Tert. Moll., p. 33.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 233.

Shell moderately large, ovate, with strong radating ribs, inequilateral. Right valve: *Beak* broken off. *Ears* unequal, the anterior very small, the posterior larger. *Anterior end* shorter, with the dorsal margin straight and rapidly descending, forming an obtuse angle below the middle with the lower convex margin; *posterior end* obtusely angled above the middle, the dorsal margin straight and rapidly descending, the lower part broadly convex; the *basal margin* rather narrowly rounded; *submargin* immersed, large, lanceolate, with crowded longitudinal riblets. *Sculpture* consisting of 18 rounded, strong, radiating ribs, rapidly increasing in width, crossed at distant intervals by scaly concentric lines; the interstices rather deep, rounded, slightly narrower than the ribs; ears with transverse rounded riblets.

Height, minus apex, 56 mm.; length, 47 mm.; diameter, 11 mm. (× 2).

Type in the collection of the New Zealand Geological Survey.

Loc.—Kaipuki Cliffs, South Island. Oligocene ?

Lima paleata Hutton. Plate X, fig. 3.

1873. *Lima paleata* Hutton, Cat. Tert. Moll., p. 33.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 233.

Shell moderately large, inequilateral, oblique, with strong but narrow rounded radial ribs. Right valve: *Beak* and *ears* missing. *Anterior end* short, the dorsal margin straight, rather long, rapidly descending, connecting with the lower convex margin without angulation; *posterior end* broadly convex, the dorsal margin rather short, straight; *basal margin* regularly convex; *submargin* deep, long, lanceolate. *Sculpture* consisting of 25 strong, rounded, radiating ribs, crossed by rather distant scaly concentric lines; the deep and rounded interstices about half the width of the ribs.

Height, minus apex, 54 mm.; length, 48 mm.; diameter, 14 mm. (× 2).

Type in the collection of the New Zealand Geological Survey.

Loc.—Curiosity Shop, South Island. Miocene.

Fam. Ostreidæ.

Ostrea ingens Zittel. Plate XI, fig. 1, *a*, *b*.

1865. *Ostrea ingens* Zittel, Voy. "Novara," Palæ., p. 54, pl. xiii, fig. 3.
1873. " " Zittel: Hutton, Cat. Tert. Moll., p. 34.
1887. " " Zittel: Hutton, P.L.S. N.S.W. (2), vol. i, p. 237.

Shell very large, massive, elongated and rather narrow, the left valve irregularly convex, the right valve flattish, exterior gibbous, irregularly strongly foliated. *Beaks* rounded, directed backwards. *Anterior end* slightly convex; *posterior end* from slightly concave to convex; *basal margin* rounded. *Area* bounded on both sides by a sulcus, transversely striated. *Sculpture* about the same on both valves, irregularly and strongly foliated. The *margins* are smooth on the inside. *Resilifer* triangular, transversely striated. *Adductor-scar* very large, reniform, below the middle, near the posterior end.

Height, 220 mm.; breadth, 110 mm. (type).

Type in the K.K. Hofmuseum, Vienna.

Loc.—Wanganui River (type). Miocene.

Remarks.—The specimen figured is from Napier. Nearly allied forms from the Pan-patagonian Formation are *O. hatcheri* Ortmann and *O. faira* Ihering.

Ostrea (Eostrea) subdentata Hutton. Plate XVII, fig. 9, *a*, *b*.

1873. *Ostrea subdentata* Hutton, Cat. Tert. Moll., p. 34.

Shell small, solid, ovate, compressed, concentrically striated, attached by a small part of the left valve, margins of the valves crenate within. *Beak* small, pointed, turned slightly backwards. *Anterior end* lightly convex; *posterior end* straight; *basal margin* convex. *Sculpture* of left valve concentrically striated. *Resilifer* small, triangular, transversely striated. Left valve very distinctly transversely crenate near the hinge. *Adductor-scar* high up, above the middle of the valve, oval, and posterior to the median line.

Height, 26 mm.; length, 21 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Broken River, South Island. Miocene.

Remarks.—The type specimen consists of a left valve only, and is no doubt a young shell.

In my collection there is a perfect specimen of an *Ostrea* from Wanganui, which in the chief characters agrees with *O. subdentata*, but it is larger, 45 mm. by 40 mm., rounded oval, and the left valve has distinct, interrupted, rounded radial ribs; it also is not so solid as the type, but I have no hesitation in assigning it to the above species. This means an addition to the Pliocene fauna. The species is distinct from *O. corrugata* Hutton, *O. reniformis* Sow., and *O. glomerata* Gould, all Recent species belonging to the subgenus *Eostrea* von Ihering, characterized by the crenate inner margins near the hinge.

Gryphæa tarda Hutton. Plate XIII, fig. 1, *a*, *b*.

1873. *Gryphæa tarda* Hutton, Cat. Tert. Moll., p. 35.
1886. „ „ Hutton: Tate, Trans. Roy. Soc. South Aust., vol. viii, p. 98, pl. vi, fig. 2.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 482.
1897. „ „ Hutton: Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 302.

Shell rather thin, oblong or irregularly rotund. *Inferior (left) valve* tumid, very convex, smooth, with broadish folds of growth; free or sessile by a small umbonal area; *anterior ventral margin* produced into a conspicuous lobe; *umbo* subacute, incurved and bent forward; *ligamental area* broad, moderately excavated medially; *muscular impression* oblong, situated towards the margin on the produced side. *Superior (right) valve* flat with an elevated margin, ornamented with imbricating lamellæ. (Tate.)

Height, 59 mm.; length, 44 mm. (type; left valve).

Type in the collection of the New Zealand Geological Survey.

Loc.—Chatham Islands. Miocene.

Remarks.—I reproduce Tate's good diagnosis, as Hutton states that Australian specimens agree with those from New Zealand. Ihering states that the species corresponds but is not identical with *Gryphæa burckhardti* Boehm, from the Tertiary of Patagonia.

Fam. Astartidæ.

Astarte australis Hutton. Plate XIII, fig. 5; Plate XVII, fig. 2.

1873. *Astarte australis* Hutton, Cat. Tert. Moll., p. 25.

Shell large, solid, inequilateral, ovato-trigonal, with distant concentric ribs. Left valve: *Beak* at about the posterior third, flatly convex, slightly prosogyrate. *Anterior end* produced and flattened, an indistinct angulation descending from the umbo, the dorsal, oblique margin long, concave; *posterior end* shorter, convex, the dorsal margin descending, straight. *Lunule* large, immersed, elongate, lanceolate, obliquely striated. *Escutcheon* deep, rather narrow and long. *Sculpture* consisting of distant, concentric, flatly rounded ribs, the interstices with fine growth-lines. *Hinge-plate* large, strong, triangular. The posterior *cardinal* tooth obsolete; the middle cardinal long and narrow, slightly oblique; of the anterior cardinal only traces are left. Anterior *lateral* convex, small, produced by the extension of the valve-margin. *Ligament* small external.

The valve of the type specimen is unfortunately imperfect, but the approximate dimensions I estimate at—height, 36 mm.; length, 48 mm.; diameter, 13 mm. (× 2).

Type in the collection of the New Zealand Geological Survey.

Loc.—Kakahu, South Island. Miocene.

Remarks.—Hutton seems to have taken this valve to be the right; the hinge is much damaged, but there can be no doubt that it is the left valve of an *Astarte*.

Fam. Crassatellitidæ.

Crassatellites amplus (Zittel). Plate XIII, fig. 3.

1865. *Crassatella ampla* Zittel, Voy. "Novara," Palæ., p. 46, pl. xiv, fig. 3, *a*, *b*.
1873. „ „ Zittel: Hutton, Cat. Tert. Moll., p. 24.
1886. „ „ Zittel: Hector, Outline Geol. N.Z., p. 51, figs. 8, 9.
1887. „ „ Zittel: Hutton, P.L.S. N.S.W. (2), vol. i, p. 228.

Shell large, elongated triangular, convex, very thick, inequilateral to subequilateral, irregularly concentrically striated and grooved. *Beaks* usually in front of the middle, convex, incurved, approximate. *Anterior end* shorter and rounded, the dorsal margin faintly excavated; *posterior end* slightly attenuated, the dorsal margin nearly straight, slowly descending, posterior margin narrowly convex; the *basal margin* regularly broadly rounded. *Lunule* and *escutcheon* subequal. *Sculpture* consisting of distant, somewhat irregularly spaced nodulous concentric striæ. *Hinge-plate* large, high, excavated below. *Right valve* with a curved anterior lateral, an attenuated strong anterior, and a thin median cardinal tooth. The *resilifer* large, deep, triangular. One oblique posterior cardinal tooth. *Left valve* with 2 cardinal teeth. *Adductor-scars* round, the posterior larger. *Pallial line* simple.

Height, 80 mm.; length, 95 mm. (type).

Type in the K.K. Hofmuseum, Vienna.

Loc.—Cape Rodney, Auckland Province (type). Miocene.

Remarks.—Zittel thinks that the Australian *C. castaneus* Reeve is nearest allied to this species, but the triangular form of the fossil shell and differences in the hinge seem to separate the two.

Crassatellites attentuatus (Hutton). Plate XII, fig. 1, *a*, *b*.

1873. *Crassatella attenuata* Hutton, Cat. Tert. Moll., p. 24.
1886. ,, ,, Hutton: Hector, Outline Geol. N.Z., p. 54, figs. 6, 15.
1887. ,, ,, Hutton, P.L.S. N.S.W. (2), vol. i, p. 229.

Shell large, solid, elongately subtrigonal, irregularly concentrically ridged. *Beaks* at about the anterior third, incurved, approximate. *Anterior end* shorter, broadly convex, the dorsal margin straight. *Posterior end* produced and tapering, the dorsal margin straight, descending, slightly excavated in front of the umbo. *Basal margin* broadly convex. *Lunule* and *escutcheon* subequal, deep, lanceolate. *Sculpture* formed by irregular, rounded, and low concentric ribs, the interspaces of about the same width. *Hinge* of right valve with 3 cardinals, the anterior high and strong, tapering above; the second small, curved, at the base of the resilifer; the third narrow, elongated, oblique, partly effaced by the resilium. The anterior edge of the hinge-margin is grooved to receive the edge of the opposite valve, which is bevelled to serve as a lateral tooth. *Adductor-scars* unequal.

Height, 116 mm.; length, 153 mm.; diameter, 40 mm. (× 2).

Type in the collection of the New Zealand Geological Survey.

Loc.—Broken River, South Island. Miocene.

Remarks.—The type specimen is a right valve, which is filled up with matrix, and does not show the hinge-plate. The drawing of the latter by Buchanan, which is here reproduced, must have been made from another specimen. Hector also figures the hinge.

Crassatellites obesus (A. Adams). Plate XIII, fig. 4.

1854. *Crassatella obesa* A. Adams, Proc. Zool. Soc., 1852, p. 90, pl. xvi, fig. 2.
1873. ,, *trailli* Hutton, Cat. Tert. Moll., p. 24.
1887. ,, *obesa* A. Adams: Hutton, P.L.S. N.S.W. (2), vol. i, p. 228.
1897. *Crassatellites trailli* Hutton: Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 366.
1906. *Mactropsis trailli* Hutton, Trans. N.Z. Inst., vol. xxxviii, 1905, p. 65.
1913. *Crassatellites obesus* A. Adams: Suter, Man. N.Z. Moll., p. 899, pl. 52, fig. 9.

Shell ovato-trigonal, solid, inequilateral, with close, rounded, concentric riblets. *Beaks* at about the anterior third, pointed, slightly incurved, and directed forward. *Anterior end* short, narrowly rounded, the dorsal margin straight and rapidly descending; *posterior end* attenuated, flattened, and truncated, a distinct angulation extending from the umbo to the lower angle, dorsal margin long and straight, slower descending than the anterior dorsal margin; *basal margin* broadly convex, straightened behind. *Lunule* sunken, lanceolate. *Escutcheon* long and narrow, concave. *Sculpture* consisting of numerous close, rounded, concentric riblets, which pass into fine striæ on the posterior flattened portion. Margins of the valves smooth. Right valve: *Hinge-plate* strong and high, the *resilifer* dorsal, triangular, below the beak; in front of it a prominent bifid *cardinal*, with a shorter posterior arm; anterior *lateral* tooth long and low, transversely finely striated; posterior lateral almost obsolete. *Ligamental pit* small, dorsal, behind the resilifer. *Pallial line* simple.

Height, 33 mm.; length, 45 mm.

Type of C. trailli in the collection of the New Zealand Geological Survey.

Loc.—Awamoa. Miocene.

Remark.—I have examined the specimen assigned by Hutton to *Mactropsis;* there is a roundish spot where a pallial sinus might be, but the pallial line is not interrupted. The above diagnosis was drawn up from the type specimen of *C. trailli.*

Fam. MACTRIDÆ.

Mactra attenuata Hutton. Plate XIII, fig. 2.

1873. *Mactra attenuata* Hutton, Cat. Tert. Moll., p. 18.
1887. *Paphia attenuata* Hutton, P.L.S. N.S.W. (2), vol. i, p. 225.

Shell moderately large, nearly equilateral, oblong, attenuated in front, concentrically striated. *Beaks* median, slightly directed forwards, approximate. *Anterior end* much attenuated, narrowly rounded, the dorsal margin slowly descending, faintly concave; *posterior end* somewhat more broadly rounded, indistinctly roundly angled dorsally, the dorsal margin very little convex; *basal margin* broadly rounded. *Sculpture* consisting of irregular fine and coarser concentric striæ. Hinge in the valve before me imperfect, but I think it agrees more with *Mactra* than with *Mesodesma.* *Adductor-scars* and *pallial line* very indistinct.

Height, 51 mm.; length, 76 mm.; diameter, right valve, 18 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Broken River. Miocene.

Remarks.—There is only a right valve, which Hutton evidently took for the left.

Mactra chrydæa Suter.

1873. *Corbula dubia* Hutton, Cat. Tert. Moll., p. 18.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 224.
1911. *Mactra chrydœa* Suter, Trans. N.Z. Inst., vol. xliii, 1910, p. 596.

Type of *C. dubia* Hutton in the collection of the New Zealand Geological Survey; of *M. chrydœa* Suter, in my collection.

Loc.—Hutton's type: New River, Grey district, South Island. Miocene.

Remarks.—I was greatly astonished when, on examining Hutton's type of *Corbula dubia*, I found it to correspond exactly with *Mactra chrydœa.* Following the recommendation of the International Rules for Zoological Nomenclature, I give preference to my name, as the diagnosis was accompanied by figures, whilst Hutton's species has never been figured.

The species has hitherto been recorded from the Pliocene and Miocene.

Mactra (Mactrotoma) ovata Gray var. rudis Hutton. Plate XIII, fig. 6.

1873. *Mactra rudis* Hutton, Cat. Tert. Moll., p. 19.
1893. *Standella rudis*, Hutton, Macleay Mem. Vol., Plioc. Moll., p. 77, pl. viii, fig. 83.

This variety is only a very short, suborbicular form of *M. ovata* Gray. The beaks are much nearer the middle of the valves; the *anterior end* is not attenuated and produced, but regularly convex, of about the same length as in the species; the *posterior* *end* is much shorter, truncated, and almost straight above the middle; the *basal margin* convex. The *sculpture* is more irregular, and the concentric ridges stronger. The *hinge* is the same, and so is the *pallial sinus*.

Height, 61 mm.; length, 64 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Wanganui. Pliocene.

Remarks.—The figure 83*b* in Macleay Mem. Vol. shows a short, subtriangular pallial sinus, which is not correct, as it is deep, tongue-shaped, subtruncated at the end. Recent, this form is mostly found together with the species, and there is almost no difference in the sculpture.

Fam. VENERIDÆ.

Dosinia (Austrodosinia) subrosea (Gray).

1835. *Arthemis subrosea* Gray in Yate's N.Z., p. 309.
1873. *Cyclina dispar* Hutton, Cat. Tert. Moll., p. 22.
1887. *Dosinia subrosea* Gray: Hutton, P.L.S. N.S.W. (2), vol. i, p. 227.

The type of Hutton's *Cyclina dispar*, a right valve embedded in the matrix, very well agrees with Gray's species; Hutton himself made his species a synonym of *D. subrosea* in 1887. In the diagnosis of *C. dispar* he writes, "Lunule large, lanceolate, not impressed nor margined." This is not correct, as in the type specimen the lunule is broken off, and Hutton mistook the anterior area surrounding the lunule for the latter.

The specimen is a young shell of 19 mm. height.

Type of *C. dispar* Hutt. in the collection of the New Zealand Geological Survey.

Loc.—Hautapu Falls, Upper Rangitikei. Miocene.

Dosinia (Austrodosinia) magna Hutton. Plate XIV, fig. 7.

1873. *Dosinia magna* Hutton, Cat. Tert. Moll., p. 22.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 226.

Shell large, solid, suborbicular, irregularly concentrically ridged, somewhat inflated, inequilateral. *Beaks* prominent, acute, bent forwards, approximate, slightly in front of the middle. *Anterior end* broken off, excavated in front of the beak. *Posterior end* regularly curved from the apex to the basal margin, which is also missing. *Lunule* very distinct, immersed, cordate, finely striated. *Escutcheon* long, broad and deep, with prominent keel. *Sculpture* consisting of irregular concentric ridges of very unequal strength, smooth or very likely finely striated towards the umbo; radiate strong riblets are present in some of the concentric grooves. *Hinge-plate* very strong and broad; left valve with 3 cardinals, the anterior subvertical, long and narrow; the second very stout, triangular, oblique; the third subparallel to the latter, long, narrow. The anterior lateral tooth is strong, tubercular, corrugated. *Inside* filled up with matrix.

Height, 87 mm.; length, 80 mm.; diameter of left valve, 26 mm.

Type in the collection of the New Zealand Geological Survey. One left valve only.

Loc.—Broken River, South Island. Miocene.

Remarks.—This species resembles somewhat *Dosinia anus* Phil., but it is much larger, more inflated, not regularly concentrically ribbed, the escutcheon is much broader, and the lunule considerably larger.

Cytherea enysi Hutton. Plate XIV, fig. 2.

1873. *Cytherea enysi* Hutton, Cat. Tert. Moll., p. 21.
1886. „ „ Hutton: Hector, Outline Geol. N.Z., p. 51, figs. 9, 10.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 226.

Shell large, solid, trigonal, inequilateral, concentrically ribbed. *Beaks* at about the anterior fourth of length, approximate and incurved, pointed forwards, inflated. *Anterior* *end* rounded, concave above; *posterior end* faintly truncated, and subangled, the dorsal margin slightly arched; *basal margin* broadly convex. *Lunule* very distinct, large, elongately cordate, longitudinally striated. *Escutcheon* well marked, slightly keeled, unequally divided, larger in the left valve. *Sculpture* consisting of concentric ribs, somewhat irregular towards the base, with narrow interstices; there are indications of distinct fine radial riblets, visible on the surface near the escutcheon, where the sculpture is fairly well preserved. *Interior* unknown, the valves of the type specimen being closed.

Height, 95 mm.; length, 110 mm.; diameter, 56 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Lower Waipara Gorge, Broken River. Miocene.

Remarks.—The locality where the type specimen was found is not known, but it is most likely from Waipara. The measurement given by Hutton is — height, 4·2 in.; length, 4·5 in.: whereas the specimen considered to be the type measures 3·75 in. by 4·35 in. The species was no doubt quite correctly placed in the genus *Cytherea* Bolten; it is not a *Meretrix*.

Chione acuminata Hutton. Plate XIV, fig. 3.

1873. *Chione accuminata* Hutton, Cat. Tert. Moll., p. 21.

Shell small, ovate, valves moderately convex, inequilateral, concentrically and radially finely striated. *Beak* situate at the anterior third, pointed, incurved and slightly directed forwards. *Anterior end* narrowly convex, the dorsal margin excavated in front of the beak; *posterior end* somewhat attenuated and subtruncated, the dorsal margin very lighty convex; *basal margin* broadly rounded. *Lunule* cordate, marked by an incised line. *Escutcheon* ill defined, almost smooth. *Sculpture* consisting of fine concentric lines, with a few stronger-marked periods of rest, crossed by fine radial riblets, of which traces are visible on the type specimen, which consists of a right valve only. *Hinge* with 3 cardinals. *Margin* of valve crenulate inside.

Height, 20 mm.; length, 24 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Pomahaka, Otago. Miocene.

Remarks.—In outline the species is very near *C. stutchburyi* Gray, but the fine, regular, radial riblets separate it from that species.

Chione meridionalis (Sowerby). Plate xiv, fig. 4.

1846. *Venus meridionalis* Sowerby, Darwin's Geol. Obs. on S. America, p. 250, pl. ii, fig. 13.
1873. *Chione vellicata* Hutton, Cat. Tert. Moll., p. 21.
1887. *Venus meridionalis* Sowerby: Philippi, Tert. und Quat. Verst. Chiles, p. 120, pl. xiv, fig. 8.
1887. „ „ Sowerby: Hutton, P.L.S. N.S.W. (2), vol. i, p. 225.
1897. „ „ Sowerby: Ihering, Revista Mus. Paul., vol. ii, p. 251.

Shell of medium size, ovate, convex, both ends rounded, inequilateral, with concentric lines and fine radiating striæ. Left valve: *Beak* at about the anterior third. *Anterior end* narrowly convex, the dorsal margin concave; *posterior end* also rounded, but the dorsal margin longer, more rapidly descending, and slightly arched; *basal margin* broadly convex. *Lunule* broadly lanceolate, well marked by an incised line, a little convex, radiately striated. *Sculpture* consisting of distant and somewhat irregular, elevated, and sharp concentric lines, much more crowded towards the ventral margin; fine, dense radiating striæ are covering the whole surface. *Margin* of shell finely crenulated.

Height, 32 mm.; length, 36 mm.; diameter, 15 mm. (× 2).

Type in the British Museum; of *C. vellicata* Hutton, in the collection of the New Zealand Geological Survey.

Loc.—Awamoa, South Island. Miocene.

Remarks.—After examining Hutton's *C. vellicata*, and comparing it with the diagnosis and figures of *Venus meridionalis* Sowerby, I came to the same conclusion as Hutton—that the two species are identical. This view is supported by the fact, ascertained by me some time back, that *Chione chiloensis* Philippi occurs in the Miocene of Castle Point.

Paphia (Ruditapes) curta (Hutton). Plate XIV, fig. 6.

1873. *Tapes curta* Hutton, Cat. Tert. Moll., p. 22.
1886. „ „ Hutton: Hector, Outline Geol. N.Z., p. 54, figs. 2, 15.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 227.

Shell rather large, solid, ovato-trigonal, inequilateral, concentrically ribbed. *Beaks* at the anterior third, convex and sharply pointed, incurved and directed forwards, approximate. *Anterior end* convex, dorsal margin concave; *posterior end* slightly attenuated, narrowly convex, the dorsal margin slowly descending, lightly convex; *basal margin* broadly rounded. *Lunule* elongato-lanceolate, somewhat impressed, not margined. *Escutcheon* slightly impressed, but ill defined. *Sculpture* consisting of rather irregular, close concentric ribs, narrow and sharp anteriorly, much broader on the posterior half of the valve, but it appears that in a perfect condition each of these broad ribs carries 3 to 4 smaller ribs on its surface. In a few places radial striæ are visible on the posterior end. Of the *hinge*, only the posterior and middle cardinals (left valve) are visible; the former is entire above but bears a sulcus on its lower end, and the median tooth is deeply bifid. Inner *margins* smooth.

Height, 59 mm.; length, 73 mm.; diameter, 24 mm. (× 2).

Type in the collection of the New Zealand Geological Survey.

Loc.—Broken River. Miocene.

Remarks.—The type specimen consists of a left valve, the interior of which is filled with the matrix. The dimensions given by Hutton are, as in several other instances, not quite correct.

Fam. Cardiidæ.

Cardium spatiosum Hutton. Plate XV, fig. 1, *a*, *b*.

1873. *Cardium spatiosum* Hutton, Cat. Tert. Moll., p. 23.
1886. „ „ Hutton: Hector, Outline Geol. N.Z., p. 54, figs. 4, 15.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 227.
1897. „ „ Hutton: Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, 367.

Shell large, subtrigonal, flattened behind, with strong radiating ribs. *Beaks* situated at about the anterior third, incurved, convex, slightly directed forwards. *Anterior end* convex, the dorsal margin short; *posterior end* produced and subangled below, almost straight above and forming an obtuse angle with the short, straight, dorsal margin; *basal margin* convex in front, straight behind. *Sculpture* consisting of about 38 radiating rounded ribs, slightly narrower upon the flattened posterior part, ornamented with strong recurved scales at the anterior and marginal portion of the median areas; and crossed near the margin with concentric, undulating, recurved, imbricating laminæ, which get scaly at the posterior end; interstices slightly narrower than the ribs, deep, with a few fine radial lines. *Margins* inside serrated. *Hinge* with 2 cardinals, the lower one oval, high, the upper one low, horizontal and elongated, a deep pit in front of the former; there are 2 anterior laterals, the lower tooth short, high, pointed, triangular, with a deep socket above; the second lateral appears as a transverse low lamina on the dorsal margin; posterior lateral distant, low, broadly triangular, rather stout; nymphæ broad and strong.

Height, 98 mm.; length, 106 mm.

Type (right valve) in the collection of the New Zealand Geological Survey.

Loc.—Waitotara, North Island. Miocene.

Protocardia sera Hutton. Plate XIV, fig. 8.

1873. *Protocardium serum* Hutton, Cat. Tert. Moll., p. 23.

1886. „ „ Hutton: Hector, Outline Geol. N.Z., p. 54, figs. 13, 15.

1887. *Cardium* (*Protocardium*) *serum* Hutton, P.L.S. N.S.W. (2), vol. i, p. 228.

1897. *Protocardium serum* Hutton: Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 369.

Shell ovato-trigonal, higher than long, subequilateral, ventricose, posterior slope radiately ribbed, the remainder concentrically ridged. Right valve: *Beak* incurved, convex, slightly angled posteriorly, and very little inclined forwards. *Anterior end* broadly convex throughout; *posterior end* a little higher, the dorsal margin lightly straightened, broadly rounded; *basal margin* rather narrowly convex. *Sculpture:* Posterior end with fine but strongly marked radiating riblets, which are flatly rounded, the interstices near the margin of about the same width as the riblets and ornamented with fine, close, concentric lines; the remainder of the surface smooth to near the middle, but with well-pronounced and somewhat irregular concentric ridges. *Hinge* with a stout upturned anterior cardinal below the beak, the posterior cardinal inconspicuous; the distant anterior lateral tooth rather long, stout, triangularly raised, the posterior lateral nearer the cardinals, stout and oblong. *Margin* of valve serrate.

Height, 61 mm.; length, 53 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Broken River, South Island. Miocene.

Remarks.—The dimensions given by Hutton, if taken from the valve before me, are not correct—2·7 in. by 2·4 in., instead of 2·4 in. by 2·1 in. In the figure the radial costæ are too numerous.

Fam. Lutrariidæ.

Lutraria solida Hutton. Plate XV, fig. 2.

1873. *Lutraria solida* Hutton, Cat. Tert. Moll., p. 19.

1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 224.

1893. „ „ Hutton, Macleay Mem. Vol., Plioc. Moll., p. 78, pl. ix, fig. 84, *a*, *b*.

Shell large, elongate-oval, moderately solid, inequilateral, gaping posteriorly, concentrically grooved. *Beaks* at about the anterior third, adjacent, very little elevated, and slightly incurved. *Anterior end* shorter, rather narrowly convex, the dorsal margin lightly rounded; *posterior end* broadly convex, the dorsal margin long and nearly straight; *ventral margin* broadly convex. *Dorsal areas* ill defined. *Sculpture* consisting of somewhat irregular concentric grooves, deeper impressed towards the base. *Margins* smooth inside. *Hinge-plate* strong, rather narrow; chondrophore large, oblique, not separated by a lamina from the short ligament. *Left cardinal* compressed, prominent; laterals obsolete: *right cardinal* with two arms which are not coalescent above, the anterior arm stronger; laterals obsolete. *Anterior adductor-scar* large, vertically elongate; *posterior adductor-scar* transversely ovate, straight in front. *Pallial line* distinct, distant from the margin, the *sinus* large, tongue-shaped, reaching to the middle of the longitudinal axis.

Height, 63 mm.; length, 114 mm.

Type seems to be lost.

Loc.—Lower Gorge of the Waipara, South Island. Miocene.

Remarks.—The figure was drawn after the type. The diagnosis has been emended after a specimen from Shakespeare Cliff in my collection.

Fam. Teredinidæ.

Teredo heaphyi Zittel.

1865. *Teredo heaphyi* Zittel, Voy. "Novara," Palæ., p. 45, pl. xiv, fig. 4.

Valves and pallets unknown. The tubes are found in great numbers together; they are round, more or less convolute and constricted, the anterior end closed by a calotte. Posterior side not much narrowed, aperture circular.

Type in the K.K. Hofmuseum, Vienna.

Loc.—Rodney Point, North Island. Miocene.

Specimens from Kaipuki Cliffs, South Island (Oligocene ?), are amongst the collection of Hutton's type specimens of 1873.

Teredo directa (Hutton).

1877 *Cladopoda directa* Hutton, Trans. N.Z. Inst., vol. ix, 1876, p. 597, pl. xvi, fig. 13.

Smooth, polished, not much curved; section, circular.

Diameter, 8 mm. (Hutton).

Before me is a tablet, without label, from the collection of Hutton's types in the collection of the New Zealand Geological Survey, on which is fastened a piece of wood with a number of *Teredo* tubes. They are round, smooth, almost straight, the aperture of 6 mm. diameter. They appear to be distinct from *T. heaphyi*, and agree much more with Hutton's species.

On the same tablet are two free tubes of quite a different texture, and I consider these to be *Annelid* tubes.

Type in the Otago Museum.

Loc. ?

Fam. Thraciidæ.

Thracia neozelanica nom. mut. Plate XIV, fig. 1.

1873. *Thracia granulosa* Hutton, Cat. Tert. Moll., p. 19; not of Adams and Reeve, 1850.
1893. ,, *vitrea* Hutton, Macleay Mem. Vol., Plioc. Moll., p. 75; not of Hutton.

Shell moderately large, elongate-oval, subequilateral, ventricose, rounded at both ends, minutely granular. *Beaks* slightly turned backwards, approximate, entire. *Anterior end* narrowly convex, the dorsal margin broadly rounded and slowly descending, an angular ridge running down from the umbo towards the lower end; *posterior end* similar to the anterior, but the dorsal margin a little more convex, a short angular ridge arising from the umbo; *basal margin* broadly rounded. *Sculpture* consisting of well-marked concentric growth-lines; umbo very finely radially striated, the remainder of the surface with fine granules, much larger than in *T. vitrea*, interrupted by radially arranged narrow smooth spaces. *Hinge* without teeth, with a rather strong elongated nymph in the left valve. *Adductor-scars* unequal, large, the posterior rounded, the anterior elongate. *Pallial sinus* very short, broad, and triangular.

Height, 28 mm.; length, 44 mm.; diameter, 11 mm. (× 2).

Type in the collection of the New Zealand Geological Survey.

Loc.—Wanganui. Pliocene.

Remarks.—This species, apparently rare, is quite distinct from *T. vitrea* Hutton. If Captain Hutton had been able to compare the latter with his type of *T. granulosa* he most certainly would have noticed the difference at once. He was a very rapid worker, and he no doubt overlooked the differences expressed in his diagnoses—viz., that the one is always distinctly truncated posteriorly, and the other rounded. I have never seen this species before. The type is a well-preserved left valve.

Fam. CUSPIDARIIDÆ.

Cuspidaria kirki (Hutton). Plate XIV, fig. 5.

1873. *Neæra kirki* Hutton, Cat. Tert. Moll., p. 18.
1886. „ „ Hutton: Hector, Outline Geol. N.Z., p. 56, figs. 10, 19.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 224.

Shell small, suborbicular, with a rather long and straight posterior rostrum, smooth. Right valve: *Beak* inconspicuous. *Anterior end* convex up to near the umbo; *posterior end* produced above into a long, straight, semicylindrical rostrum, the margin below and the *basal margin* regularly convex. *Sculpture* very likely consists of fine concentric growth-lines only.

The valve being embedded in the matrix, nothing of the inside can be examined.

Length, 16 mm.; height, 10 mm. Rostrum: Length, 4 mm.; diameter, 1·1 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Whangape Lake, Waikato. Oligocene?

EXPLANATION OF PLATES.

PLATE I.

Fig. 1. *Rissoina vana* (Hutton). Holotype. Awamoa.
Fig. 2. *Cerithium hectori* Harris. Holotype. Broken River.
Fig. 3. *Bezanconia (Ataxocerithium) huttoni* (Cossmann). Holotype.
Fig. 4. *Turritella ambulacrum* Sowerby. Plesiotype. Awatere.
Fig. 5. *Turritella (Colpospira) cavershamensis* Harris. Holotype. Oamaru.
Fig. 6. *Turritella bicincta* Hutton. Holotype. Kanieri.
Fig. 7. *Struthiolaria cincta* Hutton. Holotype. Awatere.
Fig. 8. *Struthiolaria calcar* Hutton. Holotype. Oamaru.
Fig. 9. *Struthiolaria cingulata* Zittel. Plesiotype. Awatere.
Fig. 10. *Struthiolaria cingulata monilifera* (Zittel) Suter. Holotype of subspecies. Awatere.
Fig. 11. *Struthiolaria spinosa* Hector. Holotype. Waikari.
Fig. 12. *Struthiolaria tuberculata* Hutton. Holotype. Broken River.
Fig. 13, *a*, *b*. *Capulus australis* (Lamarck). Plesiotype. Holotype of *Pilæopsis unciniata* Hutton. Wanganui.
Fig. 14. *Hipponix radiatus* (Hutton). Holotype. Awatere.
Fig. 15, *a*, *b*. *Crepidula gregaria* Sowerby. Plesiotype. Awatere.

PLATE II.

Fig. 1. *Galeodea sulcata* (Hutton). Holotype. Kanieri.
Fig. 2. *Ampullina miocænica* Suter. Holotype. Awamoa.
Fig. 3. *Lapparia corrugata* (Hutton) var. B. Holotype of subspecies. Waikari.
Fig. 4. *Lapparia corrugata* (Hutton). *a*. Holotype. Maunga-pakeha Taipo. *b*. Plesiotype. Goldsborough.
Fig. 5. *Murex crawfordi* (Hutton). Holotype. Te Awaite.
Fig. 6. *Cominella inflata* (Hutton). *a*. Plesiotype. Mount Horrible. *b*. Plesiotype. Porter River.
Fig. 7. *Ancilla hebera* (Hutton). Holotype. Awamoa.
Fig. 8. *Cylichnella enysi* (Hutton). Holotype. Broken River.
Fig. 9. *Siphonalia plicatilis* (Hutton). Holotype. Pomahaka.
Fig. 10. *Surcula huttoni* Suter. Holotype. Awamoa.
Fig. 11. *Drillia awamoaensis* (Hutton). Holotype. Awamoa.
Fig. 12. *Turris (Leucosyrinx) altus* (Harris). Holotype. Awamoa.
Fig. 13. *Drillia wanganuiensis* (Hutton). Holotype. Shakespeare Cliff.
Fig. 14. *Conus (Conospira) ornatus* Hutton. Holotype. Awamoa.
Fig. 15, *a*, *b*. *Hemiconus trailli* (Hutton). Holotype. Awamoa.

PLATE III.

Fig. 1. *Dentalium solidum* Hutton. *a*. Holotype. Waikari. *b*. Plesiotype. Type of *D. giganteum* Hutton, non Sowerby. Waitaki.
Fig. 2. *Dentalium mantelli* Zittel. (*a*.) Plesiotype. Awamoa. (*b*.) Plesiotype. Holotype of *D. tenuis* Hutton. Whangape Lake, Waikato. (*c*.) Plesiotype. Holotype of *D. irregularis* Hutton. Kanieri.
Fig. 3. *Dentalium solidum* Hutton. Plesiotype. Holotype of *D. conicum* Hutton
Fig. 4. *Dentalium pareorensis* Pilsbry and Sharp. Holotype. Kanieri.
Fig. 5, *a*, *b*. *Cucullæa ponderosa* Hutton, var. B. Holotype of var. B. Waikari.

PLATE IV.

Fig. 1, *a*, *b*, *c*. *Glycymeris globosa* (Hutton). Holotype. Kanieri.
Fig. 2, *a*, *b*. *Glycymeris traversi* (Hutton). Holotype. Chatham Islands.
Fig. 3, *a*, *b*. *Limopsis aurita* (Brocchi). Plesiotype. Awamoa.
Fig. 4. *Limopsis zitteli* Ihering. Plesiotype. Kanieri.
Fig. 5. *Trigonia subundulata* Jenkins. Plesiotype. Awamoa.

Plate V.

Fig. 1, *a*, *b*. *Cucullœa alta* Sowerby. Plesiotype. East coast, Wellington.
Fig. 2, *a*, *b*. *Cucullœa alta* Sowerby, var. B Hutton. Holotype of var. B. Callaghan's Hill.
Fig. 3. *Modiolus huttoni* Suter. Holotype. Lower Gorge of the Waipaia.
Fig. 4. *Lithophaga striata* (Hutton). Holotype. Shakespeare Cliff.

Plate VI.

Fig. 1, *a*, *b*. *Cucullœa worthingtoni* Hutton. Holotype. Waitaki.
Fig. 2. *Placunanomia incisura* Hutton. Holotype. Rangitata.
Fig. 3. *Anomia huttoni* Suter. Heautotype. Napier.
Fig. 4. *Pecten (Patinopecten) delicatulus* Hutton. Plesiotype. Holotype of *P. diffluxa* Hutton. Weka Pass.
Fig. 5, *a*, *b*. *Pecten (Amusium) zitteli* Hutton. Holotype. Whangape Lake.
Fig. 6. *Pecten (Chlamys) chathamensis* Hutton. Holotype. Broken River.

Plate VII.

Fig. 1. *Pecten (Patinopecten) beethami* Hutton. Holotype. Upoko Ngaruru.
Fig. 2. *Pecten (Camptonectes) huttoni* (Park). Plesiotype. Maerewhenua.
Fig. 3. *Pceten (Pseudamusium) yahlensis* T.-Woods. Plesiotype. Holotype of *P. hectori* Hutton. Locality uncertain.

Plate VIII.

Fig. 1, *a*, *b*. *Pecten (Patinopecten) beethami* Hutton, var. B. Plesiotype. Maerewhenua.

Plate IX.

Fig. 1. *Pecten (Patinopecten) sectus* Hutton. Right valve. Holotype. Callaghan's Creek.
Fig. 2. *Pecten (Patinopecten) accrementus* Hutton. Holotype. Napier.
Fig. 3. *Pecten (Pallium) burnetti* Zittel. Plesiotype. Castle Point.
Fig. 4. *Pecten (Patinopecten)* delicatulus Hutton. Left valve. Holotype. Castle Point.

Plate X.

Fig. 1. *Pecten (Patinopecten) hutchinsoni* Hutton. Right valve. Holotype. Kaipuki Cliffs.
Fig. 2. *Lima huttoni* Suter. Holotype. Curiosity Shop.
Fig. 3. *Lima paleata* Hutton. Holotype Curiosity Shop.
Fig. 4. *Lima paucisulcata* Hutton. Holotype. Kaipuki Cliffs.
Fig. 5. *Lima colorata* Hutton. Holotype. Awamoa.

Plate XI.

Fig. 1, *a*, *b*. *Ostrea ingens* Zittel. Plesiotype. Nelson.

Plate XII.

Fig. 1, *a*, *b*. *Crassatellites attenuatus* (Hutton). Holotype. Broken River.

Plate XIII.

Fig. 1, *a*, *b*. *Gryphœa tarda* Hutton. Holotype. Chatham Islands.
Fig. 2. *Mactra attenuata* Hutton. Holotype. Broken River.
Fig. 3. *Crassatellites amplus* (Zittel). Plesiotype.
Fig. 4. *Crassatellites obesus* (A. Ad.). Plesiotype. Holotype of *C. trailli* Hutton. Awamoa.
Fig. 5. *Astarte australis* Hutton. Holotype. Kakahu.
Fig. 6. *Mactra (Mactrotoma) ovata rudis* Hutton. Holotype of subspecies. Wanganui.

Plate XIV

Fig. 1. *Thracia neozelanica* Suter. Holotype. Wanganui.
Fig. 2. *Cytherea enysi* Hutton. Holotype. Locality uncertain.
Fig. 3. *Chione acuminata* Hutton. Holotype. Pomahaka.
Fig. 4. *Chione meridionalis* (Sowerby). Plesiotype. Holotype of *C. vellicata* Hutton. Awamoa.
Fig. 5. *Cuspidaria kirki* (Hutton). Holotype. Whangape Lake.
Fig. 6. *Paphia (Ruditapes) curta* (Hutton). Holotype. Broken River.
Fig. 7. *Dosinia (Austrodosinia) magna* Hutton. Holotype. Broken River.
Fig. 8. *Protocardia sera* Hutton. Holotype. Broken River.

Plate XV.

Fig. 1, *a, b*. *Cardium spatiosum* Hutton. Holotype. Waitotara.
Fig. 2. *Lutraria solida* Hutton. Holotype. Lower Gorge of the Waipara.

Plate XVI.

Fig. 1. *a, b*. *Pecten (Pallium) burnetti* Zittel. Plesiotype. Castle Point.
Fig. 2. *Siphonalia turrita* Suter. Holotype. Kanieri.
Fig. 3. *a, b*. *Volutospina (Athleta) huttoni* Suter. Holotype. Broken River.
Fig. 4. *Bathytoma sulcata* (Hutton). Holotype. Broken River.
Fig. 5. *Turritella (Colpospira) patagonica* Sow. Plesiotype. Holotype of *T. tricincta* var. B Hutton. Kanieri.
Fig. 6. *Siphonalia subnodosa* (Hutton). Plesiotype. Holotype of *Fusus nodosus* Quoy var. C Hutton. Shakespeare Cliff.

Plate XVII.

Fig. 1. *a, b*. *Polinices (Mamma) ovatus* Hutton. Holotype. Shakespeare Cliff.
Fig. 2. *Astarte australis* Hutton. Holotype. Kakahu.
Fig. 3. *Rissoina vana* (Hutton). Holotype. Awanoa. (Magnified two diameters.)
Fig. 4. *Batillaria pomahakensis* Harris. Plesiotype. Pomahaka. (After Harris.)
Fig. 5. *Murex crawfordi* (Hutton). Holotype. Te Awaite.
Fig. 6. *a, b*. *Siphonalia subnodosa* (Hutton). Plesiotype. White Rock River.
Fig. 7. *Conus (Conospira) ornatus* Hutton. Plesiotype. Oamaru. (Magnified three diameters.)
Fig. 8. *a, b*. *Struthiolaria canaliculata* Zittel. Holotype. Awatere. (After Zittel.)
Fig. 9, *a, b*. *Ostrea (Eostrea) subdentata*. Hutton. Holotype. Broken River.

INDEXES.

INDEX TO GENERA AND SPECIES.

(The synonyms are in italics.)

D.

E.

F.

G.

H.

I.

K.

L.

M.

S.

T.

U.

V.

INDEX TO LOCALITIES.

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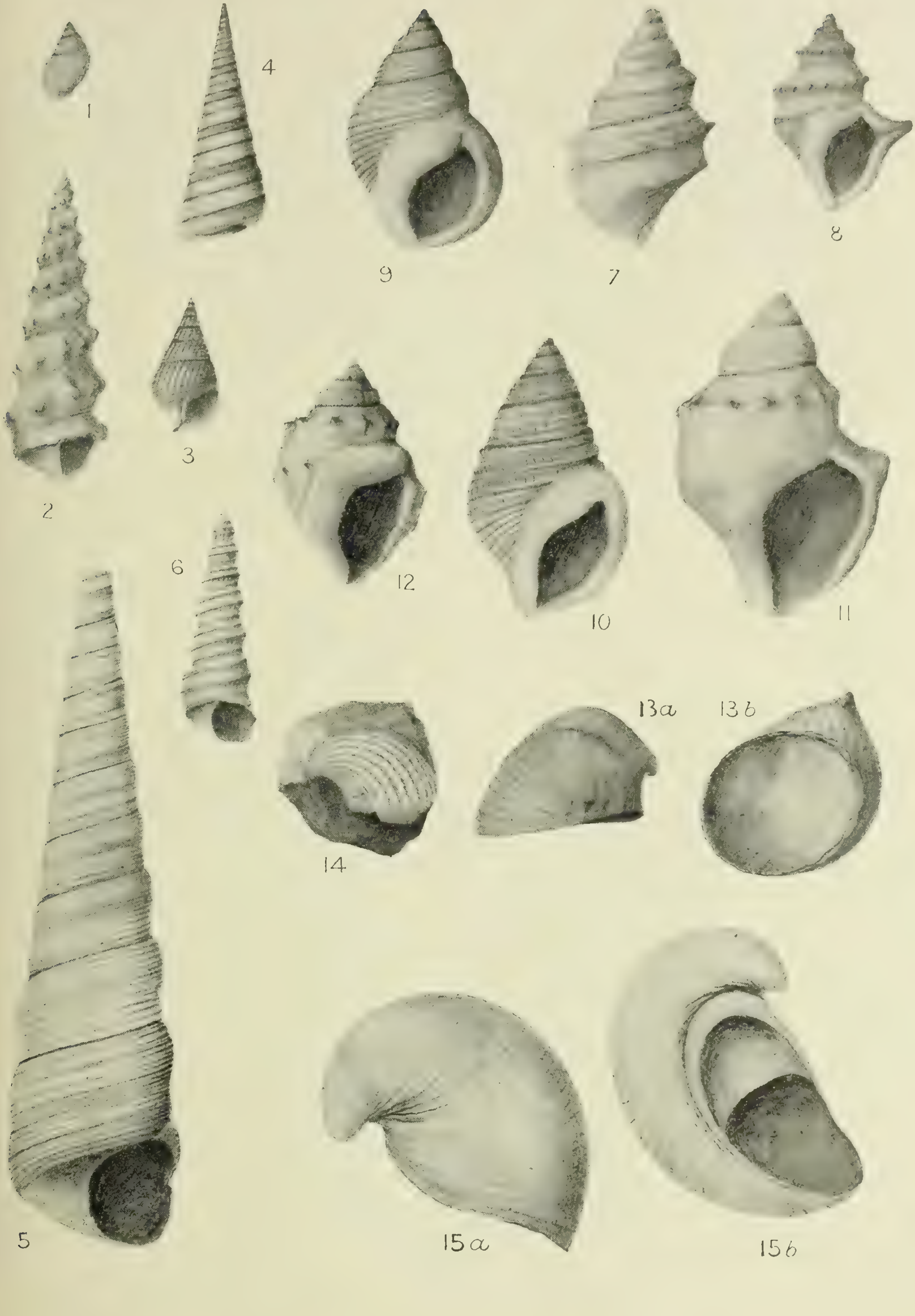
PLATE I.



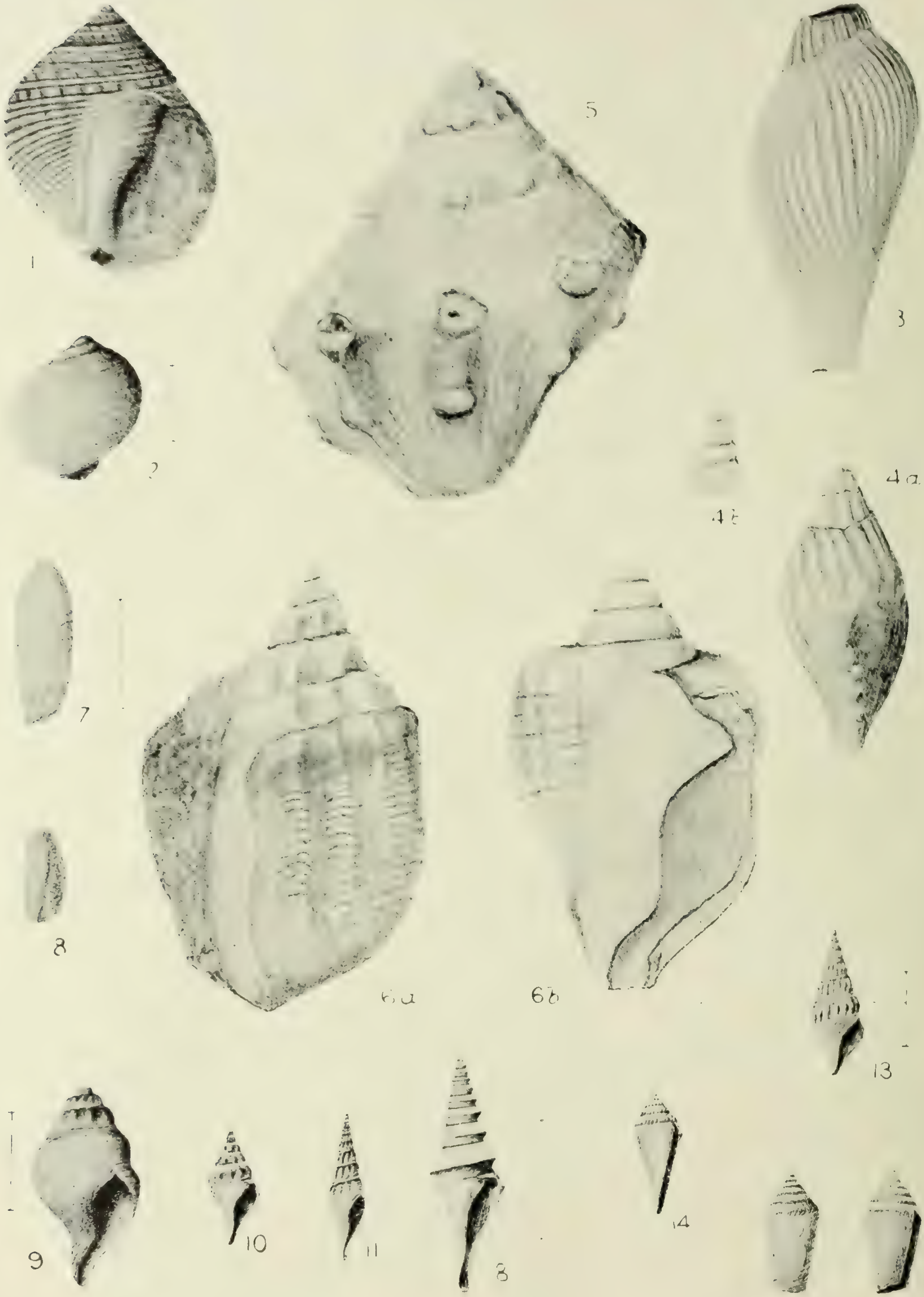

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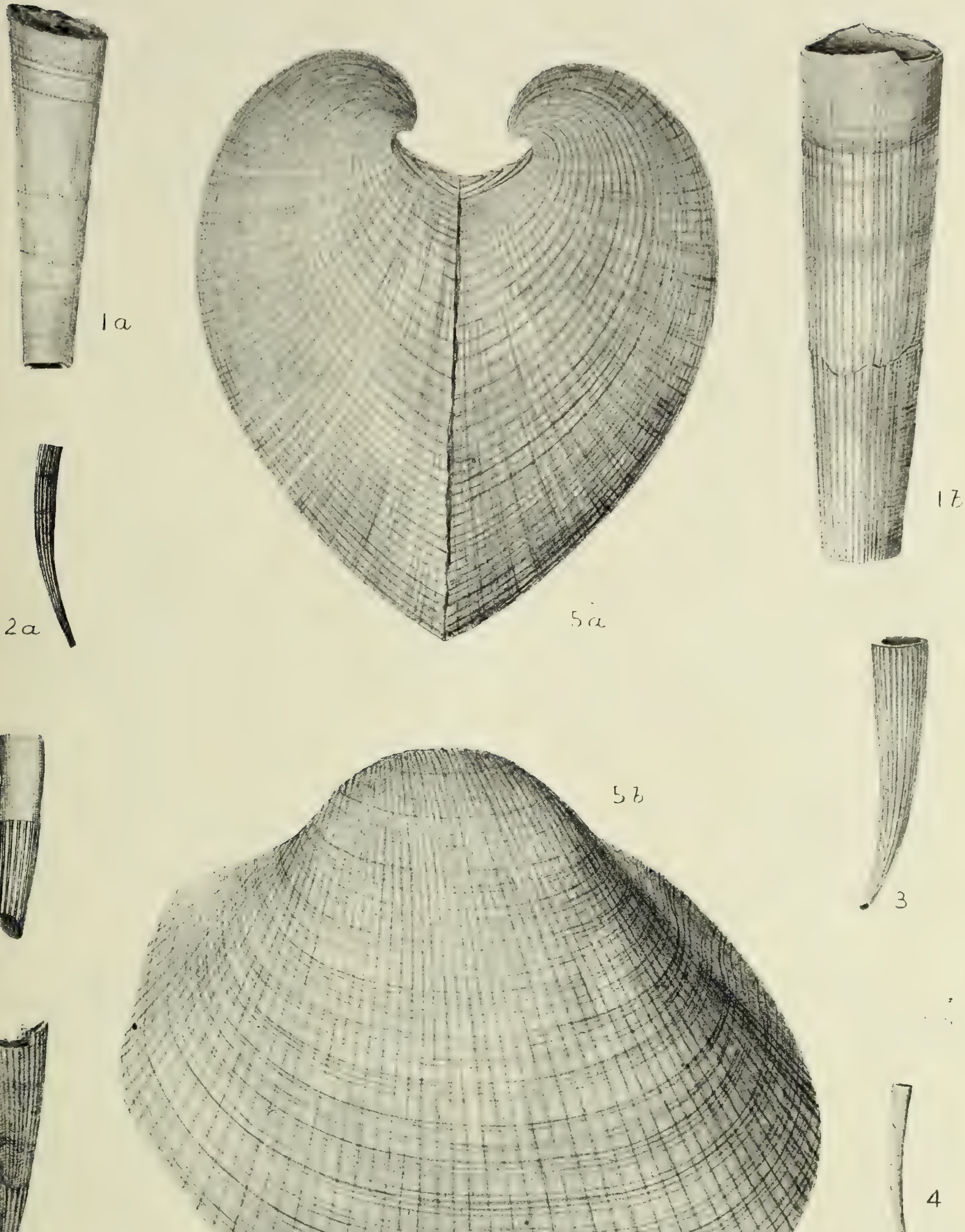
PLATE III.

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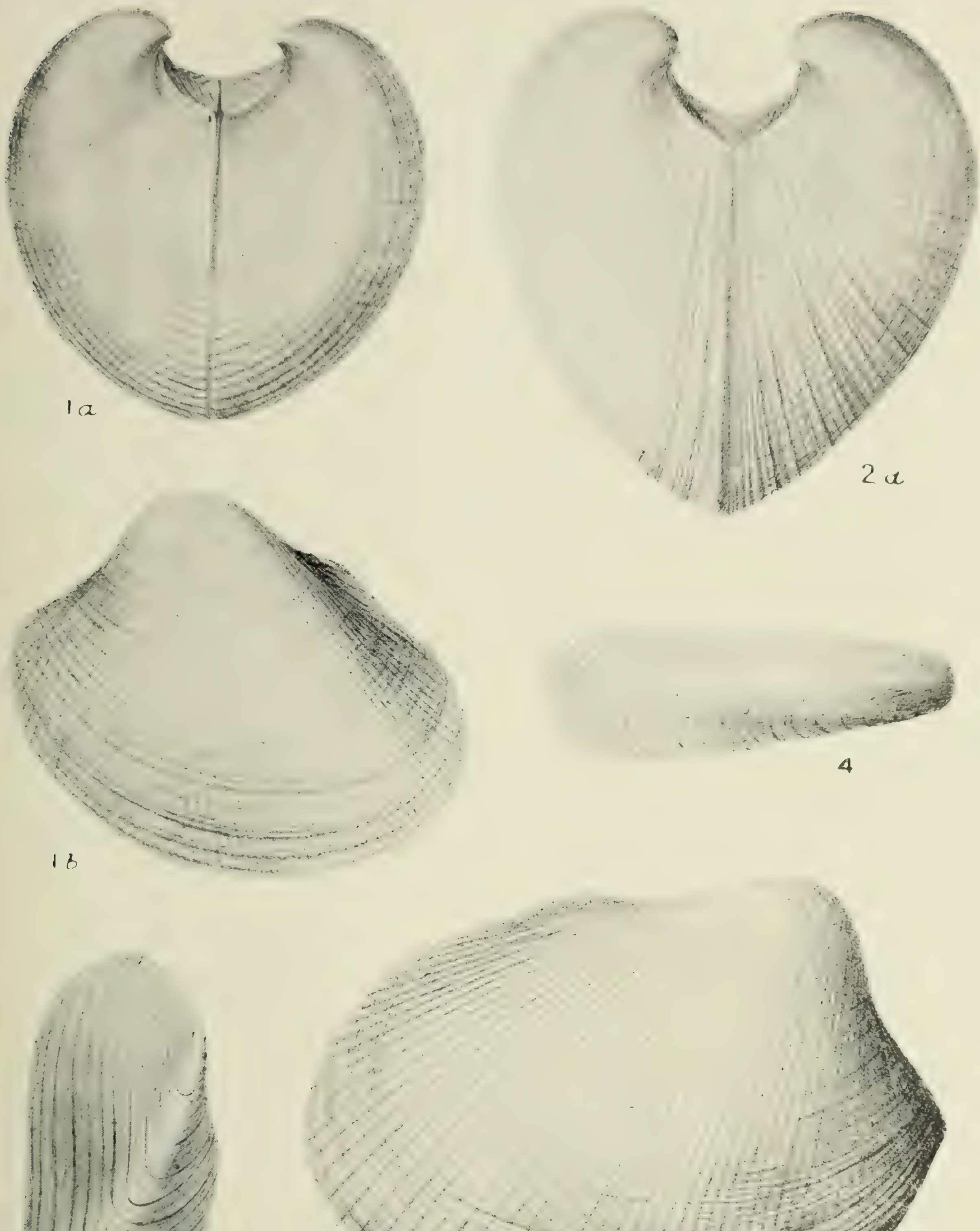

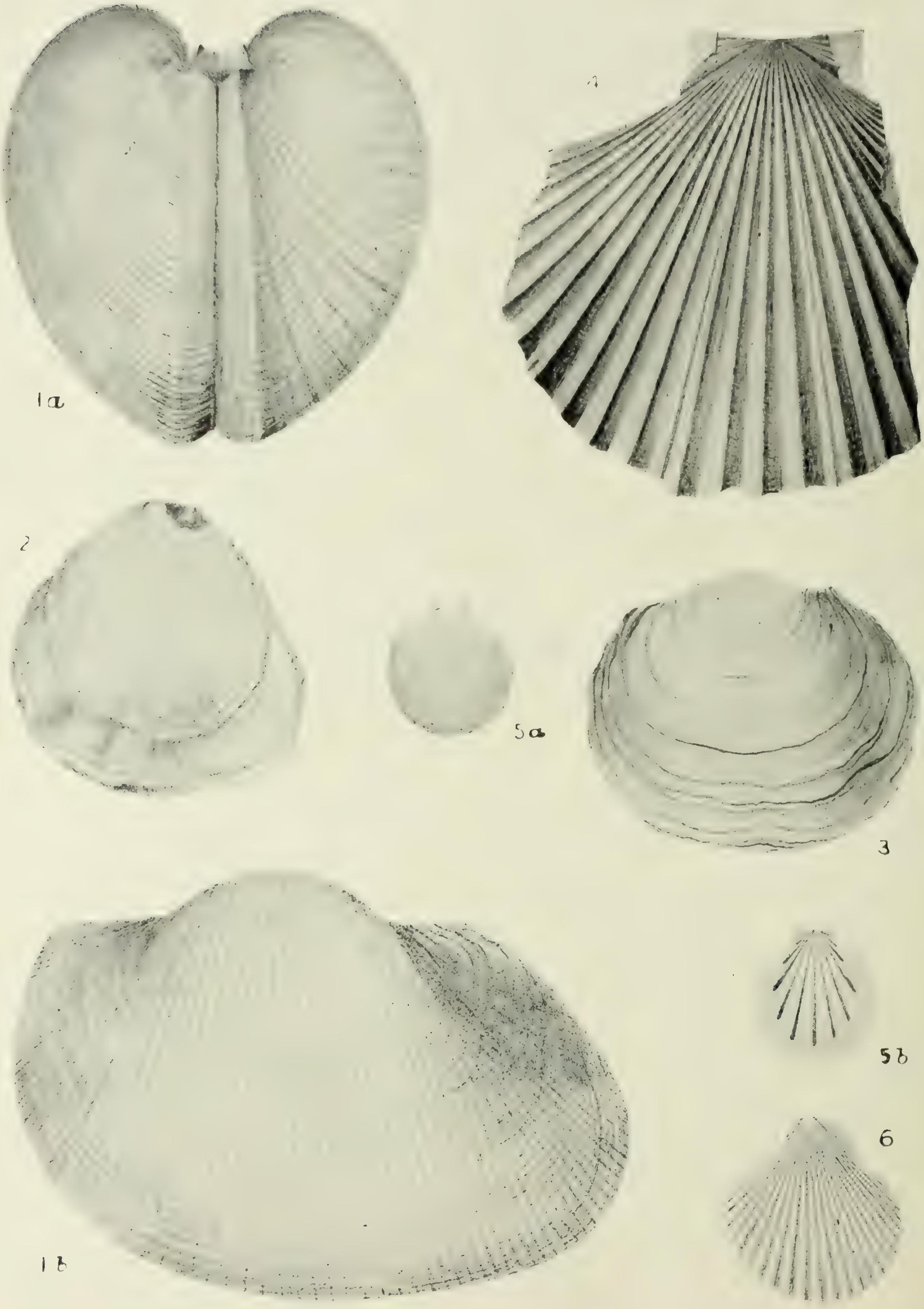
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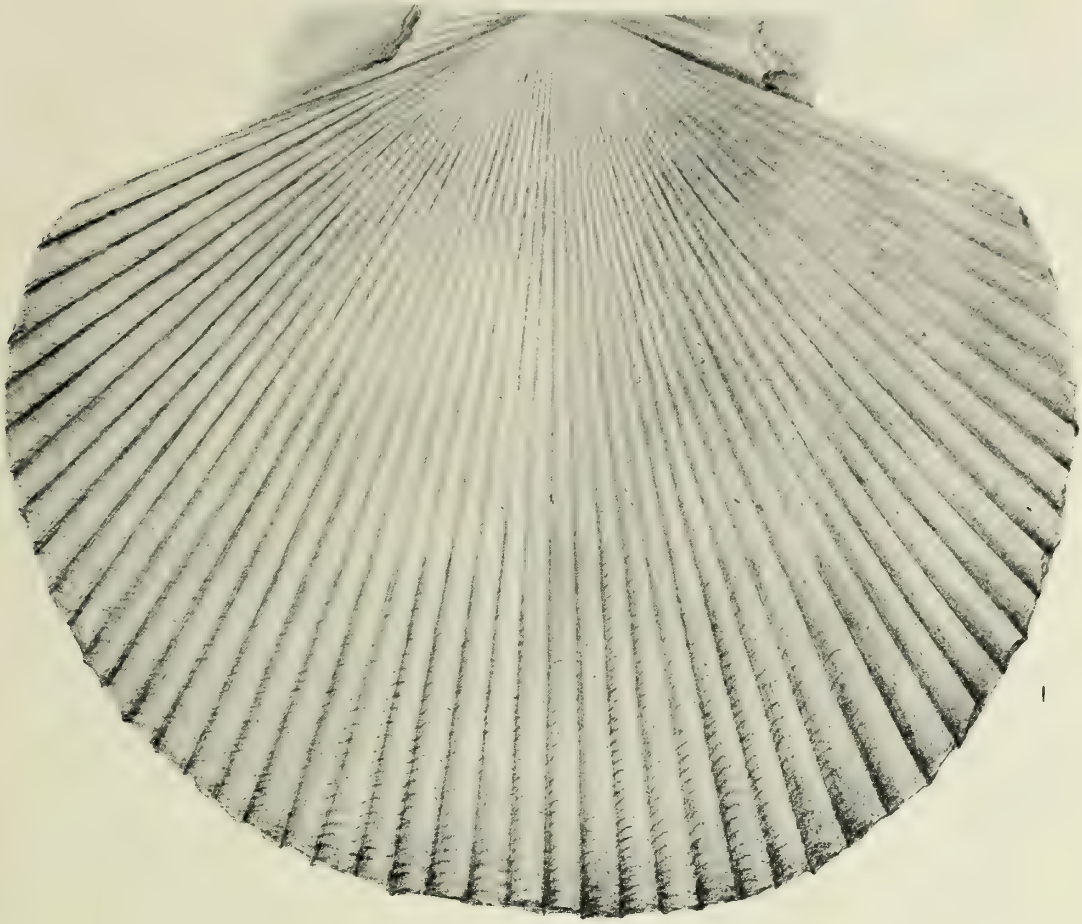

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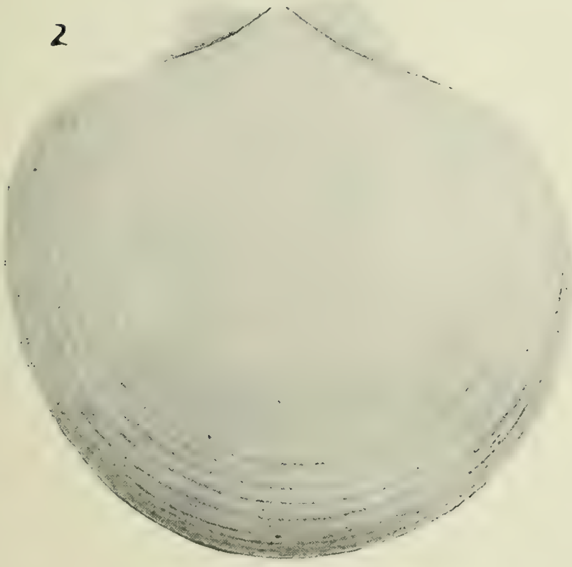

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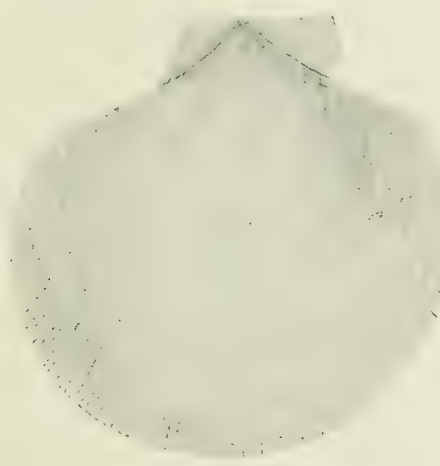

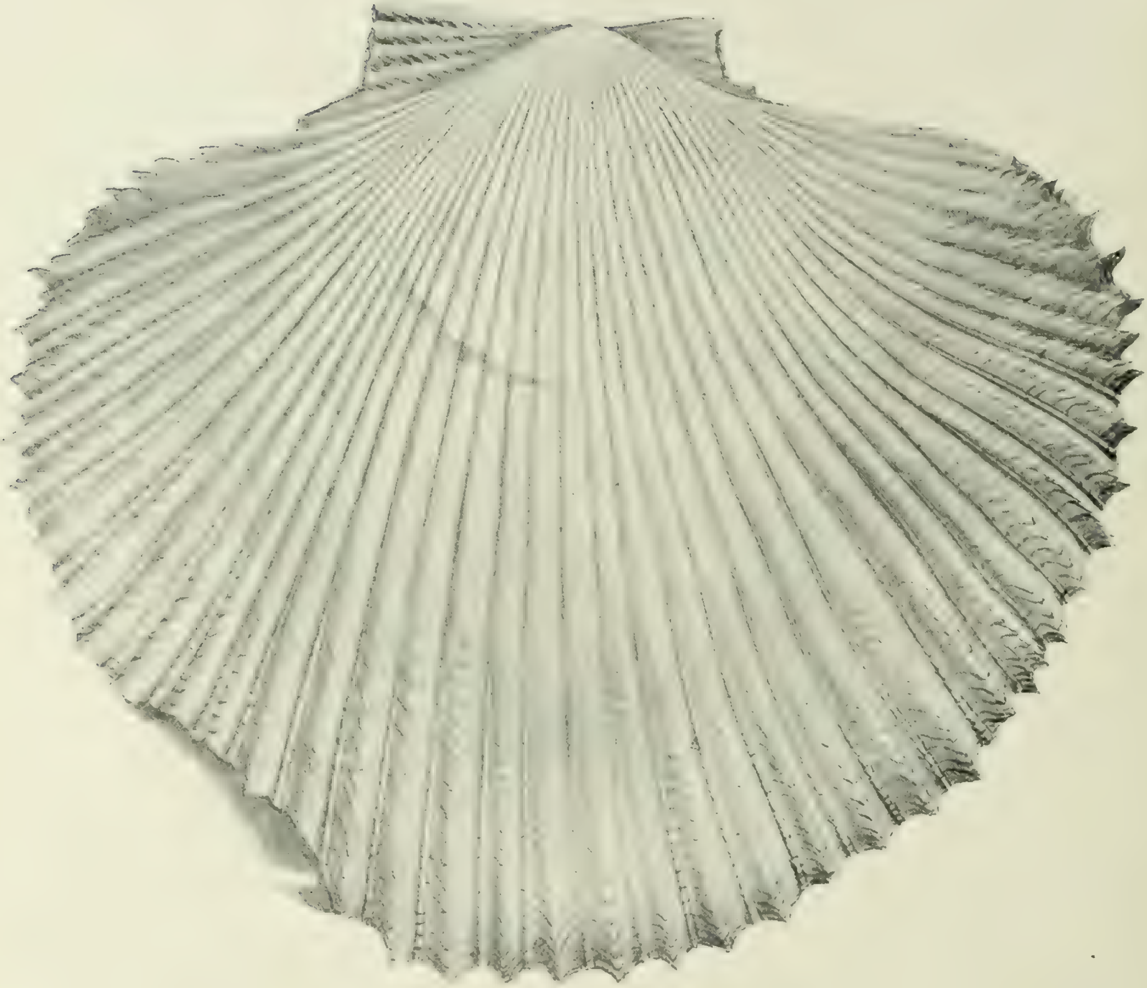

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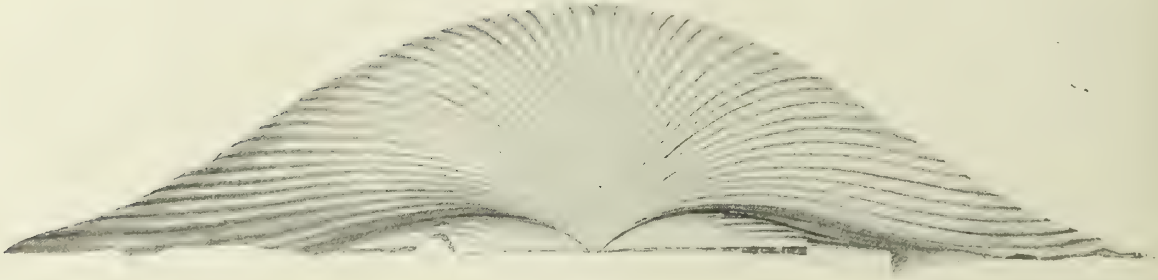

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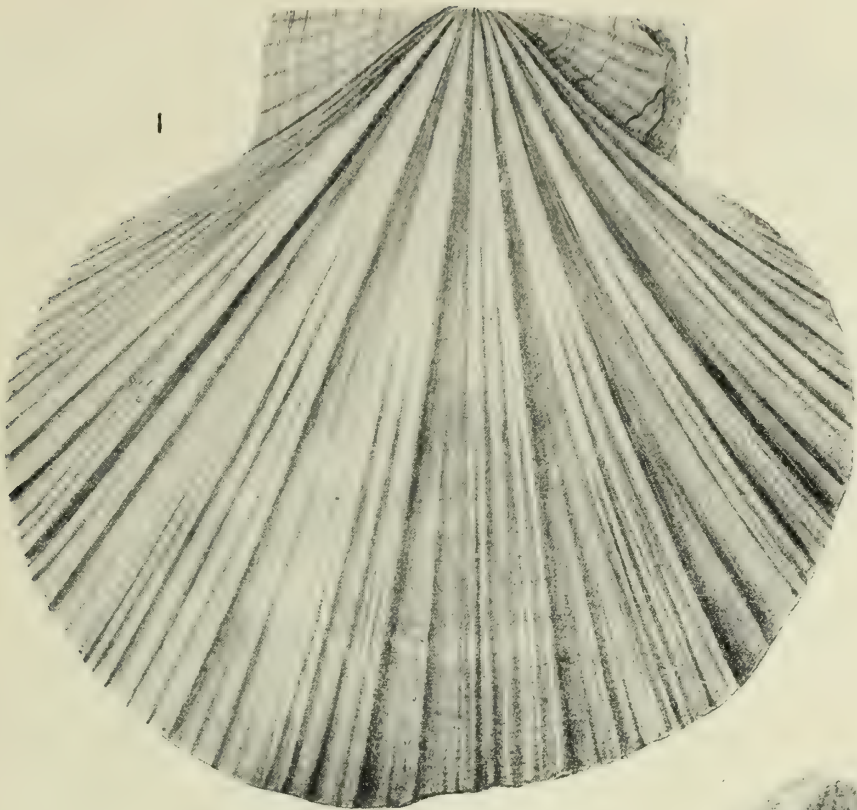

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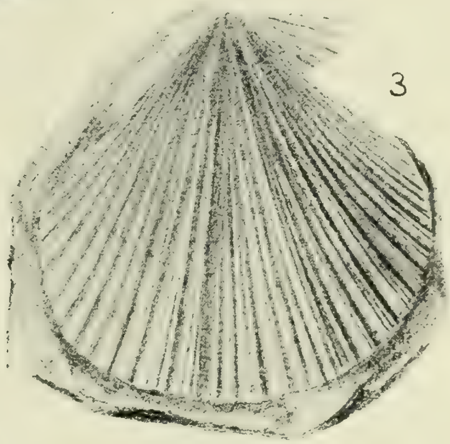

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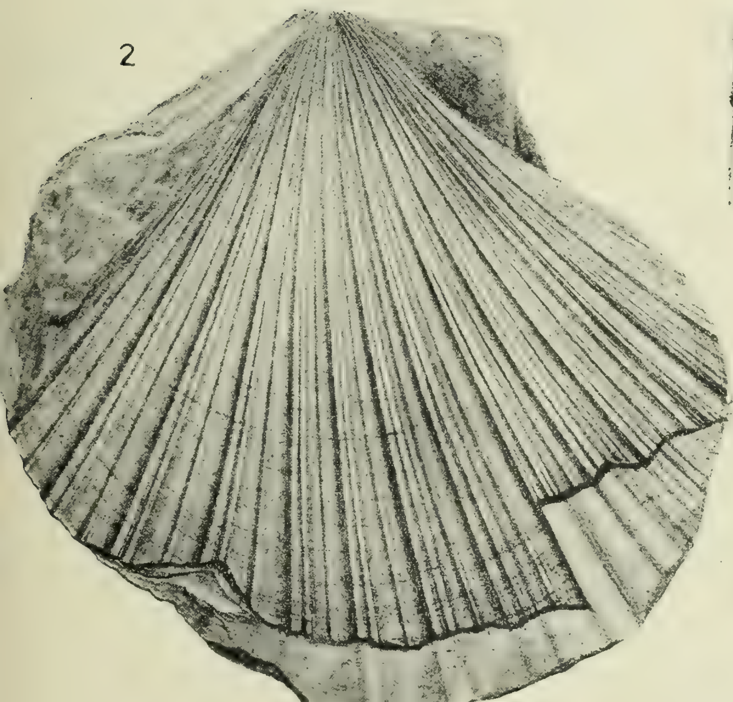

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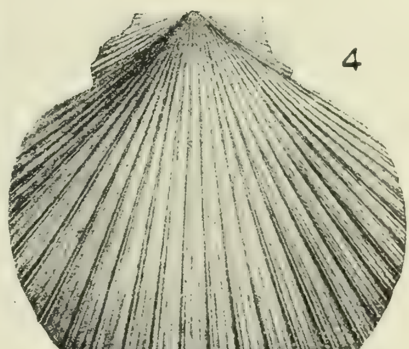

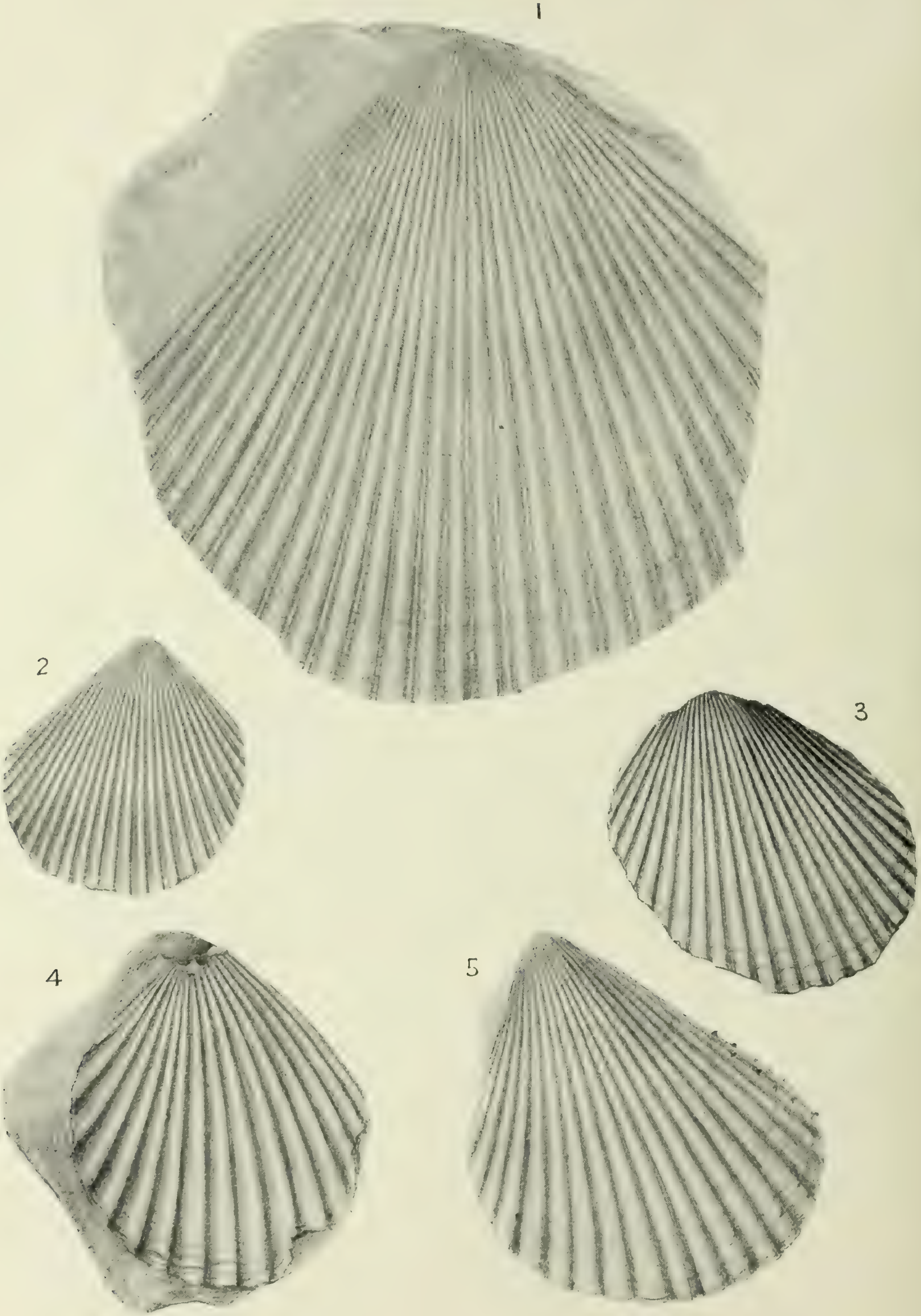
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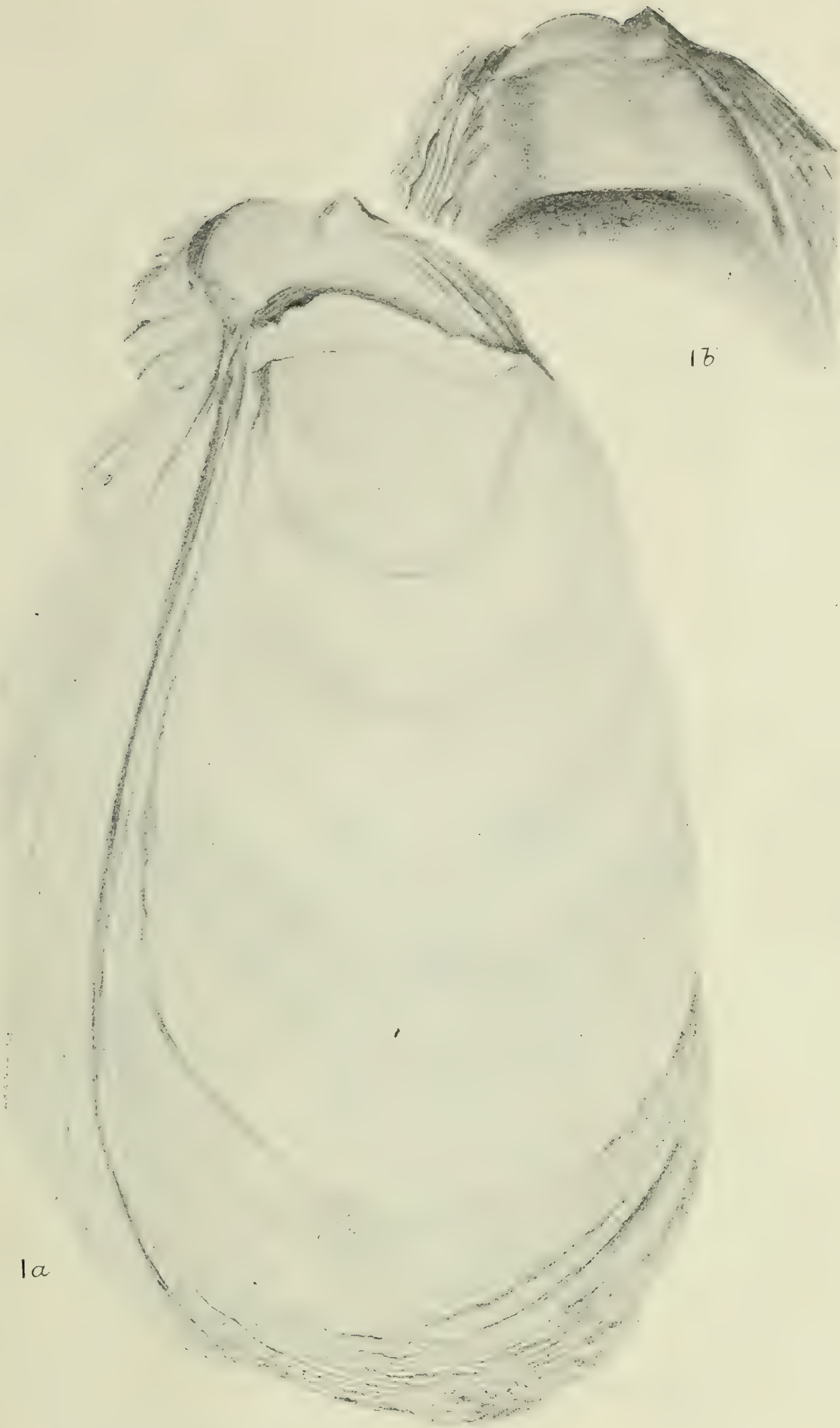
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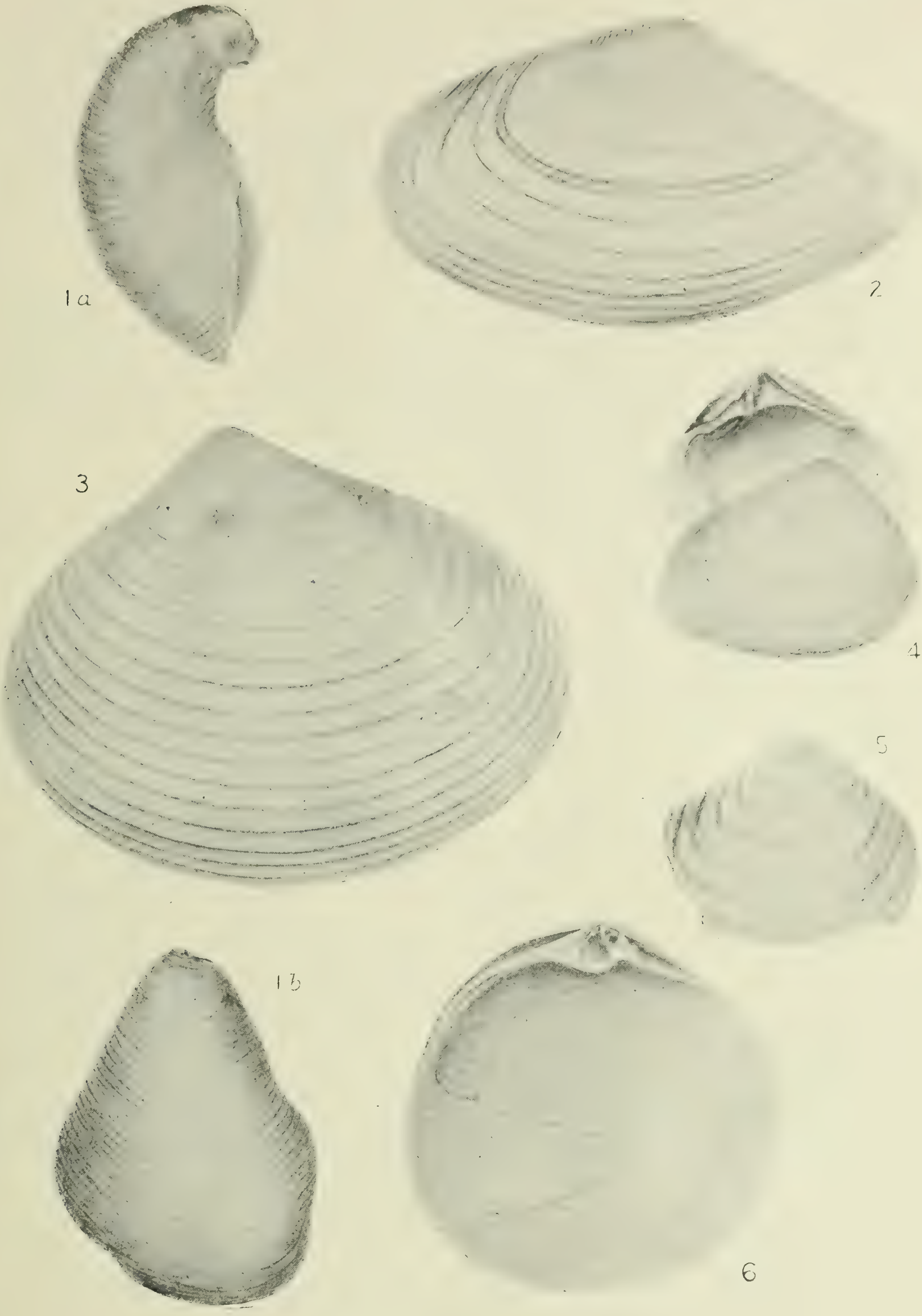
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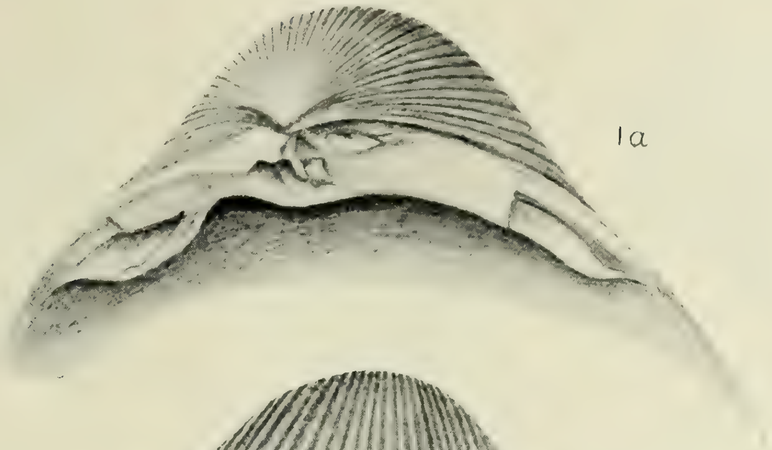
PLATE XV.



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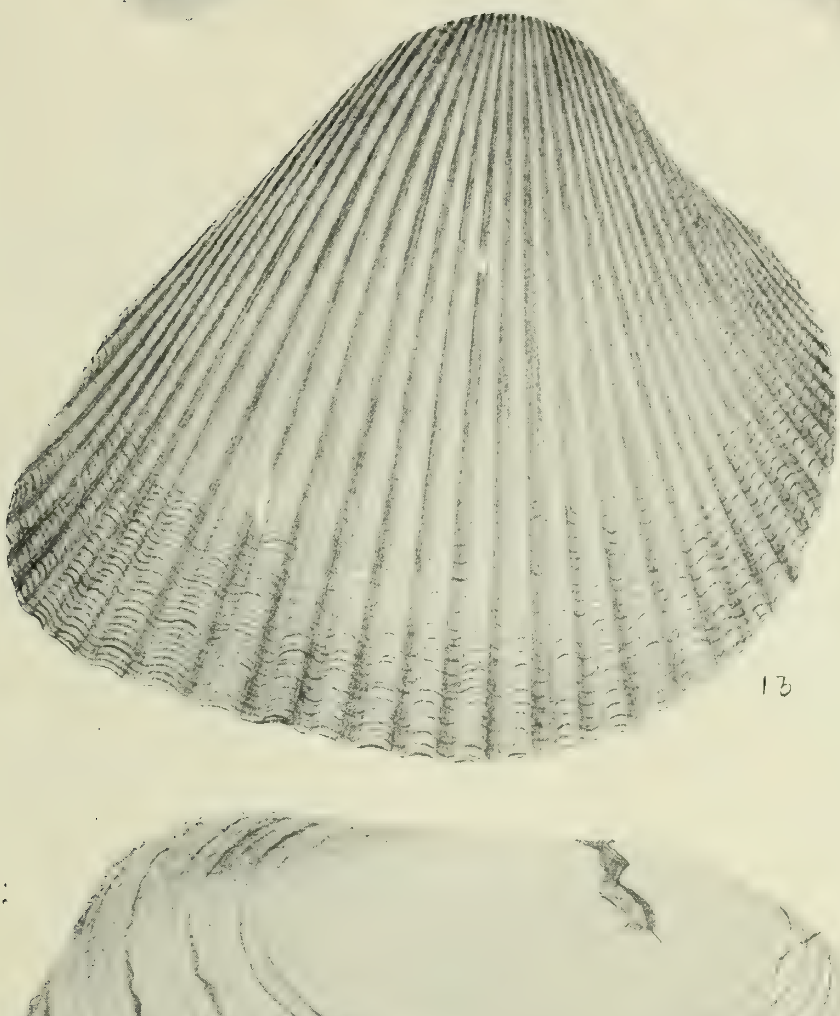

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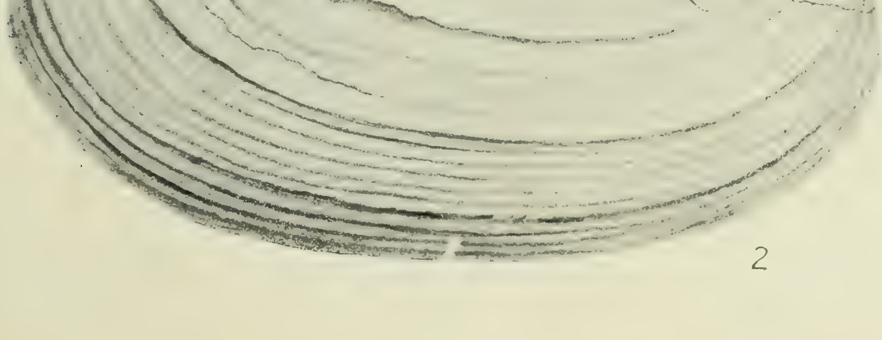

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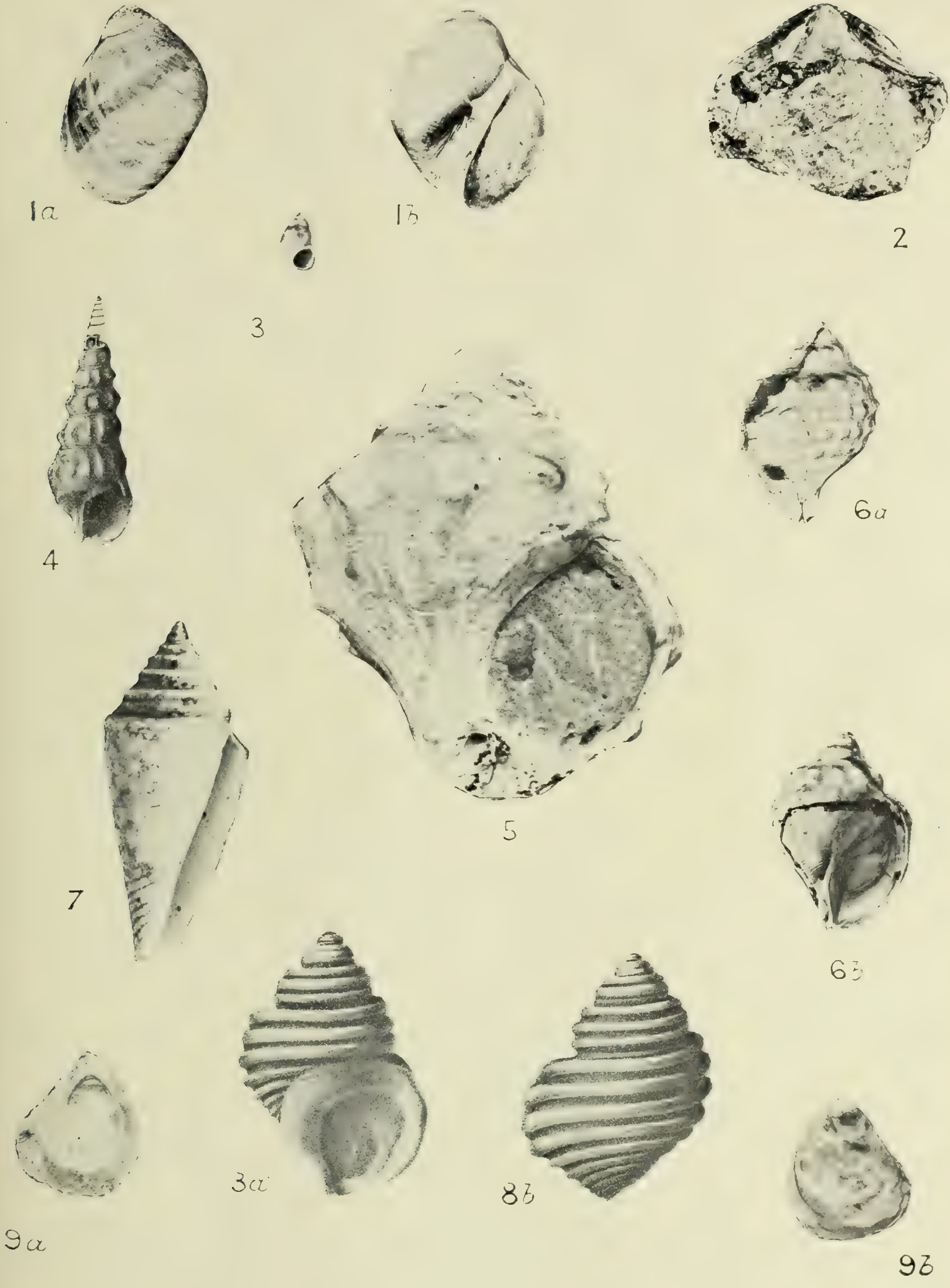
PLATE XVII.



NEW ZEALAND.

Department of Mines.

NEW ZEALAND GEOLOGICAL SURVEY

(P. G. MORGAN, Director.)

PALÆONTOLOGICAL BULLETIN No. 3.

REVISION OF THE TERTIARY MOLLUSCA OF NEW ZEALAND,

BASED ON TYPE MATERIAL.

PART II.

BY

HENRY SUTER.

ISSUED UNDER THE AUTHORITY OF THE HON. WILLIAM FRASER, MINISTER OF MINE

WELLINGTON.
BY AUTHORITY: JOHN MACKAY, GOVERNMENT PRINTER,
1915.

LETTER OF TRANSMITTAL

GEOLOGICAL SURVEY OFFICE.

SIR,— Wellington, 3rd May, 1915.

I have the honour to transmit herewith Palæontological Bulletin No. 3, entitled "Revision of the Tertiary Mollusca of New Zealand, based on Type Material: Part II," and written by Mr. Henry Suter, of Christchurch, Consulting Palæontologist to the Geological Survey. It contains sixty-nine pages of letterpress, and is illustrated by a number of plates.

This bulletin practically completes the revision of the Tertiary Mollusca represented by type specimens in New Zealand museums and the Geological Survey collections. The description of a considerable number of new species is now being undertaken by Mr. Suter, and in addition an enormous amount of material still remains to be classified.

I have the honour to be,

Sir,

Your obedient servant,

P. G. MORGAN,

Director, New Zealand Geological Survey.

The Hon. William Fraser, Minister of Mines, Wellington.

PREFACE.

THROUGH the kindness of Mr. Edgar R. Waite, Curator of the Canterbury Museum, Christchurch, and Professor W. B. Benham, F.R.S., Curator of the Otago Museum, Dunedin, I have been enabled to continue the revision of Hutton's type specimens. Both gentlemen most liberally put the material at my disposal, and I wish here to express my gratitude to them for their courtesy.

Of the Canterbury Museum collection ninety-five species, and of the Otago Museum collection twenty-one species, have been examined; furthermore, six species described by Hutton in his catalogue of 1873 have been redescribed, three of T. W. Kirk's and two of Hector's type specimens have also been dealt with. Notes will also be found on type specimens of Mr. E. de C. Clarke, Professor P. Marshall, and Dr. J. Allan Thomson. In addition, copies of the diagnoses of three Tertiary shells, described by me in the "Proceedings of the Malacological Society," London, are added, as these proceedings are wanting in most of our libraries.

A few figures drawn after the type specimens by the late Mr. Buchanan are reproduced; a number of type specimens have been photographed—those of the Canterbury and Otago Museum specimens by Mr. C. Beken, those of the Geological Survey collections by Dr. Thomson and Mr. J. A. Bartrum; finally, of a number of small specimens, I have made line-drawings for reproduction. The plates have been arranged by Dr. Thomson.

HENRY SUTER.

TABLE OF CONTENTS.

REVISION

OF THE

TERTIARY MOLLUSCA OF NEW ZEALAND,

BASED ON TYPE MATERIAL.

PART II.

CHAPTER I.

Class GASTROPODA.

Fam. TROCHIDÆ.

Trochus (Cœlotrochus) conicus (Hutton). Plate IV., fig. 1.

1883. *Anthora conica* Hutton, Trans. N.Z. Inst., vol. xv, 1882, p. 411.
1893. *Trochus conicus* Hutton, Macleay Mem. Vol., Plioc. Moll., p. 68, pl. viii, fig. 73.

SHELL conical, high, with moniliform spiral ribs and a moderately deep, smooth, false umbilicus. *Sculpture:* The protoconch is smooth, the following whorls ornamented by subequal moniliform spiral ribs, 6 on the penultimate whorl, a fine thread in the lowest interstice, and one above the suture; base with about 10 spirals. *Spire* conical, slightly gradate, about 1½ times the height of the aperture, outlines lightly convex. *Protoconch* of 1½ whorls, broadly conoidal. *Whorls* 6, slightly convex, regularly increasing, the body-whorl separated from the base by a rounded angle; base flattish. *Suture* deep, margined above. *Aperture* subrhomboidal, smooth inside. *Outer lip* lightly convex, angled towards the straight basal lip. *Columella* oblique, inserted upon the side of the false umbilicus, with a distinct fold above. *Inner lip* callous, spreading over the broad, not very deep, false umbilicus.

Height, 20 mm.; diameter, 21 mm. (holotype).

Holotype in the Canterbury Museum, Christchurch.

Loc.—Wanganui. Pliocene.

Remarks.—This species is nearly allied to *T. tiaratus* Q. & G., which, however, has a coarser sculpture, the body-whorl much more sharply angled, and a narrower, considerably deeper, umbilicus.

Trochus nodosus Hutton. Plate IV., fig. 2.

1885. *Trochus nodosus* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 330.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 221.

Shell small, with elevated, turriculate spire, cancellated sculpture, nodose keel, and without a false umbilicus. *Sculpture* consisting of close, unequal, fine spiral threads, cancellated by well-marked growth-lines; keel with a single row of tubercles, about 9 on a whorl; base spirally striated. *Spire* conical, turreted, angle about 60°, nearly twice the height of the aperture. *Protoconch* broken off. *Whorls* 6 to 7, keeled a short distance above the suture, receding below, flat above; body-whorl with a second, smooth, keel below the tubercle-bearing keel; base very lightly convex. *Suture* covered by a cancellated cord, which in the specimen before me is lost in most places, leaving a deep suture. *Aperture* rhomboidal, broader than high. *Outer lip* obliquely descending, truncated at the junction with the lightly convex basal lip. *Columella* short, concave. *Inner lip* reaching only a short distance beyond the columella. Imperforate.

Height, 13 mm.; diameter, 11·5 mm. (ideotype).

Ideotype in the Canterbury Museum, Christchurch.

Loc.—Broken River. Miocene.

Remarks.—This specimen agrees in the dimensions fairly well with those given by Hutton for the holotype. For the latter the locality is White Rock River. It may be the holotype, though it is certain that Hutton did not consider it as the type of his species.

Calliostoma hodgei (Hutton).

1875. *Zizyphinus hodgei* Hutton, Trans. N.Z. Inst., vol. vii, 1874, p. 458, pl. xxi.
1893. *Calliostoma hodgei* Hutton, Macleay Mem. Vol., Plioc. Moll., p. 70.

Shell of medium size, thin, with distant moniliform spiral riblets, somewhat concave spire, keeled body-whorl, quadrangular aperture, and small umbilical callosity. *Sculpture* of the post-embryonic whorls consisting of 3 equal moniliform spiral cords on the upper whorls, 2 finer ones being intercalated on the penultimate whorl, which increase to about 9 unequal spirals on the body-whorl; below the keel the spirals are less nodulous at first, but are getting moniliform again on approaching the centre of the base, their number being about 14; growth-lines indistinct. *Spire* conoidal, nearly $1\frac{1}{2}$ times as high as the aperture, lightly concave, especially at its upper part. *Protoconch* very small, of $1\frac{1}{2}$ smooth and convex whorls. *Whorls* about 8, first slowly increasing, flat, the last sharply keeled; base flattish. *Suture* linear. *Aperture* quadrangular. *Outer lip* thin, sharply angled towards the horizontal straight basal lip. *Columella* vertical, short, somewhat concave. *Inner lip* flattish, narrowly spread beyond the columella, and forming only a very narrow umbilical callosity.

Height, 22 mm.; diameter, 24 mm. (holotype).

Holotype in the Otago Museum, Dunedin.

Loc.—Wanganui. Pliocene.

Calliostoma ponderosum (Hutton).

1885. *Zizyphinus ponderosus* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 322.
1893. *Calliostoma ponderosum* Hutton, Macleay Mem. Vol., Plioc. Moll., p. 69, pl. viii, fig. 75.

Shell large, solid, periphery roundly angled, with inequidistant spiral liræ, and a broad umbilical callus. *Sculpture* of the post-embryonal whorls consisting of 3 distant smooth spiral cords; on the last half of the penultimate whorl the space above the median cord is filled with close spirals, numbering 4, and on the body-whorl a spiral is also appearing below the median cord, bringing up the total to 6 or 7; base with somewhat unequal spiral threads. *Spire* conoidal, of the same height as the aperture, outlines slightly convex. *Protoconch* smooth, broadly convex. *Whorls* 5, first slowly then more rapidly increasing, flattened, the last whorl roundly angled; base lightly convex. *Suture* distinct. *Aperture* subrhomboidal, broader than high. *Outer lip* thick, flattish, narrowly rounded towards the arcuate basal lip. *Columella* very oblique, very slightly excavated. *Inner lip* callous, extending over the umbilical tract, and forming a thick large callus.

Height, 35 mm.; diameter, 43 mm. (holotype).

Holotype in the Canterbury Museum, Christchurch.

Loc.—Wanganui. Pliocene.

Fam. VITRINELLIDÆ.

Lissospira corulum (Hutton).

1885. *Scalaria corulum* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 322, pl. xviii, fig. 22.
1893. „ „ Hutton, Macleay Mem. Vol., Plioc. Moll., p. 67, pl. viii, fig. 72.
1907. *Scala corulum* Hutton: Suter, Trans. N.Z. Inst., vol. xxxix, 1906, p. 267.
1908. *Cyclostrema corulum* Hutton: Suter, Proc. Mal. Soc. Lond., vol. viii, p. 24.
1908. „ „ Hutton: Iredale, Trans. N.Z. Inst., vol. xl, 1907, p. 382.
1913. *Lissospira corulum* Hutton: Suter, Man. N.Z. Moll., p. 158, pl. 34, fig. 6.

Shell minute, elevated turbinate, perforate, translucent, white, shining. *Sculpture* consisting of fine equidistant axial riblets, about 28 on the last whorl, the interstices finely microscopically spirally striate. *Spire* conical, higher than the aperture, outlines convex. *Protoconch* small, globose, of 1 smooth whorl. *Whorls* 5, rather rapidly increasing, convex, the last with the periphery and base rounded. *Suture* deep. *Aperture* roundly ovate, angled above. *Peristome* continuous, sometimes thickened by a radiate riblet. *Columella* arcuate. *Inner lip* very little expanded. *Perforation* narrow, partly hidden by the inner lip.

Height, 1·5 mm.; diameter, 1 mm. (lectotype).

Lectotype and 6 *syntypes* in the Canterbury Museum, Christchurch.

Loc.—Wanganui. Pliocene. Recent.

Circulus helicoides (Hutton). Plate VIII, figs. 1, *a*, *b*, *c*.

1877. *Cyclostrema helicoides* Hutton, Trans. N.Z. Inst., vol. ix, 1876, p. 598.
1887. *Cyclostrema (?) helicoides* Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 221.

Shell small, discoidal, flat-spired, broadly umbilicated, spirally liıate, tricarinate. *Sculpture:* The first 2½ whorls smooth, the succeeding volutions spirally striated, the spirals getting obsolete upon the base, where they are replaced by strong radiate folds which enter the umbilicus; body-whorl with a low carina half-way between the suture and the periphery, the latter with 2 distant keels, the upper one not strongly marked, but the lower one rendered prominent by a sharp spiral rib. *Spire* very little elevated, obtuse. *Protoconch* very large, flat, consisting of 2½ convex smooth whorls. *Whorls* 3½, convex, the last flattened outside the suture, tricarinate; base lightly convex. *Suture* not impressed, margined. *Aperture* subcircular, subpentagonal on the outside. *Peristome* partly broken off, but no doubt continuous. *Umbilicus* wide, showing all the whorls, with an indistinct carina.

Height, 1·7 mm.; diameter, 3·5 mm. (holotype).

Holotype in the Otago Museum, Dunedin.

Loc.—White Rock River. Miocene.

Fam. TURBONIDÆ.

Turbo marshalli J. A. Thomson.

1908. *Turbo marshalli* J. A. Thomson, Trans. N.Z. Inst., vol. xl, 1907, p. 103, pl. xiv, fig. 6.

Shell small, turbinate-conical, imperforate, with acutely keeled whorls, body-whorl with double keel, the keels of the periphery with tubercles, shoulder and base with granulose lineations, suture having the appearance of being deeply canaliculate. *Sculpture:* Protoconch with coarse granules, succeeding whorls with a sharp keel near the suture below, ornamented with triangular tubercles, about 13 on a whorl; between the keel and the suture above there are 3 to 4 spiral cords cut up into oblong nodules by numerous oblique retrocurrent axial ribs, the uppermost spiral strongest, much elevated and distant from the suture, the oblique axials continued to the suture; body-whorl with a distinct spiral cord below the keel, followed by a sharp second keel, both moniliform; base with 6 spiral cords, crossed by zigzag radial lines. *Spire* low, conical, slightly higher than the aperture. *Protoconch* planorboid, of about 2 volutions. *Whorls* about 6, the first 2½ quite flat, the following whorls acutely keeled below; base very faintly convex. *Suture* linear, situate in a deep canal produced by the lower keel and upper spiral cord. *Aperture* subcircular, slightly broader than high. *Outer lip* biangulate. *Columella* vertical, concave. *Inner lip* callous, spreading as a smooth disc over the umbilical area, terminating below in a point produced by the innermost spiral rib. *Operculum* calcareous, elliptical, the nucleus subcentral, outside smooth, with an indistinct spiral rib close to the margin.

Height, 18 mm.; diameter, 21 mm.

Primary types (6 shells, 1 operculum) in the Otago Museum, Dunedin.

Loc.—Fossiliferous layers of the tuff underlying the limestone on the cliffs, North Shore, Kakanui. Miocene.

Fam. Rissoidæ.

Rissoa (s. str.) impressa Hutton.

1885. *Rissoa impressa* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 321.
1893. ,, ,, Hutton, Macleay Mem. Vol., Plioc. Moll., p. 64, pl. viii, fig. 64.
1905. *Rissoina agrestis* Webster, Trans. N.Z. Inst., vol. xxxvii, 1904, p. 279, pl. x, fig. 10.
1907. *Rissoa impressa* Hutton: Suter, Trans. N.Z. Inst., vol. xxxix, 1906, p. 257.
1913. *Rissoa* (s. str.) *impressa* Hutton: Suter, Man. N.Z. Moll., p. 201, pl. 12, fig. 3.

Shell minute, ovate, imperforate, solid, costate, with a distinct groove below the suture. *Sculpture* consisting on the last 3 whorls of rather stout axial riblets, about 20 on the last whorl, extending over the base; they are slightly oblique on the upper whorl, but distinctly so on the body-whorl, directed backwards; the interstices are slightly narrower and smooth; the riblets are crossed by a distinct groove a little below the suture, and usually of the same depth as the latter, reducing the riblets between suture and groove to flat nodules; the protoconch is microscopically minutely reticulated, the fine spirals distinct. *Spire* elevated conic, about twice the height of the aperture; outlines slightly convex. *Protoconch* of 2 convex whorls, dome-shaped. *Whorls* 5, the last 2 rather rapidly increasing, flatly convex; base rounded. *Suture* not much impressed. *Aperture* roundly ovate. *Peristome* continuous, thickened, slightly expanded, with a sharp edge. *Columella* short, arcuate, and thick.

Height, 2·1 mm.; diameter, 1·2 mm. (lectotype).

Lectotype and 17 *syntypes* in the Canterbury Museum, Christchurch.

Loc.—Petane (Pliocene). Also in the Pliocene of Wanganui and Waikopiro. Recent.

Rissoa (Alvania) gradata Hutton.

1885. *Rissoa gradata* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 321, pl. xviii, fig. 21.
1893. ,, ,, Hutton, Macleay Mem. Vol., Plioc. Moll., p. 64, pl. viii, fig. 65.

Shell minute, ovate, cancellated, imperforate, aperture roundly ovate, peristome continuous. *Sculpture:* Protoconch smooth, the following whorls with subvertical equidistant axial riblets, about 18 on a whorl, cancellated by spiral threads, a posterior one near the angle of the whorl, and 2 anterior ones with a smooth band between; on the body-whorl there are 7 spirals, the anterior ones close together; the axial riblets obsolete on the base. *Spire* gradated, about $1\frac{1}{2}$ times the height of the aperture. *Protoconch* globose, of 1 whorl. *Whorls* 4, narrowly shouldered, then straight, but contracted again towards the suture; body-whorl convex. *Suture* impressed. *Aperture* roundly ovate, angled above, convex below. *Peristome* continuous, somewhat thickened, and sometimes a little expanded. *Columella* short, concave.

Height, 2·4 mm.; diameter, 1·4 mm. (lectotype).

Lectotype and 2 *syntypes* in the Canterbury Museum, Christchurch.

Loc.—Wanganui (Pliocene). Also Petane.

Rissoa (Alvania) rugosa Hutton.

1885. *Rissoa rugosa* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 321.
1893. „ „ Hutton, Macleay Mem. Vol., Plioc. Moll., p. 65, pl. viii, fig. 66.

Shell small, pupiform, spirally lirate and axially costate, suture margined, peristome continuous. *Sculpture:* Protoconch smooth, the post-embryonic whorls with numerous axial riblets, about 22 on a whorl, often obsolete, rendering the spiral bands slightly nodulous; spire-whorls with 5 spiral cords, the uppermost margining the suture, the second and third close together, separated only by a narrow groove, body-whorl with 5 to 8 spirals, the lowest 3 mostly obsolete. *Spire* high, about 3 times the height of the aperture, conical, outlines lightly convex. *Protoconch* of $1\frac{1}{2}$ convex whorls, the nucleus somewhat eccentric. *Whorls* 6, regularly increasing, flatly convex, base rounded. *Suture* impressed, margined below. *Aperture* broadly ovate. *Peristome* thickened, acute, rather patulous, continuous.

Height, 4·2 mm.; diameter, 1·7 mm. (lectotype).

Lectotype and 5 *syntypes* in the Canterbury Museum, Christchurch.

Loc.—Petane. Pliocene.

Rissoa (Onobia) semisulcata Hutton.

1885. *Rissoa semisulcata* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 321.
1893. „ „ Hutton, Macleay Mem. Vol., Plioc. Moll., p. 66, pl. viii, fig. 69.

Shell small, pupiform, solid, smooth to the last $1\frac{1}{2}$ whorls, which have 5 spiral riblets, aperture roundly ovate. *Sculpture* of the last $1\frac{1}{2}$ whorls consisting of 5 equidistant spiral cords, separated by narrow grooves, but getting obsolete toward the aperture; base smooth. *Spire* high, conical, about 3 times the height of the aperture, outlines lightly convex. *Protoconch* of $1\frac{1}{2}$ smooth whorls, papillate, the nucleus slightly eccentric. *Whorls* 5 to 6, regularly increasing, flattish; base convex. *Suture* impressed, margined below on the last 2 whorls, canaliculate on the last turn. *Aperture* roundly ovate, subangled above. *Peristome* continuous, slightly thickened and patulous, acute.

Height, 3·7 mm.; diameter, 1·8 mm. (lectotype).

Lectotype and 18 *syntypes* in the Canterbury Museum, Christchurch.

Loc.—Wanganui. Pliocene.

Rissoina (Zebina) emarginata (Hutton).

1885. *Rissoa emarginata* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 320, pl. xviii, fig. 20.
1893. „ „ Hutton, Macleay Mem. Vol., Plioc. Moll., p. 65, pl. viii, fig. 68.
1907. *Rissoina parvilirata* Suter, Trans. N.Z. Inst., vol. xxxix, 1906. p. 257, pl. ix, fig. 5.
1908. *Rissoa emarginata* Hutton: Iredale, Trans. N.Z. Inst., vol. xl, 1907, p. 383.
1913. *Rissoina (Zebina) emarginata* Hutton: Suter, Man. N.Z. Moll., p. 222, pl. 13, fig. 14.

Shell small, oblong, imperforate, polished, microscopically lirate, base subtruncate. *Sculpture* formed by close, fine, spiral grooves, visible only under a good lens, the interspaces being broader than the grooves. *Spire* conical, about $1\frac{1}{2}$ times the height of the aperture. *Protoconch* minute, smooth, globularly pointed. *Whorls* 5, lightly convex, the last large, occupying nearly three-fourths of the total height, slightly flattened below the suture. *Suture* superficial, submargined above. *Aperture* vertical, pyriform, truncated at the base. *Outer lip* strong, descending nearly straight, then turning at a narrowly rounded angle toward the straight and slightly notched basal lip. *Columella* concave, and truncated below. *Inner lip* forming a strong but narrow callus on the body-whorl, broadening above, where it joins the outer lip; on the columella it is much narrower, covering only the inner half of it.

Height, 3 mm.; diameter, 1·5 mm. (holotype).

Holotype and 2 *paratypes* in the Canterbury Museum, Christchurch.

Loc.—Wanganui (Pliocene). Also Petane. Recent.

Fam. Thiaridæ.

Melanopsis trifasciata Gray. Plate I, fig. 8.

1843. *Melanopsis trifasciata* Gray, Dieffenbach, N.Z. p. 263.
1873. *Ancillaria (Amalda) pomahaka* Hutton, Cat. Tert. Moll., p. 6.
1887. *Melanopsis pomahaka* Hutton, P.L.S. N.S.W. (2), vol. i, p. 216.
1913. „ *trifasciata* Gray: Suter, Man. N.Z. Moll., p. 236, pl. 39, fig. 11.

Shell ovate, smooth, with a strong callus on the upper part of the columella. *Sculpture* consisting of growth-lines only, which sometimes develop into folds. *Protoconch* of 1 very rapidly increasing costellate whorl. *Whorls* 3 to 4, the last very large, slightly ventricose. *Suture* superficial. *Aperture* large, elongately oval, sharply angled above, distinctly notched below. *Outer lip* simple, acute. *Columella* strongly callous above, then excavated and concavely twisted at the base.

Height, 21 mm.; diameter, 11 mm. (*M. pomahaka*).

Holotype of *M. pomahaka* in the collection of the New Zealand Geological Survey.

Loc.—Pomahaka, Otago. Miocene.

Remarks.—The figure represents the type specimen of *Ancillaria pomahaka* drawn by Buchanan. I am unable to separate this fossil from our Recent *M. trifasciata.*

Fam. Cerithiopsidæ.

Seila huttoni nom. mut.

1886. *Bittium cinctum* Hutton, Trans. N.Z. Inst., vol. xviii, 1885, p. 334; not *Cerithium cinctum* Hutton, 1873.
1893. *Bittium cinctum* Hutton, Macleay Mem. Vol., Plioc. Moll., p. 60, pl. vii, fig. 57.

Shell elongated, with a high spire, 4 spiral ribs on the spire-whorls, aperture with a very short canal. *Sculpture* consisting of 4 equal flatly rounded spiral ribs, the interstices about the same width as the ribs, but getting slightly broader anteriorly; body-whorl with 7 spirals, in the uppermost interstice a fine thread is intercalated, which, with further growth, would develop into an additional rib; interstices with fine growth-lines; base smooth, with growth-lines only. *Spire* high, subcylindrical. *Protoconch* lost in all specimens. *Whorls* many, regularly increasing, flat; body-whorl somewhat convex; base concave. *Suture* impressed. *Aperture* vertical, ovate, subangled above, with a very short truncated canal below. *Outer lip* thin, convex. *Columella* short, straight. *Inner lip* thin and narrow.

Height, 7 mm.; diameter, 4·5 mm. (holotype, 2 whorls). Height, 6 mm.; diameter, 3·2 mm. (paratype, 3 whorls).

Holotype and 4 *paratypes* in the Canterbury Museum, Christchurch.

Loc.—Petane (Pliocene). Also Wanganui.

Remarks.—Hutton says, "I have revived for this species the name which I formerly bestowed on *B. terebelloides* Martens." This is against the rules of nomenclature, and I now rename the species in honour of the late Captain F. W. Hutton

Fam. TURRITELLIDÆ

Turritella (Colpospira) concava Hutton. Plate V, fig. 4.

1877. *Turritella (Haustator) concava* Hutton, Trans. N.Z. Inst., vol. ix, 1876, p. 597.
1887. „ *concava* Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 218.

Shell large, many-whorled, pyramidal, the whorls concave, spirally striated, this sculpture getting obsolete on the upper half of the lower whorls, growth-lines indicating a deep sinus, body-whorl rounded. *Sculpture:* The earlier whorls have a spiral ridge below the middle, which, however, disappears on the lower whorls; on these there appears an elevated ridge below the suture, which increases in breadth; the whole surface is ornamented with equal fine spiral threads, which are more or less obsolete on the upper elevated ridge; growth-lines distinct, oblique, with a rather deep and broad sinus; upon the base the spirals are less numerous and distant. *Spire* high. *Protoconch* lost. *Whorls* about 15, regularly increasing, convex above, concave on the lower half, the body-whorl narrowly rounded towards the lightly convex base. *Suture* well impressed, margined above. *Aperture* subquadrate. *Outer lip* with a deep median sinus. *Columella* vertical, faintly concave. *Inner lip* forming a shining enamel over columella and body.

Height, 89 mm.; diameter, 28 mm.; angle of spire, 22° (holotype).

Holotype in the Otago Museum, Dunedin.

Loc.—White Rock River. Miocene.

Fam. STRUTHIOLARIIDÆ.

Struthiolaria (Pelicaria) obesa Hutton. Plate IV, fig. 3.

1885. *Struthiolaria obesa* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 329.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 217.

Shell fairly large, globose-ovate, spirally striated, with a short spire, and a broad and thick callosity over the ventral side of the body-whorl. *Sculpture:* The specimen before me is much worn, smooth, but in some places there are traces of fine spiral striation visible. *Spire* conoidal, short, about two-thirds the height of the aperture, apex blunt. *Protoconch* dome-shaped. *Whorls* 5, convex, the body-whorl large, ventricose, very slightly flattened in the middle; base somewhat concave. *Suture* impressed. *Aperture* ovate, higher than broad, subangled above, distinctly channelled below. *Outer lip* angularly convex, lightly produced below the middle, thick, rounded and reflexed. *Columella* excavated, straightened and truncated below. *Inner lip* very callous, spreading as a thick flattish layer over the ventral side of the body, extending above to the suture with a basal concave depression.

Height, 46 mm.; diameter, 33 mm. (holotype).

Holotype in the Canterbury Museum, Christchurch.

Loc.—Shepherd's Hut, Waipara. Miocene.

Struthiolaria parva (Hutton MS.) n. sp. Plate IV, fig. 4.

Shell very small, ovate, with tubercular cinguli, canaliculate suture. *Sculpture:* First whorl smooth; second whorl with fine equal spiral threads; third whorl strongly shouldered, with 4 spiral cords upon the shoulder, keel of the latter slightly nodulous; between it and the suture below there is another keel, which is smooth, the interstice above with a fine spiral thread; fourth or body-whorl with a smooth and narrow band margining the suture, a prominent tubercular keel marking the shoulder, 3 spiral keels below, the upper 2 getting nodulous on approaching the peristome, interstices concave, equal to the width of the cinguli, but wider between the second and third carina, with a fine thread in the middle; base with 5 distant fine spirals. *Spire* conic, gradate, nearly 1½ times the height of the aperture. *Protoconch* of 1 flatly convex whorl. *Whorls* 4, the first 2 convex, the others carinated; base narrowed. *Suture* impressed, canaliculate on the third and fourth whorl. *Aperture* subpentagonal, large, shortly channelled below. *Outer lip* angular, slightly produced at the middle, callous, rounded. *Columella* short, oblique, straight, truncated below. *Inner lip* rather thick, the callosity extending over part of the base.

Height, 17 mm.; diameter, 12 mm. (chirotype).

Holotype in the Canterbury Museum, Christchurch.

Loc.—Unknown.

Remark.—A chirotype labelled "*Struthiolaria parva*, type," is in the Canterbury Museum, the name having no doubt been given to the species by the late Captain F. W. Hutton, but there exists no description or figure of it. It now constitutes the holotype of the species.

Fam. CALYPTRÆIDÆ.

Calyptræa (s. str.) scutum Lesson.

1830. *Calyptræa scutum* Lesson, Voy. "Coquille," Zool., vol. ii, p. 395.
1865. *Trochita dilatata* Sowerby (?): Zittel, Voy. "Novara," Palæ., p. 43, pl. xv, fig. 8; non Sowerby.
1873. ,, ,, Zittel: Hutton, Cat. Tert. Moll., p. 14.
1887. ,, ,, Sow. (?): Hutton, P.L.S. N.S.W. (2), vol. i, p. 217.
1913. *Calyptræa scutum* Lesson: Suter, Man. N.Z. Moll., p. 284, pl. 44, fig. 4.

A shell from Motanau, in the collection of the New Zealand Geological Survey, perfectly agrees with Recent specimens of *C. scutum* Lesson. It is labelled "*T. dilatata*, Zittel." The shell is conoidal, with a nearly central elevated apex, circular or slightly oval, thin and fragile; basal plate smooth, the edge slightly concave.

Height, 7 mm.; diameter, 17 mm. (Motanau specimen).

Remarks.—*C. scutum* Lesson, a Recent shell, is also recorded from the Pliocene and Miocene. *Calyptræa dilatata* Sow., to which Zittel doubtfully assigned our species, is a synonym of the Recent *Calyptræa trochiformis* Gmelin, occurring from Panama to Valparaiso, and distinct from *C. scutum.*

Calyptræa (s. str.) alta (Hutton).

1885. *Trochita alta* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 329.
1893. *Calyptræa alta* Hutton, Macleay Mem. Vol., Plioc. Moll., p. 62, pl. vii, fig. 59.
1906. ,, ,, Hutton: Suter, Trans. N.Z. Inst., vol. xxxviii, 1905, p. 326.
1913. *Calyptræa* (s. str.) *alta* Hutton: Suter, Man. N.Z. Moll., p. 284, pl. 44, fig. 2.

Shell rather large, conical, high. *Sculpture* consisting of oblique, close, rugose, elevated growth-striæ. *Spire* conical; outlines convex. *Protoconch* small, of 1½ convex smooth whorls. *Whorls* 4, rapidly increasing, flatly convex; apex subcentral. *Suture* distinct, not much impressed. *Aperture* entire, subcircular. *Basal plate* with oblique growth-lines; margin thin, sharp. *Columella* short, arcuate, slightly reflexed, and forming a very narrow false umbilicus.

Height, 12 mm.; diameter, 21 mm. (heautotype).

Heautotypes in the Canterbury Museum, Christchurch.

Loc.—Petane (Pliocene); White Rock River (Miocene); and Recent.

Remark.—The holotype seems to be lost. Hutton gives Kikowheru Creek, Hawke's Bay, as locality, and the dimensions are: Height, 16 mm.; diameter, 25 mm.

Calyptræa (Sigapatella) maculata (Q. & G.) subsp. inflata (Hutton).

1883. *Trochita inflata* Hutton, Trans. N.Z. Inst., vol. xv, 1882, p. 411.
1893. *Calyptræa inflata* Hutton, Macleay Mem. Vol., Plioc. Moll., p. 61, pl. vii, fig. 58.

This variety is distinguished from the species by the high spire, subglobose form, the convex whorls, and the much inflated body-whorl.

Height, 10·5 mm. : diameter—maj., 22 mm. ; min., 19 mm. (holotype).

Holotype and 1 *paratype* in the Canterbury Museum, Christchurch.

Loc.—Wanganui (Pliocene). Recent.

Remark.—It was only quite recently that I came across some specimens of this subspecies collected some years back on *Flabellum rubrum* Q. & G. in Auckland Harbour. The spiral ribs are very variable, often obsolete in the species and the subspecies.

Fam. NATICIDÆ.

Polinices (Euspira) cinctus (Hutton). Plate IV, fig. 5.

1885. *Sigaretus (Naticina) cinctus* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 318, pl. xviii, fig. 12.
1893. „ *cinctus* Hutton, Macleay Mem. Vol., Plioc. Moll., p. 55.

Shell rather small, globose ovate, thin, umbilicated, with low spire and fine spiral liræ. *Sculpture:* The first 3 whorls smooth, the last with subequal, narrow, flat spiral threads, with linear interstices, and crossed by fine oblique growth-lines. *Spire* low, conoidal, outlines convex, about one-fourth the height of the aperture. *Protoconch* convex, of 1½ whorls. *Whorls* 4, first slowly increasing, the last high and ventricose; base convex. *Suture* excavated. *Aperture* vertical, oblong, angled above, broadly convex below. *Outer lip* rounded, thin and sharp, smooth inside. *Columella* high, slightly oblique, almost straight. *Inner lip* spreading over the parietal wall and covering the columella with a distinct layer of enamel. *Umbilicus* partly hidden by the reflexed inner lip, open, deep, smooth.

Height, 16 mm. ; diameter, 12·5 mm. (holotype).

Holotype in the Canterbury Museum, Christchurch.

Loc.—Wanganui. Pliocene.

Polinices gibbosus (Hutton). Plate V, figs. 1, 2.

1886. *Natica (Neverita) gibbosa* Hutton, Trans. N.Z. Inst., vol. xviii, 1885, p. 334.
1887. „ *gibbosa* Hutton, P.L.S. N.S.W. (2), vol. i, p. 215.
1893. „ „ Hutton, Macleay Mem. Vol., Plioc. Moll., p. 54.
1893. „ „ Hutton: Tate, Trans. Roy. Soc. South Aust., vol. xvii, p. 320, pl. vi, fig. 4.

Shell large, solid, smooth, globose, the spire almost buried, with an oblique straight columella and a large callus over the umbilical region. *Sculpture* consisting of fine growth-lines; 1 of the paratypes, however, shows a few distant spiral lines. *Spire* very short, almost hidden in adult specimens, conoidal. *Protoconch* broadly conic, with blunt nucleus, the 2 whorls convex. *Whorls* 4 to 5, first very slowly increasing, but the last very large, globose, gibbous posteriorly. *Suture* not deep. *Aperture* semicircular, oblique, lightly angled above, narrowly rounded below. *Outer lip* regularly convex, solid, with a blunt margin. *Columella* oblique, straight. *Inner lip* thickly callous, filling the posterior portion of the aperture, and eventually filling the whole of the umbilical region.

Height, 50 mm. ; diameter, 50 mm. (holotype).

Holotype and 3 *paratypes* in the Canterbury Museum, Christchurch.

Loc.—Broken River (Miocene). Also in the Pliocene of Matapiro.

Remarks.—I find this species exceedingly variable, the spire being sometimes elevated, the shell having the shape of *P. ovatus* Hutton, and intermediate forms are met with; the thick callus covering the umbilicus is present in all of them.

Polinices lævis (Hutton).

1885. *Natica (Ampullina) lævis* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 317, pl. xviii, fig. 10.
1893. „ *lævis* Hutton, Macleay Mem. Vol., Plioc. Moll., p. 54, pl. vii, fig. 39.

Shell moderately large, globose, imperforate, smooth. *Sculpture* consisting of arcuate growth-lines only. *Spire* low, broadly conoidal. *Protoconch* of 2 flatly convex whorls, dome-shaped. *Whorls* 4, the last large, globose; base convex. *Suture* lightly impressed. *Aperture* ovate, angled above, convex below, higher than broad. *Outer lip* regularly rounded, acute. *Columella* vertical and concave. *Inner lip* moderately callous, narrowly spread beyond the pillar and covering the umbilicus, extending above over the convex parietal wall.

Height, 20 mm.; diameter, 22 mm. (holotype).

Holotype and 1 *paratype* in the Canterbury Museum, Christchurch.

Loc.—Petane (Pliocene). Also Wanganui.

Ampullina (Megatylotus) suturalis (Hutton).

1877. *Lunatia suturalis* Hutton, Trans. N.Z. Inst., vol. ix, 1876, p. 597, pl. xvi, fig. 11.
1887. *Natica suturalis* Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 215.

Shell rather small, globose, thin, umbilicated, with a canaliculate suture, microscopically finely spirally striated. *Sculpture* consisting of fine flexuous growth-lines, and dense, fine, microscopic spiral striæ, distant and more distinct round the umbilicus. *Spire* moderately high, somewhat gradate, about half the height of the aperture. *Protoconch* small, flattish. *Whorls* 5, first slowly, then rather rapidly increasing and descending, convex, body-whorl slightly inflated, base convex. *Suture* deeply excavated. *Aperture* subvertical, semi-lunar, nearly twice as high as broad. *Outer lip* convex, thin and sharp. *Columella* oblique, vertically arcuate towards the narrowly convex basal lip. *Inner lip* moderately callous, narrow, a little expanded, and partly covering the rather narrow deep umbilicus, which has no funicle, but a shallow spiral groove running to the anterior end of the inner lip.

Height, 17 mm.; diameter, 15·5 mm. (type, *fide* Hutton). Height, 16 mm.; diameter, 15 mm. (specimen from Awamoa, in the Canterbury Museum).

Type lost.

Loc.—Waihao. Miocene.

Remark.—The diagnosis has been drawn up after a specimen in the Canterbury Museum.

Ampullina carinata (Hutton). Plate VIII, figs. 2, *a*, *b*, *c*.

1877. *Sigaretus carinatus* Hutton, Trans. N.Z. Inst., vol. ix, 1876, p. 597.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 215.

Shell very small, thin and fragile, umbilicated, carinated, microscopically spirally striate, with depressed spire. *Sculpture* consisting of very fine and close microscopic spiral striæ, crossed by fine, oblique, arcuate lines of growth; periphery with a sharp keel which is narrowly excavated on the under-side, a lightly raised sharp ridge between the carina and the umbilicus. *Spire* depressed, broadly convex. *Protoconch* of 1 whorl, smooth, convex. *Whorls* $2\frac{1}{2}$, rapidly increasing, convex, the base flat below the keel. *Suture* deep. *Aperture* transversely rotundly ovate, very wide. *Outer lip* thin and sharp, broadly rounded, advancing at the middle. *Columella* vertical, slightly concave. *Inner lip* thin, smooth, reflexed above, curving off below towards the regularly convex basal lip. *Umbilicus* infundibular, deep and rather narrow.

Height, 2 mm.; diameter, 5 mm. (holotype).

Holotype in the Otago Museum, Dunedin.

Loc.—White Rock River. Miocene.

Ampullina undulata (Hutton).

1885. *Sigaretus undulatus* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 318, pl. xviii, fig. 11.
1893. „ „ Hutton, Macleay Mem. Vol., Plioc. Moll., p. 55, pl. vii, fig. 41.

Shell moderately large, subglobose, imperforate, with very fine, dense, undulating spiral liræ. *Sculpture:* Protoconch smooth, the succeeding whorls with very fine, unequal, and slightly undulating spiral lines with linear interstices; on the upper fourth of the body-whorl the liræ are more unequal, the interstices slightly wider. *Spire* low, dome-shaped. *Protoconch* very broadly convex, consisting of 2½ smooth, polished, and lightly convex whorls. *Whorls* 4, first very slowly increasing, the last large, globose, convex; base with a slight depression over the umbilical area. *Suture* not deep. *Aperture* ovate, angled above, convex below. *Outer lip* regularly rounded, thin, acute. *Columella* slightly oblique and excavated. *Inner lip* callous, polished, spreading over the parietal wall and beyond the columella, sealing up the umbilicus. *Umbilical tract* limited by an obscure broadly rounded semicircular elevation.

Height, 21 mm.; diameter 21 mm. (holotype).

Holotype and 2 *paratypes* in the Canterbury Museum, Christchurch.

Loc.—Wanganui (Pliocene). Also in the Pliocene of Petane, and Recent (*fide* W. Webster).

Fam. CYPRÆIDÆ.

Cypræa ficoides (Hutton). Plate I, fig. 2.

1873. *Volvaria ficoides* Hutton, Cat. Tert. Moll., p. 8.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 211.

The type of this species is an internal cast of a *Cypræa*, and nothing can at present be added to Hutton's diagnosis, which runs as follows: Shell ovato-pyriform; smooth; whorls 4; spire not exserted; aperture narrow, outer lip inflected."

Height, 28 mm.; diameter, 21 mm.

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Oamaru.

Remarks.—The outlines of this species do not correspond with any of the Australian Tertiary species known to me. It is to be hoped that a good specimen will turn up amongst the rich material of the Geological Survey, when a more comprehensive diagnosis can be given. The figure here reproduced was drawn by Buchanan, after the type.

Trivia zealandica T. W. Kirk. Plate VIII, figs. 3, *a*, *b*.

1882. *Trivia zealandica* T. W. Kirk, Trans. N.Z. Inst., vol. xiv, 1881, p. 409.
1893. „ *neozelanica* Kirk: Hutton, Macleay Mem. Vol., Plioc. Moll., p. 58.

Shell small, globosely ovate, thin, back roundly elevated at the middle, and smooth. *Sculpture* consisting of distant transverse ribs, about 17, over the outer lip and columella, passing only a short way up the back of the shell, shorter ribs being sometimes intercalated on the outside. *Spire* hidden, marked by a low round tubercle. *Aperture* narrow, more curved at the posterior extremity, straight in the middle. *Outer lip* flatly convex. *Columella* with a keel-like ridge, broad and flat, usually with a few transverse ribs less than on the outer lip.

Length, 13 mm.; diameter, 8·5 mm. (holotype, *fide* T. W. Kirk), Length, 10 mm.; diameter, 7·5 mm. (lectotype). Length, 14 mm.; diameter, 12 mm. (largest specimen in the Canterbury Museum).

Lectotype and 2 *syntypes* in the collection of the New Zealand Geological Survey, Wellington.

Loc.—Petane (Pliocene). Also Matapiro.

Remarks.—The holotype seems to be lost. I therefore select one of the syntypes as a lectotype.

Fam. Cassididæ.

Galeodea muricata (Hector). Plate I, fig. 6.

1877. *Cassis muricata* Hector, Prog. Rep. Geol. Surv. N.Z., vol. 9, p. 4.
1881. „ „ Hector, *fide* S. H. Cox, Rep. Geol. Explor. for 1879–80, p. 33.
1886. „ „ Hector, *fide* J. Park, Rep. Geol. Explor. for 1885, p. 167.
1886. „ „ Hector, "Outline of the Geology of New Zealand," p. 51, fig. 9, No. 7.

Shell moderately large, ovato-ventricose, with depressed spire, appressed suture, the spire-whorls with 1, the body-whorl with 3 to 4 spinous or tuberculous keels, the whole surface finely reticulated, outer lip somewhat reflexed, lirate towards the base, inner lip forming a broad callus, lirate below. *Sculpture:* Spire-whorls with a distinct keel at the lower third bearing sharply pointed tubercles, developing to bluntly pointed compressed spines on the last whorl, 8 to 9 on a volution; below the uppermost keel on the body-whorl there are 3 more equally spaced rows of tubercles, diminishing in size towards the base, the lowest row having only inconspicuous tubercles; the whole surface is ornamented by close, fine spiral threads, unequal in strength, usually stronger ones have from 1 to 3 much finer ones between them; on the base the stronger threads are broader and unequal in strength; these liræ are reticulated by sinuous growth-striæ; the suture is margined below by a narrow band of irregular oblique riblets. *Spire* low, conoidal, its height about half that of the aperture. *Protoconch* small, papillate, consisting of 2 convex smooth whorls. *Whorls* 6, first slowly descending, but the last large and ventricose; spire-whorls slightly concave at the shoulder, flat below the keel; body-whorl convex, the shoulder lightly excavated, base very little contracted. *Suture* appressed, margined below. *Aperture* subvertical, ovate, obsoletely and broadly channelled above, produced below into a distinct, short, recurved canal. *Outer lip* broad, thick, slightly reflexed, strongly lirate at the lower third. *Columella* vertical, arcuate above, straight below, inflected towards the canal. *Inner lip* broadly reflexed over the body, its outer edge more or less free in the adult, with an entering low plait above, and irregular oblique folds on the lower part. The *siphonal fasciole* strong, sharply keeled.

Height, 57 mm.; diameter, 40 mm. (from drawing of the lost holotype).

Paratype in the collection of the New Zealand Geological Survey.

Loc.—Komiti Point, Kaipara; calcareous sandy marls. Miocene.

Galeodea senex (Hutton). Plate IX, figs. 1, *a*, *b*.

Palæontological Bulletin No. 2, Part I, p. 22.

Figures of that species, after a specimen in my collection, are now given.

Fam. Epitoniidæ.

Epitonium marginatum (Hutton). Plate IV, fig. 6.

1885. *Scalaria marginata* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 330.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 220.

Shell large, elongated, imperforate, with distant axial ribs, connected below with a spiral rib which margins the suture on its upper side, interstices finely spirally lirate. *Sculpture* consisting of distant, narrow, high, lightly convex axial costæ, 8 on a whorl, joining below a spiral keel of the same strength as the costæ; interstices with rather distant fine spiral grooves and much closer growth-lines. *Whorls* flattened, the upper ones overlapping the succeeding ones, sharply keeled at the base. *Suture* very deep, margined above.

The holotype is a fragment of 3 whorls only.

Height, 39 mm.; diameter, 16 mm. (holotype).

Holotype in the Canterbury Museum, Christchurch.

Loc.—Curiosity Shop. Miocene.

Epitonium nympha (Hutton).

1885. *Scalaria nympha* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 321.
1893. „ „ Hutton, Macleay Mem. Vol., Plioc. Moll., p. 66, pl. viii, fig. 71.

Shell small, turreted, axially costate and spirally finely lirate, with discontinuous varices, whorls united, suture margined, base with a spiral keel. *Sculpture* consisting of smooth, rounded axial costæ, 18 to 20 on a whorl, the interstices of about the same width, with fine and numerous spiral lines; 1 or 2, sometimes 3 varices on a whorl; suture margined by a fine cord which is continued on the body-whorl as a distinct keel, arresting the axial sculpture and leaving a smooth base. *Spire* high, turreted. *Protoconch* lost in both specimens. *Whorls* convex, not disunited; base slightly concave. *Suture* impressed, margined. *Aperture* subrotund. *Peristome* continuous, strengthened by a varix. *Columella* concave. *Inner lip* narrow, not extended beyond the columella.

Height, 6·5 mm.; diameter, 2·6 mm. (lectotype). Height, 6·5 mm.; diameter, 3·2 mm. (syntype).

Both specimens are imperfect.

Lectotype and 1 *syntype* in the Canterbury Museum, Christchurch.

Loc.—Petane. Pliocene.

Epitonium (Acirsa) ornatum (Hutton). Plate I, fig. 9.

1873. *Turritella ornata* Hutton, Cat. Tert. Moll., p. 13.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 219.

Shell small, slender, turreted, with deeply excavated sutures, whorls bicarinate, a row of nodules on each keel; base with a spiral keel; aperture roundish oval, peristome thin. *Sculpture* consisting of inconspicuous axial riblets, antecurrent upon the shoulder, about 15 on the lower whorls; there are 2 spiral keels which bear well-developed nodules at the points of intersection with the axial riblets; last whorl with a smooth carina emanating from the suture. *Spire* high and narrow, angle about 17°. *Whorls* numerous, biangulate, shoulder broad, flat, rather steep, interspace between the 2 keels slightly concave; base flattish. *Suture* linear. *Aperture* subrotund, slightly effuse below the columella. *Peristome* entire, thin and acute, the outer lip slightly tricarinate. Fragments only.

Height, 11 mm. (from figure); diameter, 3 mm.

Type in the collection of the New Zealand Geological Survey.

Loc.—Pomahaka, Otago. Miocene.

Remarks.—The figure here reproduced was drawn by Buchanan, most likely from a better specimen than the fragmentary type, as Hutton in 1887 mentions as further localities for the species Hampden and Tapanui. An allied species is *Epitonium pyrrhias* Watson, from the West Indies.

Eglisia planostoma (Hutton).

1885. *Turritella (Eglisia) planostoma* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 320, pl. xviii, fig. 19.
1893. *Eglisia planostoma* Hutton, Macleay Mem. Vol., Plioc. Moll., p. 63, pl. viii, fig. 62.

Shell very small, turreted, many-whorled, spirally striated, ovate mouth and a minute funicle upon the umbilical tract. *Sculpture:* Protoconch of 2 whorls smooth; third whorl with 2 spiral cords; fourth and fifth whorls with 3 spirals; sixth and seventh whorls with 4 spirals; body-whorl with 6 spirals; the last 2 whorls have on the otherwise smooth shoulder an additional fine spiral; base smooth; the interstices above of the same width as the cinguli, but narrower farther down, sometimes with distinct growth-lines. *Spire* high, conical, turreted, nearly 4 times the height of the aperture. *Protoconch* of 2 convex whorls, the nucleus small, papillate, slightly tilted. *Whorls* 8, regularly increasing, with a flat, oblique shoulder, lightly convex below; base flattish. *Suture* not much impressed. *Aperture* ovate, slightly oblique, rounded above and somewhat effuse below. *Outer lip* convex, denticulated on the outside by the spirals. *Columella* oblique, excavated. *Inner lip* narrow and thin. *Umbilical* area with a small funicle, producing a minute perforation.

Height, 4·5 mm.; diameter, 1·4 mm. (holotype).

Holotype and 1 *paratype* in the Canterbury Museum, Christchurch.

Loc.—Petane (Pliocene). Also in the Pliocene of Wanganui.

Eglisia striolata Hutton. Plate VIII, fig. 4.

1885. *Eglisia striolata* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 329.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 219.

Shell minute, turreted, acicular, thin and fragile, spirally striated. *Sculpture:* Protoconch smooth, the succeeding whorls spirally striated, the number of the cinguli variable, but 2 or 3 are usually more prominent than the rest; the growth-lines forming sometimes faint varices. *Spire* high, scalar, 2½ to 3 times the height of the aperture. *Protoconch* of 2 convex whorls, the nucleus obtuse. *Whorls* 8, rounded, rendered slightly angular by the cinguli; base convex. *Suture* deeply impressed. *Aperture* broadly ovate or subrotund, effuse below. *Outer lip* convex, thin and sharp. *Columella* concave. *Inner lip* somewhat callous, shining, slightly expanded. *Umbilical* region with an almost obsolete funiculus.

Height, 3·4 mm.; diameter, 1·3 mm. (lectotype).

Lectotype and 14 *syntypes* in the Canterbury Museum, Christchurch.

Loc.—White Rock River. Miocene.

Aclis costellata Hutton.

1885. *Aclis costellata* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 319, pl. xviii, fig. 14.
1893. „ „ Hutton, Macleay Mem. Vol., Plioc. Moll., p. 57, pl. vii, fig. 47.

Shell minute, turriculated, imperforate, with convex whorls, the lower of them with strong spiral riblets and weak axial costæ, the aperture ovate, slightly effuse below. *Sculpture:* Protoconch smooth; the third whorl with indistinct spiral and axial striæ; the fourth whorl with 1 spiral thread on the shoulder, 1 upon its angle, and 2 below it, cancellated by axial riblets; the body-whorl with a strong spiral on the shoulder and upon its angle, reticulated by equidistant axial threads; from the angle of the shoulder to the base there are 10 distinct cinguli with linear interstices, but a little wider towards the base, crossed by growth-lines only. *Spire* conical, turreted, nearly twice the height of the aperture. *Protoconch* of 2 convex and polished whorls, nucleus globular. *Whorls* 5, rather broadly shouldered, lightly convex below, body-whorl large in proportion, convex, contracted below. *Suture* well marked. *Aperture* ovate, broadly angled above, slightly effuse below. *Outer lip* thin and sharp, convex, denticulated on the outside by the spiral riblets. *Columella* rather long, vertical, concave. *Inner lip* obsolete.

Height, 3 mm.; diameter, 1·5 mm. (holotype).

Holotype and 1 *paratype* in the Canterbury Museum, Christchurch.

Loc.—Wanganui. Pliocene.

Fam. Pyramidellidæ.

Pyramidella (Eulimella) deplexa (Hutton).

1885. *Eulimella deplexa* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 318.
1893. „ „ Hutton, Macleay Mem. Vol., Plioc. Moll., p. 56, pl. vii, fig. 45.

Shell minute, polished, subulate, imperforate, smooth, with flat whorls, deep suture and twisted columella; pullus heterostrophic. *Sculpture:* None, except fine growth-lines and exceedingly fine microscopic spiral lines upon the base. *Colour* white, a dark-grey spiral band arising from the upper part of the aperture. *Spire* high, with straight outlines, about 3 times the height of the aperture. *Protoconch* small, heterostrophic, the nucleus lateral. *Whorls* 7, regularly increasing, flattened; body-whorl convex towards the base. *Suture* very deep. *Aperture* vertical, ovate, angled above, narrowly convex below. *Outer lip* broken off. *Columella* short, straight, strongly twisted. *Inner lip* narrow, extending a short way to the umbilical area.

Height, 3 mm.; diameter, 1 mm. (holotype).

Holotype and 1 *paratype* in the Canterbury Museum, Christchurch.

Loc.—Wanganui. Pliocene.

Remark.—The figure in Hutton's Plioc. Moll. has the whorls more convex than the type.

Pyramidella (Eulimella) media (Hutton.)

1885. *Eulima media* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 318, pl. xviii, fig. 13.
1893. *Eulima (?) media* Hutton, Macleay Mem. Vol., Plioc. Moll., p. 56, pl. vii, fig. 43.

Shell minute, subulate, polished, straight, imperforate, microscopically faintly spirally lirate. *Sculpture* consisting of numerous fine growth-plications and fine microscopic spiral lines. *Spire* high, subcylindrical, much higher than the aperture. *Protoconch* heterostrophic, the nucleus lateral. *Whorls* about 7, convex; base slightly contracted. *Suture* much impressed. *Aperture* vertical, ovate, roundly angled above, narrowly convex below. *Outer lip* broadly convex, thin, acute. *Columella* vertical, curved towards the basal lip. *Inner lip* narrow, smooth.

Height, 3 mm.; diameter, 1·1 mm. (holotype of 4½ whorls, minus the protoconch).

Holotype and 1 *paratype* in the Canterbury Museum, Christchurch.

Loc.—Wanganui. Pliocene.

Remarks.—This species stands very near *P. levilirata* Murdoch and Suter, but it is smaller, more cylindrical, the whorls are more convex, and the suture deeper. Hutton was right when he said that it "should perhaps be placed in *Eulimella*."

Odostomia (Oceanida) georgiana Hutton.

1885. *Odostomia georgiana* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 319, pl. xviii, fig. 16.
1893. „ „ Hutton, Macleay Mem. Vol., Plioc. Moll., p. 57, pl. vii, fig. 49.

Shell fairly large, elongated, many-whorled, last whorl angled at the periphery, suture margined, a few varices, columellar fold distinct, perforated. *Sculpture* consisting of sinuous growth-lines and a few varices; a strong lens reveals very fine dense spiral striation; a fine thread margins the suture below. *Spire* high, narrowly conic, nearly twice the height of the aperture, outlines straight. *Protoconch* minute, heterostrophic. *Whorls* 10, first slowly then more rapidly increasing, flattened, body-whorl angled at the periphery and more indistinctly round the umbilical perforation; base convex. *Suture* impressed, margined. *Aperture* vertical, oval, pointed above, narrowly rounded below. *Outer lip* convex, thin and sharp. *Columella* somewhat oblique and excavated. *Inner lip* narrow, with a distinct oblique posterior fold, nearly or quite covering the narrow umbilicus.

Height, 15 mm.; diameter, 6·5 mm. (holotype).

Holotype and 5 *paratypes* in the Canterbury Museum, Christchurch.

Loc.—Wanganui. Pliocene.

Odostomia (Evalea) huttoni Suter.

1885. *Odostomia (Pyramis) fasciata* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 320; not of Dunker, 1860.
1893. *Odostomia fasciata* Hutton, Macleay Mem. Vol., Plioc. Moll., p. 58, pl. vii, fig. 50.
1908. „ *(Evalea) huttoni* Suter, Trans. N.Z. Inst., vol. xl, 1907, p. 368.

Shell minute, elongated-conical, with flat spiral liræ, leaving a smooth area at the periphery, on the lower whorls, with a minute columellar fold, perforated. *Sculpture:*

The first 3 whorls smooth, the following whorl with 2 linear grooves below the suture and 1 above it, the posterior grooves increasing to 3 on the penultimate and last whorl, a broad smooth band in the centre; base with fine spiral grooves. *Spire* high, conic, about 1½ times the height of the aperture, outlines faintly convex. *Protoconch* subheterostrophic, the nucleus obliquely raised, rounded and polished. *Whorls* 5, rather rapidly increasing, flatly convex, body-whorl and base rounded. *Suture* impressed. *Aperture* ovate, angled above, narrowly rounded below. *Outer lip* convex, thin and acute. *Columella* subvertical, lightly excavated. *Inner lip* narrow, with a nearly obsolete posterior fold. *Perforation* narrow.

Height, 3 mm.; diameter, 1·6 mm. (holotype).

Holotype and 1 *paratype* in the Canterbury Museum, Christchurch.

Loc.—Wanganui. Pliocene.

Remark.—This species is nearly allied to the Recent *O. impolita* Hutton and *O. liricincta* Suter.

Odostomia (Pyrgulina) rugata Hutton.

1885. *Odostomia (Parthenia) plicata* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 319, pl. xviii, fig. 17; not of Montfort.
1886. *Odostomia rugata* Hutton, Trans. N.Z. Inst., vol. xviii, 1885, p. 353.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 216.
1893. „ „ Hutton, Macleay Mem. Vol., Plioc. Moll., p. 58, pl. vii, fig. 51.
1905. „ *(Pyrgulina) rugata* Hutton: Murdoch, Trans. N.Z. Inst., vol. xxxvii, 1904, p. 227.
1913. „ „ „ Hutton: Suter, Man. N.Z. Moll., p. 344, pl. 17, fig. 8.

Shell small, ovato-elongated, imperforate, rather solid, axially plicated. *Sculpture* consisting of numerous oblique flatly rounded axial riblets, usually stopped by a spiral thread below the periphery of the last whorl, but very often extending over the base; the riblets on the last volution sometimes, though rarely, almost vertical; interstices of about the same width as the riblets, and adorned with minute dense spiral striæ; the riblets number about 18 on the body-whorl. *Spire* elevated conical, about twice the height of the aperture; outlines almost straight. *Protoconch* minute, of 1 smooth whorl, heterostrophic, nucleus lateral. *Whorls* 6, regularly increasing, flatly rounded; base convex. *Suture* impressed and slightly margined. *Aperture* subvertical, ovate, angled above, slightly effuse below. *Outer lip* solid, sharp, somewhat convex. *Columella* vertical, with a rather strong plait above, slightly convex below. *Inner lip* rather broad and strong, angularly produced below, and forming a distinct callosity over the parietal wall.

Height, 3 mm.; diameter, 1·5 mm. (holotype).

Holotype and 1 *paratype* in the Canterbury Museum, Christchurch.

Loc.—Wanganui (Pliocene). Also in the Miocene and Recent.

Odostomia (Jordaniella) sherriffi Hutton. Plate VIII, fig. 17.

1883. *Odostomia sherriffi* Hutton, Trans. N.Z. Inst., vol. xv, 1882, p. 411.
1893. „ „ Hutton, Macleay Mem. Vol., Plioc. Moll., p. 58.

Shell small, subulate, slightly gradate, smooth, except a fine spiral sulcus on the periphery of the lower whorls, and a strong columellar plait. *Sculpture:* All the whorls are smooth to the naked eye, but a good lens reveals a fine spiral sulcus some little distance above the suture on the third and fourth whorl, continued over the body-whorl; and there are in addition microscopic fine and close spiral lines present. *Spire* subulate, somewhat gradate, about 1½ times the height of the aperture. *Protoconch* heterostrophic. *Whorls* 5, regularly increasing, very narrowly shouldered above, flattish; base convex. *Suture* much impressed. *Aperture* ovate, angled above, rounded below. *Outer lip* thick. *Columella* short, with a strong spiral plait which extends over the base and is united with the basal lip.

Height, 2·5 mm.; diameter, 1·1 mm. (holotype).

Holotype in the Canterbury Museum, Christchurch.

Loc.—Wanganui. Pliocene.

Remark.—This species is nearly allied to the Recent *O. incidata* Suter. In Hutton's diagnosis of the species we find the number of whorls 15; length of shell, 0·55 in.; breadth, 0·17 in. = 14 × 4 mm.!

Fam. EULIMIDÆ.

Eulima (Arcuella) obliqua (Hutton).

1885. *Eulimella obliqua* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 318.
1893. „ „ Hutton, Macleay Mem. Vol., Plioc. Moll., p. 56, pl. vii, fig. 46.

Shell minute, subulate, polished, slightly curved to the left, with a spiral groove at the periphery of the body-whorl, subquadrangular aperture, and the columella turned outside the aperture. *Sculpture* consisting of a distinct spiral rib below the peripheral angle, the remainder of the shell smooth. *Spire* high, somewhat bent to the left above, with straight outlines below the curvature, about 2½ times the height of the aperture. *Protoconch* small, rounded, obtuse. *Whorls* 7, regularly increasing, flat, the last whorl distinctly angled at the periphery; base somewhat contracted. *Suture* linear. *Aperture* subquadrate, angled above, broadly convex below. *Outer lip* straight, roundly angled towards the lightly convex basal lip. *Columella* straight and vertical, extending below beyond the aperture. *Inner lip* forming a thin polished layer over the columella.

Height, 3·3 mm.; diameter, 1·3 mm. (holotype).

Holotype in the Canterbury Museum, Christchurch.

Loc.—Petane. Pliocene.

Eulima treadwelli Hutton.

1885. *Eulima micans* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 318; not of Carpenter nor T.-Woods.
1893. *Eulima treadwelli* Hutton, Macleay Mem. Vol., Plioc. Moll., p. 55, pl. vii, fig. 42.
1906. „ „ Hutton: Suter, Trans. N.Z. Inst., vol. xxxviii, 1905, p. 324.
1913. „ „ Hutton: Suter, Man. N.Z. Moll., p. 349, pl. 17, fig. 15.

Shell small, subulate, slightly curved to the right, polished. *Sculpture:* None. *Spire* curved, high conical, a little more than twice the height of the aperture. *Protoconch* small, globose. *Whorls* 6 (holotype) to 8, regularly increasing, rather high, flat; base flatly rounded. *Suture* linear, superficial. *Aperture* pyriform, angled above and rounded below. *Outer lip* almost straight, thin and sharp. *Columella* subvertical, a little arcuate. *Inner lip* slightly reflexed beyond the upper part, and spreading as a thin layer over the flat parietal wall.

Height, 3·3 mm.; diameter, 1·3 mm. (holotype). Height, 6 mm.; diameter, 2 mm. (Recent specimens of 8 whorls).

Holotype in the Canterbury Museum, Christchurch.

Loc.—Wanganui (Pliocene). Recent.

Eulima sp. Plate VIII, fig. 5.

1877. *Eulima aciculata* Pease: Hutton, Trans. N.Z. Inst., vol. ix, 1876, p. 597; not of Pease.
1887. „ „ Pease: Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 215; not of Pease.

The specimen consists of the 4 lower whorls only, and it is therefore quite useless to apply any specific name, the initial whorls being, in this genus, of very great importance. There is no specimen in the Canterbury Museum, but perfect specimens may be amongst the collections of the Geological Survey which have not been examined yet. The shell is subulate, quite smooth, polished; the whorls flat, the varices not in one line over the whorls; suture oblique, inconspicuous, simple; the aperture vertical, narrow, pyriform, narrowly angled above and convex below; inner lip narrow and thin.

Height, 7·5 mm.; diameter, 2·2 mm.; aperture, 2·3 by 1 mm.

Specimen in the Otago Museum, Dunedin.

Loc.—White Rock River. Miocene.

Fam. Fasciolariidæ.

Fusinus spiralis A. Adams, subsp. dentatus (Hutton).

1877. *Fusus dentatus* Hutton, Trans. N.Z. Inst., vol. ix, 1876, p. 594.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 207.

Shell fusiform, thin and fragile; whorls carinated, spinous, axially ribbed; canal long and straight. *Sculpture* consisting of 3 spiral threads upon the shoulder, 1 below the sharp keel on the upper whorls, increasing to 3 on the lower whorls; base and canal distantly spirally lirate; axial sculpture consisting of 12 low rounded ribs, which on the keel are produced into flattened sharp teeth; growth-lines distinct, fine and flexuous. *Spire* high, narrowly conic, more than twice the height of the aperture. *Protoconch* lost. *Whorls* 8 to 9, sharply keeled below the middle, flat above and below the keel; base contracted. *Suture* superficial, margined above by a fine thread. *Aperture* broadly triangularly ovate, suddenly narrowed into the canal, which is much produced, narrow, quite straight, and of about the same length as the spire. *Outer lip* sharp, slightly denticulated by the spiral sculpture. *Columella* straight, smooth. *Inner lip* narrow, thin, extending over the parietal wall and down into the canal.

Height, 35 mm.; diameter, 13 mm. (holotype).

Holotype of the subspecies in the Otago Museum, Dunedin.

Loc.—Mount Harris. Miocene.

Remark.—Chiefly distinguished from *F. spiralis* by the axial ribs and the slightly narrower spire.

Fusinus tegens (Hutton). Plate VIII, fig. 6.

1877. *Fusus tegens* Hutton, Trans. N.Z. Inst., vol. ix, 1876, p. 594.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 208.

Shell small, elongato-fusiform, thin, carinated, with a row of tubercles on the keel, spirally lirate anterior portion and a long canal. *Sculpture:* The 2 embryonic whorls convex and smooth, the succeeding whorls with a row of tubercles on the keel, about 11 on the body-whorl, extending as sharp axial riblets to the suture on the spire-whorls, and as narrow riblets down to the base on the body-whorl; shoulder of the whorls with flexuous growth-lines and a few indistinct spiral threads on the penultimate whorl; body-whorl with about 10 distinct, rounded, spiral riblets below the keel. *Spire* conical, gradate, slightly higher than the aperture. *Protoconch* of 2 convex whorls, the nucleus papillate. *Whorls* 7, carinated, the shoulder indistinctly concave; base contracted. *Suture* impressed. *Aperture* ovate, gradually tapering into the long narrow canal, which inclines to the left and very slightly backwards. *Outer lip* thin, angled and denticulated by the spiral sculpture. *Columella* straight, slightly truncated below. *Inner lip* thin and narrow.

Height, 10 mm.; diameter, 4 mm. (holotype).

Holotype in the Otago Museum, Dunedin.

Loc.—White Rock River. Miocene.

Exilia dalli Suter. Plate VIII, fig. 7, *a*, *b*.

1907. *Exilia dalli*, Suter, Proc. Mal. Soc. Lond., vol. vii, p. 209, pl. xviii, figs. 4, 5.

Shell slender, fusiform, longitudinally costate and spirally striate, with a narrow aperture and long straight canal. The *sculpture* consists of longitudinal close, oblique, and slightly flexuous ribs, about 20 on the penultimate whorl; they are rounded and of the same width as the interstices. Spiral sculpture formed by close-set narrow grooves, extending over the ribs, and absent over a short space below the suture from the eighth whorl downwards. *Spire* subulate, higher than the aperture. *Protoconch* small, formed by 2 smooth, shining, and rounded whorls. *Whorls* 10 on the immature specimen before me, flatly convex, regularly increasing in size, the body-whorl very little expanded, prolonged into a straight and long canal. The lower part of this is broken off. *Suture* impressed, distinct. *Aperture* narrow, pyriform. *Outer lip*, which is broken off, no doubt slightly flexuous. *Columella* with a slight elevation in the middle, 2 inconspicuous and slender plaits just below the suture, which may easily be overlooked. *Inner lip* spreading as a thin narrow glaze over the pillar.

Height, about 20 mm.; breadth, 5 mm. (holotype).

Holotype in my collection.

Loc.—White Rock, Pareora River, Canterbury. Labelled "Oamaru Series, Oligocene." Miocene (Professor J. Park, 1905).

Remarks.—Dr. W. H. Dall's comment on this species is, "Immature shell, related to, if not identical with, my *Plicifusus*. We have a Recent species.—*P. rectirostris*, Carpenter—very much like this, though larger; we have in our Eocene a number of species very similar to your fossil, and for them Conrad proposed the genus *Exilia* (which does not have plaits on the pillar, as stated by Cossmann). It is quite possible that the name should be retained, as there are some characters which seem to divide the Eocene and Oligocene forms from our similar, but always larger and coarser, *Plicifusus* of the Recent fauna. As stated in the diagnosis, my specimen has 2 columellar plaits However, I must confess that I might not have seen them if I had not especially looked for them in consequence of Cossmann's statement" (Essais Paléoconch. Comp., livr. iv, 1901, p. 26).

Latirus brevirostris (Hutton).

1877. *Turbinella brevirostris* Hutton, Trans. N.Z. Inst., vol. ix, 1876, p. 596, pl. xvi, fig. 10.

1887. *Peristernia brevirostris* Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 208.

Shell moderately large, ovato-fusiform, axially costate and spirally finely lirate, with 3 columellar plaits, a very distinct siphonal fasciole, and an umbilical chink. *Sculpture* consisting of about 17 low, rounded, vertical axial ribs, the interstices slightly broader, almost obsolete on the upper whorls, and extending to the base of the body-whorl; these are crossed by subequidistant, low and broadly convex spiral ribs, about 5 on the penultimate whorl, the interspaces as well as the ribs ornamented with fine spiral threads. *Spire* moderately high, conical, its height slightly less than that of the aperture, outlines straight. *Protoconch* obtuse, paucispiral. *Whorls* 5, first slowly, then rapidly increasing, those of the spire flatly convex, the ventricose large body-whorl convex, but suddenly contracted below; base excavated. *Suture* impressed. *Aperture* subovate, vertical, angled above, suddenly narrowed below to form a short, straight, and narrow canal. *Outer lip* broken off. *Columella* vertical, straight. *Inner lip* thin, broadly expanded, with 3 oblique plaits, the upper one strongest, and a trace of a fourth fold above it. Siphonal fasciole prominent, leaving between it and the inner lip a very narrow umbilical perforation.

Height, 37 mm.; diameter, 22 mm. (holotype).

Holotype in the Otago Museum, Dunedin.

Loc.—White Rock River. Miocene.

Fam. Mitridæ.

Mitra (Cancilla) hectori Hutton.

1905. *Mitra hectori* Hutton, Trans. N.Z. Inst., vol. xxxvii, 1904, p. 473, pl. xliv, fig. 2.

Shell moderately large, elongato-fusiform, the aperture as long as the spire, with inconspicuous spiral ornamentation, channelled suture and 4 columellar plaits. *Sculpture* consisting of 5 to 6 flat, inequidistant, and very low spiral riblets on the upper spire-whorls, being reduced to 3 or 4 distant cinguli on the lower whorls and the body; the whole surface microscopically spirally lirate, decussated by equally fine growth-lines; base very distinctly spirally ribbed. *Spire* acute, conical, angle about 25°, of the same height as the aperture with canal, outlines straight, slightly scalar. *Protoconch* small, sharply pointed. *Whorls* 11, regularly increasing, nearly flat, the lower whorls with a narrow flat shoulder-band, base slightly contracted. *Suture* canaliculate. *Aperture* long and narrow, channelled above, narrowed below to an open short canal, which is slightly twisted toward the left, base very little notched. *Outer lip* smooth, acute. *Columella* subvertical, slightly turned to the left below. *Inner lip* narrow, with 4 well-marked oblique plaits decreasing in size towards the base, a callous pad at the posterior angle.

Height, 47 mm.; diameter, 13 mm. (holotype).

Holotype in the Canterbury Museum, Christchurch.

Loc.—Waihao, near the coal-mine. Miocene. Collected by Mr. Aug. Hamilton.

Mitra inconspicua Hutton. Plate IV, fig. 7.

1885. *Mitra inconspicua* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 326.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 212.

Shell small, biconic, smooth, spire conical, shorter than the aperture, columella with 4 plaits. *Sculpture* none, except a few spiral oblique riblets on the base. *Spire* acute, conical, outlines straight, its height about two-thirds that of the aperture. *Protoconch* minute, obtuse. *Whorls* 7, regularly increasing, but the last high in proportion, rather flat, body-whorl moderately convex, contracted below. *Suture* deep. *Aperture* oblique, long and narrow, slightly channelled above, with a short open and truncated canal below. *Outer lip* lightly convex, acute, smooth. *Columella* subvertical, nearly straight. *Inner lip* narrow, with 4 almost horizontal plaits, diminishing in size towards the base, the lowest plait very small.

Height, 17 mm.; diameter, 7·5 mm. (holotype).

Holotype and 1 *paratype* in the Canterbury Museum, Christchurch.

Loc.—Mount Harris (Miocene). Also Waihao greensands.

Remark.—Much like *M. grœnlandica* Gray, but narrower anteriorly (Hutton).

Vexillum apicale (Hutton). Plate I, fig. 5.

1873. *Mitra apicalis* Hutton, Cat. Tert. Moll., p. 7, No. 50.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 212.

Shell small, elongato-fusiform, with produced spire, keeled whorls, with a row of small nodules on the keel, finely spirally striated, columella with 4 transverse plaits, the lowest of them but feebly developed. *Sculpture:* Protoconch smooth, the following whorls with a row of about 25 very small nodules upon the keel, prolonged as low riblets to the suture below, and a short distance only on the body-whorl; the whole surface ornamented with fine spiral cords, about 7 on the shoulder, the interstices linear. *Spire* turreted, a little lower than the aperture with canal. *Protoconch* papillate, of 2 convex whorls, the nucleus tilted. *Whorls* about 7, regularly increasing, keeled, the shoulder rather broad and straight, body-whorl convex below the carina, contracted towards the base. *Suture* impressed. *Aperture* oval, vertical, contracted and produced into a short canal below. *Outer lip* broken off. *Columella* slightly concave. *Inner lip* with 4 nearly transverse folds upon the columella, the lowest very close to the plait above and almost obsolete, the callosity not extending beyond the folds on the outside.

Height, 11 mm.; diameter, 5 mm. (holotype).

Plesiotypes (2) in the collection of the Geological Survey.

Loc.—Awamoa. Miocene.

Remarks.—The holotype was sent to the late Professor R. Tate, Adelaide, but not returned. The figure was made after the holotype by the late Mr. Buchanan.

Vexillum linctum (Hutton). Plate VIII, fig. 8.

1885. *Turricula lincta* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 326.
1893. „ „ Hutton, Macleay Mem. Vol., Plioc. Moll., p. 47.

Shell small, fusiform, turreted, with numerous small nodules upon the shoulder, smooth or spirally striated, the inner lip with 4 plaits. *Sculpture:* Protoconch smooth, the following whorls with about 16 axial costæ, which are produced into distinct nodules upon the angle of the whorls, the costæ remaining inconspicuous; the holotype, which is neanic, shows only spiral striation on the base, but specimens in my collection show sometimes very distinct spiral striation, whilst others are almost devoid of it. *Spire* turreted, slightly lower than the aperture. *Protoconch* of 2 convex whorls, papillate, the nucleus eccentric. *Whorls* 7 (4 in holotype), regularly increasing, the last high, very distinctly shouldered, the shoulder concave on the earlier, straight on the later whorls, flat below the carina; body-whorl lightly convex; base somewhat contracted. *Suture* not deep, margined below. *Aperture* a little oblique, narrow, angled above, with a short, open, somewhat recurved and truncated canal below. *Outer lip* thin and sharp, convex, contracted below. *Columella* somewhat oblique. *Inner lip* narrow, with 4 but little oblique plaits, decreasing in size towards the base, the anterior plait very small.

Height, 5 mm.; diameter, 2·8 mm. (holotype). Height, 13 mm.; diameter, 5 mm. (adult specimen in my collection).

Holotype in the Canterbury Museum, Christchurch.

Loc.—Petane. Pliocene.

Vexillum marginatum (Hutton).

1885. *Turricula marginata* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 315, pl. xviii, fig. 4; not *Vulpecula marginata* Suter, Trans. N.Z. Inst., vol. xl, 1908, p. 349, pl. xxvii, fig. 8.
1893. *Turricula marginata* Hutton, Macleay Mem. Vol., Plioc. Moll., p. 47.
1906. *Vulpecula (Pusia) biconica* Murdoch and Suter, Trans. N.Z. Inst., vol. xxxviii, 1905, p. 289, pl. xxiii, fig. 22.
1913. *Vexillum marginatum* Hutton: Suter, Man. N.Z. Moll., p. 363, pl. 18, fig. 4.

Shell very small, biconic, with a row of nodules on the angle of the whorls, suture margined, columella with 4 plaits. *Sculpture:* Protoconch smooth, on the following whorls about 14 axial rounded ribs, produced into nodules on the angle of the whorls, with fine spiral threads, mostly absent on the shoulder; below the suture a broad rim. *Spire* conoidal, of nearly the same height as the aperture. *Protoconch* of 1½ whorls, smooth, papillate, nucleus broadly convex, slightly tilted. *Whorls* 5 to 7, rapidly increasing, distinctly angled; base contracted. *Suture* impressed, margined. *Aperture* somewhat oblique, narrow, with subparallel sides, angled above, at the base with a distinct, short, open canal, truncated below. *Outer lip* thin and sharp, subangled above, contracted below. *Columella* subvertical, faintly concave. *Inner lip* narrow, with 4 plaits, the first and second nearly horizontal, the others oblique, the basal plait very small.

Height, 6·5 mm.; diameter, 3 mm. (lectotype). Height, 8 mm.; diameter, 3·2 mm. (syntype).

Lectotype and 1 *syntype* in the Canterbury Museum, Christchurch. *Holotype* of *V. biconica* in the Dominion Museum, Wellington.

Loc.—Wanganui (Pliocene). Also Recent.

Remarks.—Not having seen Hutton's type, Mr. Murdoch and myself described and figured this shell as a new species; on the other hand, I identified an evidently new species as Hutton's *V. marginatum*, which I named *pseudo-marginatum* (Man. N.Z. Moll., p. 364, pl. 18, fig. 5); it also occurs in the Wanganui Pliocene. I select the perfect though smaller specimen as lectotype.

Vexillum planatum (Hutton).

1885. *Turricula planata* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 315, pl. xviii, fig. 3.
1893. „ „ Hutton, Macleay Mem. Vol., Plioc. Moll., p. 47.
1913. *Vexillum planatum* Hutton: Suter, Man. N.Z. Moll., p. 365, pl. 18, fig. 6.

Shell small, ovato-fusiform, solid, axially costate. *Sculpture* consisting of distant not very distinct spiral striæ, the base with a few oblique rounded riblets; all the whorls below the protoconch are prominently axially costate, the ribs beginning a short distance below the suture above, but extending to the suture below and nearly to the base on the body-whorl; they number 12 to 14 in a whorl, are angularly rounded, the interstices slightly wider. *Spire* elevated, conic, acute, of the same height as the aperture; outlines nearly straight. *Protoconch* of $1\frac{1}{2}$ smooth whorls, minute, papillate, the nucleus tilted. *Whorls* 7, first slowly increasing, the last high, flatly convex; base somewhat contracted. *Suture* impressed, undulating, submargined below. *Aperture* narrow and high, angled above, with a short, open, and lightly recurved canal below, which is distinctly notched at the base. *Outer lip* moderately arched, sharp, somewhat thickened and smooth inside. *Columella* subvertical. *Inner lip* narrow, with 4 slightly oblique plaits, decreasing in size towards the base, the uppermost sometimes continued as an oblique riblet over the neck.

Height, 14 mm.; diameter, 6 mm. (holotype).

Holotype in the Canterbury Museum, Christchurch.

Loc.—Wanganui (Pliocene). Recent.

Remark.—All specimens I have seen are a little smaller than the holotype.

Fam. Chrysodomidæ.

Siphonalia costata (Hutton).

1877. *Neptunæa (Sipho) costatus* Hutton, Trans. N.Z. Inst., vol. ix, 1876, p. 594, pl. xvi, fig. 2.
1887. *Siphonalia costata* Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 209.

Shell rather small, broadly fusiform, axially costate and spirally lirate, whorls distinctly shouldered, spire rather short, canal oblique, short. *Sculpture* consisting of 12 rounded axial costæ, faint upon the shoulder, but very distinct from the keel downwards, and extending on the body-whorl to the base; they are crossed by strong, somewhat unequal, spiral cords with slightly broader interspaces. *Spire* conical, not high, of the same height as the aperture with canal. *Protoconch* lost, but evidently small. *Whorls* 7 to 8, regularly increasing, the last large, with a concave shoulder, the body-whorl slightly convex below the rounded keel, much contracted below. *Suture* inconspicuous, wavy. *Aperture* somewhat oblique, ovate, with a small sinus above, produced below into a rather short open and oblique canal, strongly twisted to the left and slightly recurved. *Outer lip* sharp, angled, lirate within. *Columella* short, straight, slightly truncated below. *Inner lip* thin and narrow.

Height, 30 mm.; diameter, 19 mm. (holotype).

Holotype and 1 *paratype* in the Otago Museum, Dunedin.

Loc.—Mount Harris. Miocene.

Remarks.—Hutton added to our Tertiary fauna *Siphonalia regularis* Sowerby (P.L.S. N.S.W. (2), vol. i, 1886, p. 209). There are specimens in the Canterbury Museum from Awamoa and Pareora which agree very well with *S. costata* Hutton. The latter species is no doubt nearly allied to the South American *S. regularis* Sowerby, but specimens have first to be compared to decide whether the two are conspecific or not. For the present it seems to me advisable to omit *S. regularis* from our list.

Siphonalia orbita Hutton. Plate IV, fig. 8.

1885. *Siphonalia orbita* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 326.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 208.

Shell moderately large, fusiform, spire gradate, with strong and rather distant spiral ribs and indistinct axial costæ, vanishing towards the base, moderate anterior canal. *Sculpture:* Protoconch smooth, the post-embryonic whorls with distant strong spiral ribs, none on the shoulder of the whorls; there are 3 and then 4 of these cinguli on the spire-whorls, a fourth and fifth margining the suture above, the interstices slightly wider than the ribs; on the body-whorl there are 11 to 12 of these flattish cinguli with much wider interspaces; indistinct axial ribs, about 13 to 14 on a whorl, render the upper 2 or 3 spiral ribs on each whorl distinctly nodulous, but they disappear on the body-whorl below the second spiral; the whole surface with fine growth-striæ. *Spire* conical, gradate, slightly higher than the aperture without canal. *Protoconch* of 2½ whorls, apex rounded. *Whorls* 7, regularly increasing, the body-whorl large and ventricose, shoulder concave, below it convex; base contracted. *Suture* well impressed, the whorls overlapping it. *Aperture* subvertical, oval, angled above, with a moderately long, open, oblique and slightly recurved canal, truncated at its base. *Outer lip* convex, denticulated on the outside by the spirals. *Columella* vertical, straight, truncated and turned to the left below. *Inner lip* not thick, smooth, narrow, tapering towards the canal.

Height, 37 mm.; diameter, 19 mm. (holotype).

Holotype in the Canterbury Museum, Christchurch.

Loc.—Greta. Miocene.

Euthria drewi (Hutton).

1883. *Cominella drewi* Hutton, Trans. N.Z. Inst., vol. xv, 1882, p. 410.
1893. *Pisania drewei* Hutton, Macleay Mem. Vol., Plioc. Moll., p. 42, pl. vi, fig. 13.

Shell rather small, ovate, spirally lirate and distinctly axially costate on the upper whorls only, with distinct short canal and denticulate outer lip. *Sculpture* consisting of narrow, flatly rounded spiral liræ, 4 to 5 on the spire-whorls, about 12 on the body-whorl of the holotype, 16 on the paratype, the interstices of the same width or narrower than the cinguli; the upper whorls with about 16 straight axial riblets, which vanish on the body-whorl. *Spire* conical, of the same height as the aperture with canal, outlines faintly convex. *Protoconch* (lost on the holotype) smooth, obtuse. *Whorls* 5 to 6, the last high in proportion, lightly convex; base contracted. *Suture* not deep. *Aperture* subvertical, ovate, with a distinct posterior canal, produced below into an oblique, narrow, and short canal, its base slightly notched. *Outer lip* convex, somewhat thickened, denticulate inside. *Columella* straight, truncated and turned to the left below. *Inner lip* smooth, except for a denticle marking the posterior canal, narrow, tapering below.

Height, 17 mm.; diameter, 8 mm. (holotype).

Holotype and 1 *paratype* in the Canterbury Museum, Christchurch.

Loc.—Wanganui (Pliocene). Also Petane.

Euthria media (Hutton). Plate IV, figs. 9, 10.

1885. *Pisania media* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 326.
1887. ,, ,, Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 209.

Shell moderately large, elongated ovate, strongly and narrowly spirally lirate, with a short distinct anterior canal. *Sculpture* consisting of close convex spiral ribs, 12 on the penultimate whorl, with slightly narrower interstices, crossed by growth-lines only. *Spire* conical, its outlines a little convex, of about the same height as the aperture with canal. *Protoconch* smooth, of 2 rounded whorls, the apex obtuse. *Whorls* 6 to 7, first slowly, then more rapidly increasing, lightly convex; base contracted. *Suture* well impressed. *Aperture* ovate; canal distinct, short. *Outer lip* convex. *Columella* short and straight, bent to the left below. *Inner lip* smooth, narrow.

Height, 24 mm.; diameter, 12 mm. (holotype).

Holotype and 2 *paratypes* in the Canterbury Museum, Christchurch.

Loc.—Waikari (Miocene). Also Pareora and White Rock River.

Remark.—The holotype has the greater part of the outer lip broken off.

Euthria striata (Hutton).

1875. *Cominella striata* Hutton, Trans. N.Z. Inst., vol. vii, 1874, p. 458, pl. xxi.
1884. *Pisania striata* Hutton, *op. cit.*, vol. xvi, 1883, p. 230; not of Gmelin.
1893. ,, *striatula* Hutton, Macleay Mem. Vol., Plioc. Moll., p. 42, pl. vi, fig. 12.
1904. *Euthria striata* Hutton, Index Faunæ N.Z., p. 73.
1913. ,, ,, Hutton: Suter, Man. N.Z. Moll., p. 379, pl. 45, fig. 1.

Shell fusiform, rather small, spirally lirate. *Sculpture* consisting of equidistant, narrow, and flatly rounded spiral ridges, the interspaces with fine spiral threads; whorls below the protoconch with broadly rounded axial ribs, extending sometimes over all the spire-whorls; growth-lines distinct, flexuous. *Spire* conical, about the same height as the aperture with canal, outlines straight. *Protoconch* very small, papillate, of 2 smooth convex whorls. *Whorls* 6 to 7, first slowly increasing, the last high, rounded, flattened below the suture; base contracted, concave. *Suture* impressed. *Aperture* subvertical, oval, channelled above, with a moderately long oblique canal below, which is recurved, open, and notched at the base. *Outer lip* convex, thickened and grooved in adult specimens. *Columella* vertical, slightly concave, with a few small tubercles below. *Inner lip* rather broadly extended over the pillar, forming but a thin callosity upon the parietal wall, which has 1 or 2 plaits below the suture; below the lip is narrowed, drawn out to a fine point half-way down the margin of the canal.

Height, 30 mm.; diameter, 15 mm.; angle of spire, 45° (holotype).

Holotype and 1 *paratype* in the Otago Museum, Dunedin.

Loc.—Wanganui (Pliocene). Also Recent.

Fam. Buccinidæ.

Cominella acuminata Hutton.

1885. *Cominella elongata* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 315, pl. xviii, fig. 5; not of Dunker.
1893. *Cominella accuminata* Hutton, Macleay Mem. Vol., Plioc. Moll., p. 43, pl. vi, fig. 14.

Shell moderately large, elongated, with spiral grooves and, on the upper whorls only, axial costæ, high and acuminate spire, and a deeply notched short siphonal canal. *Sculpture:* The protoconch smooth, the next 3 or 4 whorls with about 10 or 11 axial riblets; all the post-embryonic whorls bear distant spiral grooves, 5 on the spire-whorls and 9 on the body-whorl; the siphonal fasciole with carinated upper margin. *Spire* high and narrow, with straight outlines, twice the height of the aperture in adult specimens. *Protoconch* formed by $2\frac{1}{2}$ convex smooth whorls, the nucleus obtuse and slightly tilted. *Whorls* 7 to 8, regularly and rather rapidly descending, convex, but slightly flattened below the suture; base flattish, very little contracted. *Suture* well impressed. *Aperture* vertical, ovate, with a slightly marked channel above, produced below into a short, oblique, broad and deeply notched canal. *Outer lip* solid, acute, strongly convex, lightly plicated inside. *Columella* excavated, twisted below towards the siphonal canal. *Inner lip* callous, narrow, smooth.

Height, 32 mm.; diameter, 13 mm.; angle of spire, 30° (holotype).

Holotype and 1 *paratype* in the Canterbury Museum, Christchurch.

Loc.—Wanganui. Pliocene.

Cominella huttoni Kobelt.

1878. *Cominella huttoni* Kobelt, Jahrb. Deutsch. Malak. Gesellsch., p. 233.
1885. *Clathurella hamiltoni* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 316, pl. xviii, fig. 7.
1893. „ „ Hutton, Macleay Mem. Vol., Plioc. Moll., p. 52, pl. vii, fig. 35.
1900. „ „ Hutton: Murdoch, Trans. N.Z. Inst., vol. xxxii, 1899, p. 219.
1913. *Cominella huttoni* Kobelt: Suter, Man. N.Z. Moll., p. 384, pl. 45, fig. 5.

The four type specimens in the Canterbury Museum of Hutton's species are undoubtedly *C. huttoni* Kobelt, the spiral liræ being more prominent than is usually the case in Recent specimens.

If the shell belonged to the family *Turritidæ* I would class it under *Mangilia*, not *Clathurella*, as the outer lip is not denticulate inside, and the columella bears no rugosities, nor is there a parietal tubercle. The shell has, however, no sinus on the outer lip, the nucleus of the protoconch is not tilted, and the base of the canal is not truncated, but deeply notched.

Type specimens of *C. hamiltoni* Hutt. in the Canterbury Museum, Christchurch.

Loc.—Petane. Pliocene.

Cominella monilifera Hutton. Plate IV, fig. 11.

1885. *Cominella monilifera* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 327.

Shell small, solid, ovate, with low spire, broadly margined suture, axially costate and spirally lirate, aperture with distinct posterior channel and short oblique siphonal canal, outer lip dentate inside. *Sculpture* consisting of about 18 oblique, elevated, and rounded axial costæ, obsolete upon the base of the body-whorl, the interstices deep and narrower than the ribs; a broad convex band margins the suture below, 3 to 5 spiral cords on the spire-whorl and the penultimate whorl render the axials nodulous; about 12 spirals on the body-whorl, increasing in width towards the base. *Spire* short, conical, of the same height as the aperture. *Protoconch* broken off, the inside of the volutions, very likely 2, only left. *Whorls* about 5, convex, rather rapidly increasing, the body-whorl ventricose, base flattened. *Suture* superficial, broadly margined below. *Aperture* vertical, semi-oval, the posterior channel strongly marked, with a short, oblique, and notched anterior canal. *Outer lip* callous, rounded, depressed above, convex, denticulate inside, a prominent tooth at the mouth of the canal. *Columella* vertical, slightly excavated, twisted towards the canal. *Inner lip* narrow, smooth, but with a distinct plait above to mark the channel.

Height, 17 mm.; diameter, 11 mm. (holotype).

Holotype in the Canterbury Museum, Christchurch.

Loc.—Shepherd's Hut, Waipara. Miocene

Cominella ordinatis Hutton.

1877. *Cominella ordinatis* Hutton, Trans. N.Z. Inst., vol. ix, 1876, p. 596, pl. xvi, fig. 8.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 210.

Shell very small, ovate, finely spirally lirate. *Sculpture* consisting of fine spiral threads on the body-whorl, close together and equal on the upper third of the whorl, stronger and finer threads alternating at the middle, and more distant, stronger spirals upon the base; the spire-whorls with obsolete nodulous axial ribs, about 10 on a whorl. *Spire* conical, about the same height as the aperture, its outlines faintly convex. *Protoconch* lost. *Whorls* 5 or 6, slightly convex, the body-whorl convex, flattened below the suture, contracted at the base. *Suture* not much impressed. *Aperture* slightly oblique, narrow, with an upper sinus, produced below into an oblique short canal, its end broken off. *Outer lip* broadly convex, solid and acute, smooth inside. *Columella* vertical, straight, short. *Inner lip* distinct, narrow.

Height, 13 mm.; diameter, 8 mm. (holotype).

Holotype in the Otago Museum, Dunedin.

Loc.—White Rock River. Miocene.

Phos cingulatus (Hutton). Plate IV, fig. 12.

1885. *Nassa (Tritiaria) cingulata* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 327.
1887. *Clathurella cingulata* Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 210 (as synonym of *Nassa incisa*).

Shell rather large, elongato-ovate, with an acute high spire, cancellated by axial and spiral ribs, the whorls narrowly shouldered, with a short, wide, and notched siphonal canal. *Sculpture:* The protoconch smooth, the following whorls with numerous oblique rounded axial ribs, about 16 on a whorl, vanishing on the lower half of the body-whorl, the interstices rather deep and narrower than the ribs; spire-whorls with 6 high rounded spiral cords passing over the axials, 2 upon the shoulder, which are slightly finer, the interspaces of the same width as the cinguli; body-whorl with about 12 spirals with wider interstices towards the base. *Spire* rather high, conical, about $1\frac{1}{3}$ times the height of the aperture. *Protoconch* of 2 convex whorls, the nucleus obtuse. *Whorls* 7, regularly increasing, narrowly and flatly shouldered, convex below; the body-whorl rather large, contracted below. *Suture* not much impressed. *Aperture* ovate, narrowly angled above, produced anteriorly into a short, wide, oblique canal, its base notched. *Outer lip* thickened by an axial rib, lightly striate inside. *Columella* vertical, short, twisted to the left, with a slight fold, towards the canal. *Inner lip* narrow, smooth.

Height, 27 mm.; diameter, 13 mm.; angle of spire, 40° (holotype).

Holotype and 2 *paratypes* in the Canterbury Museum, Christchurch.

Loc.—Greta, Canterbury. Miocene.

Phos incisus (Hutton). Plate IV, fig. 13.

1885. *Clathurella incisa* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 328.
1887. *Nassa incisa* Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 210.

Shell moderately large, ovate, almost biconic, whorls shouldered, with prominent axial and spiral ribs, aperture ovate, with a short siphonal canal. *Sculpture:* Protoconch smooth, the post-embryonic whorls with almost vertical rounded axial ribs, which extend to the base on the body-whorl, the interstices concave, slightly narrower than the costæ, ribs 16 on a whorl; they are crossed by narrowly rounded, conspicuous spiral riblets, 9 on the penultimate whorl, 2 of them upon the shoulder, body-whorl with 13 spirals; the interstices on the spire and the upper part of the body are a little narrower than the cinguli, but wider on the base. *Spire* rather short, conical, of the same height as the aperture with canal. *Protoconch* papillate, of 2 whorls. *Whorls* 6, regularly increasing, distinctly narrowly shouldered, convex below; body-whorl ventricose, contracted at the base. *Suture* not impressed. *Aperture* ovate. *Outer lip* and canal broken off. *Columella* vertical, straight, with a slight fold below, and twisted to the left. *Inner lip* narrow, smooth.

Height, 20 mm.; diameter, 11 mm.; angle of spire, 52° (holotype).

Holotype in the Canterbury Museum, Christchurch.

Loc.—Te Aute, Hawke's Bay. . Miocene.

Fam. ALECTRIONIDÆ.

Alectrion socialis (Hutton).

1877. *Nassa (Uzita) compta* Hutton, Trans. N.Z. Inst., vol. ix, 1876, p. 596, pl. xvi, fig. 9; not of A. Adams.
1886. *Nassa socialis* Hutton, Trans. N.Z. Inst., vol. xviii, 1885, p. 333.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 210.
1887. „ *tatei* T.-Woods: Hutton, *t.c.*, p. 480; not of T.-Woods.

Shell small, ovate, axially costate and strongly spirally lirate, the post-embryonic whorls narrowly shouldered, aperture ovate with a short oblique canal. *Sculpture:* The protoconch smooth, the succeeding whorls with about 14 oblique narrowly rounded axial ribs, the interstices on the body-whorl broader than the ribs; the whole crossed by strong spiral threads, those on the shoulder finer and closer together, 6 to 7 on the penultimate whorl, the spirals extending over the base and the neck of the canal. *Spire* conic, 1½ times the height of the aperture. *Protoconch* of 2½ convex whorls, the nucleus very small. *Whorls* 6, first slowly, then regularly increasing, the last large in proportion, narrowly shouldered, the body-whorl convex, suddenly contracted at the base. *Suture* channelled. *Aperture* broadly ovate, produced below into a wide short canal, inclined to the left, slightly curved and sinuated at the base. *Outer lip* with a varix, dentate inside. *Columella* short and vertical, a little excavated. *Inner lip* narrow, sometimes with a tooth above, its outer margin partly free in one specimen.

Height, 8 mm.; diameter, 4·5 mm. (holotype).

Holotype and 2 *paratypes* in the Otago Museum, Dunedin.

Loc.—White Rock River (Miocene). Also in the Pliocene of Petane.

Remark.—Tate (Trans. Roy. Soc., South Aust., vol. x, 1888, p. 170) says that *Nassa tatei* T.-Woods is a distinct species.

Fam. MURICIDÆ.

Trophon (Xanthochorus) expansus Hutton.

1883. *Trophon expansus* Hutton, Trans. N.Z. Inst., vol. xv, 1882, p. 410.
1893. „ „ Hutton, Macleay Mem. Vol., Plioc. Moll., p. 39, pl. vi, fig. 5.
1903. *Trophon (Xanthochorus) expansus* Hutton: Cossmann, Essais Palæoconch. Comp., livr. 5, p. 52, pl. iii, fig. 6.

Shell moderately large, ventricose, with fine spiral liræ and feeble axial riblets on the upper whorls, outer lip expanded. *Sculpture:* Protoconch smooth, the succeeding volutions with fine and close spiral liræ, 5 on the spire-whorls, about 26 on the body-whorl, the cinguli of the spire being sometimes divided by a median groove; the interstices of about half the width of the cinguli; the upper spire-whorls are cancellated by low, roundish, close radial riblets, about 20 on a whorl, but they are reduced to laminæ of growth farther down and upon the body-whorl. *Spire* rather short, conical, about the height of the aperture without the canal. *Protoconch* of $1\frac{1}{2}$ convex whorls, the nucleus obtuse. *Whorls* 5 to 6, subangled above, convex, the last rather large and ventricose; base much contracted. *Suture* not deep. *Aperture* ovate, wide, angled above and below the shoulder, produced below into a large, short, and oblique canal, truncated below. *Outer lip* rather thin, convex, crenulated inside, and with a low tubercle below at the origin of the canal. *Columella* vertical, a little excavated above, rounded, suddenly turned to the left towards the canal. *Inner lip* smooth, thin, broad, covering the umbilical fissure.

Height, 22 mm.; diameter, 13 mm. (holotype).

Holotype and 2 *paratypes* in the Canterbury Museum, Christchurch.

Loc.—Wanganui (Pliocene). Also Petane and Matapiro.

Typhis maccoyi Tenison-Woods.

1876. *Typhis maccoyi* T.-Woods, Pap. Roy. Soc. Tasm., 1875, p. 22, pl. i, fig. 5.
1877. ,, *hebetatus* Hutton, Trans. N.Z. Inst., vol. ix, 1876, p. 594, pl. xvi, fig. 1.
1897. ,, *maccoyi* T.-Woods: Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 170.

Shell ovato-fusiform, moderately large, with keeled whorls, 4 spinous varices, tubular spines, ovate aperture, and short closed canal. *Sculpture:* The 2 embryonic whorls smooth, the following whorls medially keeled, body-whorl with 4 spinous varices which end posteriorly on the blunt posterior keel in a strong spine, anteriorly they are flatly expanded; there are 5 to 6 spines on each varix, which diminish in size towards the base; the spines of the varices of the second posterior whorl are sometimes connected by a faint spiral ridge; between each varix is a tubular spine; the posterior whorls with alternating conical spines and tubular projections; surface marked with striæ of growth. *Spire* gradate, conical, somewhat less than twice the height of the aperture. *Protoconch* of 2 smooth and rounded whorls, the pullus tilted. *Whorls* $7\frac{1}{2}$, squarely rounded and medially keeled; base contracted. *Suture* wavy, not impressed. *Aperture* ovate. *Peristome* continuous, thick, erect. *Canal* closed, compressed, of moderate length, curved to the right; anterior varix decurrent on the outer face of the canal.

Height, 29 mm.; diameter, 20 mm. (holotype of *T. hebetatus*).

Holotype of *T. maccoyi* in the Hobart Museum, Tasmania; *holotype* of *T. hebetatus* in the Otago Museum, Dunedin.

Loc.—Mount Harris. Miocene.

Remark.—The identification of *T. hebetatus* with the Australian *T. maccoyi* rests upon the comparison of authentic specimens (Tate).

Fam. Cancellariidæ.

Admete ambigua Hutton.

1885. *Admete (?) ambigua* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 320, pl. xviii, fig. 18.
1893. ,, ,, Hutton, Macleay Mem. Vol., Plioc. Moll., p. 59, pl. vii, fig. 54.

Shell minute, ovate, with an umbilical chink, spirally closely lirate, columella smooth. *Sculpture:* Protoconch smooth, the following whorls with fine spiral threads, separated by linear grooves, the penultimate whorl with 7 cinguli, the median one double the width of the others, body-whorl with about 18 spirals. *Spire* conic, of about the same height as the aperture. *Protoconch* of 1 convex whorl, the nucleus elevated, papillary. *Whorls* 3, the last large, moderately convex; base narrowed, flattish. *Suture* well marked. *Aperture* ovate, angled above, slightly narrowed and effuse below. *Outer lip* lightly convex. *Columella* vertical, very little excavated, smooth, rather produced and slightly twisted below. *Inner lip* thin and narrow, not spreading beyond the columella. There is a minute umbilical chink.

Height, 3 mm.; diameter, 2 mm. (holotype).

Holotype in the Canterbury Museum, Christchurch.

Loc.—Wanganui. Pliocene.

Remark.—The specimen is no doubt only at the beginning of the neanic stage, but I hold that the classification under *Admete* will prove to be correct.

Admete lacunosa (Hutton).

1885. *Cancellaria lacunosa* Hutton, Trans. N. Z. Inst., vol. xvii, 1884, p. 320.
1893. „ „ Hutton, Macleay Mem. Vol., Plioc. Moll., p. 59, pl. vii, fig. 53.

Shell moderately large, buccinoid, imperforate, axially and spirally ribbed, with 3 columellar plaits. *Sculpture:* Protoconch smooth, the following whorls with equidistant, oblique, rounded axial ribs extending to the base, about 17 on the last whorl, crossed by 3 spiral ribs on the spire-whorls, 8 on the body-whorl, the points of intersection slightly nodulous; interstices with 2 fine spiral threads close to the cinguli, about 4 below the suture. *Spire* conical, slightly gradate, of the same height as the aperture. *Protoconch* of 2 whorls, rounded, the nucleus oblique and flattened. *Whorls* 6, regularly increasing, very lightly shouldered, convex below; base very little contracted. *Suture* impressed. *Aperture* vertical, broadly ovate, angled above, with a very short basal canal which is not notched. *Outer lip* convex, smooth inside, strengthened by the last axial rib. *Columella* subvertical, excavated above. *Inner lip* somewhat callous, narrow, with 3 equidistant prominent oblique folds.

Height, 14 mm.; diameter, 9 mm. (holotype).

Holotype and 1 *paratype* in the Canterbury Museum, Christchurch.

Loc.—Petane. Pliocene.

Fam. PYRENIDÆ.

Alcira angustata (Hutton). Plate VIII, fig. 9.

1886. *Columbella angustata* Hutton, Trans. N.Z. Inst., vol. xviii, 1885, p. 333.
1893. „ „ Hutton, Macleay Mem. Vol., Plioc. Moll., p. 45.
1902. „ „ Hutton: Pace, Proc. Mal. Soc. Lond., vol. v, p. 54.

Shell fairly large, elongato-fusiform, spirally lirate, with a very short canal, convex and smooth outer lip. *Sculpture:* Protoconch smooth, the post-embryonic whorls with flat and low spiral cords, 7 on the penultimate whorl, and about 15 on the body-whorl; they are separated by linear, rather shallow, grooves; retrocurrent growth-striæ are distinctly visible. *Spire* acuminate, conical, very little higher than the aperture. *Protoconch* (the nucleus lost) consisting very likely of 2 convex volutions. *Whorls* 5 to 6, regularly increasing, flatly convex, the base slightly contracted. *Suture* well marked. *Aperture* narrow, elongately oval, not contracted in the middle, angled above, with a very short open canal below, its base truncated. *Outer lip* moderately convex, thin and sharp, anterior part smooth inside. *Columella* straight, truncated and slightly twisted towards the canal. *Inner lip* thin, narrow, smooth, drawn out to a point below.

Height, 10·5 mm.; diameter, 4·2 mm. (holotype).

Holotype in the Canterbury Museum, Christchurch.

Loc.—Petane. Pliocene.

Alcira varians (Hutton).

1885. *Columbella varians* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 314, pl. xviii, fig. 2 ; not of Sowerby, 1832.
1893. *Columbella varians* Hutton, Macleay Mem. Vol., Plioc. Moll., p. 44, pl. vi, fig. 16.
1899. *Surcula varians* Hutton : Suter, Trans. N.Z. Inst., vol. xxxi, 1898, p. 69.
1906. *Columbella inconstans* Suter, Trans. N.Z. Inst., vol. xxxviii, 1905, p. 329.
1913. *Alcira varians* Hutton : Suter, Man. N.Z. Moll., p. 442, pl. 20, fig. 4.

Shell small, oblong, solid, spirally grooved or smooth. *Sculpture:* The whole shell is either smooth, with a few spiral grooves on the neck of the canal only, or distantly spirally ribbed, the ribs very unequal in number and width; on the penultimate whorl they vary from 2 to 5, and their number may be up to 15 on the body-whorl; the ribs are flat, usually broad on the spire-whorls, but narrow on the base; the interstices are mostly much narrower than the riblets; the fine growth-lines are distinct only in the moderately deep grooves. *Spire* elevated, conic, nearly twice the height of the aperture, outlines straight, sometimes slightly scalar. *Protoconch* small, papillate, of 2 smooth whorls. *Whorls* 7, regularly increasing, periphery of body-whorl convex; base somewhat contracted. *Suture* canaliculate. *Aperture* vertical, oval and narrow, lightly channelled above, produced below into a short open and slightly oblique canal, its base moderately notched. *Outer lip* flatly convex, thickened, with a few small denticles within, the uppermost larger than the others. *Columella* vertical, straight, and smooth, with an oblique spiral fold at its base, distinctly visible on looking up through the canal. *Inner lip* narrow and thin, spreading over the straight parietal wall.

Height, 9·5 mm.; diameter, 4 mm. (lectotype).

Lectotype and 4 *syntypes* in the Canterbury Museum, Christchurch.

Loc.—Wanganui (Pliocene). Also Petane and Recent.

Anachis cancellaria (Hutton).

1885. *Columbella cancellaria* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 314.
1893. ,, ,, Hutton, Macleay Mem. Vol., Plioc. Moll., p. 45, pl. vi, fig. 18.
1902. ,, ,, Hutton : Pace, Proc. Mal. Soc. Lond., vol. v, p. 64.

Shell moderately large, elongato-ovate, with an acute spire, well-developed spiral liræ which are cancellated by less conspicuous axial riblets, short siphonal canal, outer lip straightened, denticulate inside. *Sculpture:* Protoconch smooth, the succeeding whorls with prominent spiral liræ, 4 to 5 on the penultimate, and about 15 on the body-whorl, the interstices about the same width as the cinguli; a smooth cord is margining the suture below; these spirals are cancellated by weaker axial riblets, about 18 on a whorl, which may die away on the base or persist. *Spire* acute, narrowly conical, somewhat higher than the aperture with canal. *Protoconch* papillate, of 2 convex volutions. *Whorls* 6 to 7, regularly increasing, convex, the body-whorl subcylindrical, slightly compressed at the base. *Suture* well marked, margined. *Aperture* vertical, narrow, the margins parallel, lightly channelled above, below with a very short open canal, its base faintly notched. *Outer lip* thickened, sharp, straight at the middle, denticulate inside. *Columella* vertical and straight, with a light notch a little below the middle, which, however, is absent in the younger specimen. *Inner lip* narrow, with a callous pad below the suture.

Height, 13 mm.; diameter, 5 mm. (holotype).

Holotype and 1 *paratype* in the Canterbury Museum, Christchurch.

Loc.—Petane (Pliocene). Also Wanganui.

Remarks.—The species is distinguished from the nearly allied *A. pisaniopsis* by the more cylindrical form, the coarser spiral sculpture, the margined suture, and the more cylindrical body-whorl. The ratio of diameter to height is 1 : 2·6; in *A. pisaniopsis,* 1 : 2·3.

Anachis pisaniopsis (Hutton).

1885. *Columbella pisaniopsis* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 314.
1893. „ „ Hutton, Macleay Mem. Vol., Plioc. Moll., p. 45, pl. vi, fig. 17.
1902. „ „ Hutton : Pace, Proc. Mal. Soc. Lond., vol. v, p. 122.

Shell moderately large, elongato-ovate, spirally finely ribbed and axially costate, with narrow aperture and short canal. *Sculpture:* Protoconch smooth, the following whorls with close spiral ribs, 6 on the penultimate whorl, about 18 on the body-whorl, the interstices narrower than the cinguli; they are crossed by 18 to 20 axial plications which are not strong, and vanish on the lower half of the body-whorl. *Spire* high, acute, scalar, very little higher than the aperture with canal. *Protoconch* papillate, of 2 convex volutions. *Whorls* 6, regularly increasing, convex, sometimes a little flattened below the suture; base contracted. *Suture* well marked. *Aperture* narrow, the margins subparallel, roundly angled behind, with a very short open canal anteriorly, its base truncated. *Outer lip* straightened at the middle, strong and sharp, lightly denticulate inside. *Columella* straight, turned to the left below towards the canal. *Inner lip* thin and narrow, tapering to a point below.

Height, 10·5 mm.; diameter, 4·5 mm. (lectotype).

Lectotype and 6 *syntypes* in the Canterbury Museum, Christchurch.

Loc.—Petane (Pliocene). Also Matapiro.

Fam. Volutidæ.

Fulguraria (Alcithoe) aculeata (Hutton). Plate IV, fig. 14.

1885. *Voluta aculeata* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 325.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 212.

Shell small, fusiform, spire produced, acute, whorls broadly shouldered, with distant sharp tubercles upon the carina, aperture narrow, columella with 4 plaits. *Sculpture* consisting of short, broadly rounded axial ribs, produced into sharp tubercles pointing outwards on the carina, 8 on a whorl; there are distinct fine growth-striæ crossed by faint distant spiral lines. *Spire* acute, conic, somewhat shorter than the aperture, gradate. *Protoconch* lost. *Whorls* 5 on the holotype, but they very likely number about 10 in an adult specimen, the shoulder excavated, the body-whorl very little convex below the angle, somewhat contracted at the base. *Suture* undulating, lightly impressed. *Aperture* vertical, narrow, narrowly angled above, ending below in a slightly oblique open and short canal, the base notched. *Outer lip* slightly thickened, sharp. *Columella* subvertical. *Inner lip* narrow, with 4 somewhat oblique plaits, the upper 3 of equal size, the lowest inconspicuous. *Siphonal fasciole* distinct.

Height, 20 mm.; diameter, 8 mm. (holotype).

Holotype and 1 *paratype* in the Canterbury Museum, Christchurch.

Loc.—White Rock River. Miocene.

Remarks.—The paratype belongs to a larger, perhaps adult, specimen, but the upper and lower parts are broken off. Its diameter is 12 mm., which would correspond to a height of about 30 mm. The shell represents a miniature form of *F. arabica* Martyn, but, the protoconch being unknown, its generic position is somewhat uncertain.

Volutospina (Athleta) huttoni Suter subsp. nov. pseudorarispina (McCoy, MS.). Plate V, fig. 6.

1879. *Voluta pseudorarispina* McCoy : Haast, "Geology of Canterbury and Westland," p. 320 (list name only).
1885. *Voluta kirkii* v. *kirki* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 325.
1887. „ *kirki* Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 211.

In Part I of this revision I pointed out that the Recent shell in the Auckland Museum upon which Hutton bestowed the name of *Voluta (Cymbiola) kirki* (Cat. Mar.

Moll., 1873, p. 18) is an Australian species (*Heteroaulica flavicans* Gmelin); and the fossil shell from Broken River, which Hutton assigned to *Voluta kirki* (Cat. Tert. Moll., p. 7, No. 46), the holotype being in the collection of the New Zealand Geological Survey, I named *Volutospina (Athleta) huttoni.*

Dr. J. Allan Thomson has sent me the type specimen of *Voluta pseudorarispina* McCoy (MS.) from Broken River, which was kindly lent to him by the Director of the National Museum of Victoria, Melbourne, and a photo of which is here reproduced. This example corresponds with specimens in the Canterbury Museum, Christchurch, from Porter River, and which were described by Hutton as *V. kirkii* v. *kirki.* Hutton was evidently not satisfied that the fossil shell was the same as the Recent example; and to distinguish it he called the former "var. *kirki*" in 1885, and giving the reference: Cat. Tert. Moll., p. 7, 1873. This implies that he took the specimens from Porter River to be identical with the specimen from Broken River which he called *V. kirki.* This, however, is not the case.

The subspecies has a much more produced spire, which is conoidal, whereas in the species the spire forms only a small cone on top of the large ventricose body-whorl. This elevated spire is the chief distinguishing feature, and fairly constant, and it can no doubt be considered as a good subspecies. McCoy's name is very appropriate, as *Voluta rarispina* Lamarck is the type of the subgenus *Athleta* Conrad, 1853.

A specimen from Porter River has the protoconch well preserved, it is paucispiral, turbinoid, the nucleus flatly coiled. The holotype of the subspecies has 2 rows of tubercles on the body-whorl, one of smaller ones below the suture, and a second upon the keel issuing from the upper part of the aperture; their number is 10, they form stout sharply raised spines prolonged below into short, rounded, axial ribs. Aperture slightly oblique, channelled above. Outer lip thick, rounded, smooth inside, with a narrow sinus above the row of spines. Columella almost straight. Inner lip very broad and callous, with 4 oblique plaits upon the columella, the lowest somewhat smaller, the callosity extending with the outeı lip to the suture above.

Height, 102 mm.; diameter, 6·2 mm. (holotype of *V. pseudorarispina*). Height, 89 mm.; diameter, 50 mm. (holotype of *V. kirkii* v. *kirki*).

Holotype of the subspecies in the National Museum of Victoria, Melbourne. *Holotype* and 2 *paratypes* of *V. kirkii* v. *kirki* in the Canterbury Museum, Christchurch.

Loc.—Broken River (Miocene). Hutton's types are from the Miocene of Porter River. There is also one specimen from Kakahu in the Canterbury Museum.

Fam. OLIVIDÆ.

Ancilla depressa (Sowerby).

1859. *Ancillaria depressa* Sowerby, Thes. Conch., vol. iii, p. 63, pl. 211, fig. 3.
1885. ,, *lata* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 325.
1887. ,, ,, Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 210.
1893. ,, ,, Hutton, Macleay Mem. Vol., Plioc. Moll., p. 44, pl. vi, fig. 15.
1913. *Ancilla depressa* Sowerby: Suter, Man. N.Z. Moll., p. 454, pl. 49, fig. 3.

Shell of variable size, broadly oval, flattened on the ventral side, solid, shining, with short spire and a thick and broad callous pad outside the parietal wall. *Sculpture:* The callus of the spire and body minutely granulated, the last whorl microscopically finely transversely striated, a shallow narrow groove above the fasciole, the latter slightly raised, depressed in the centre, the lower third overlaid by a well-defined narrow band; growth-lines fine, sometimes raised into unequal and low plications. *Spire* typically short, but in the larger forms it is more elongated, its height about half that of the aperture, but it is very often much more; outlines concave. *Protoconch* small, sharply conical, mostly free of enamel. *Whorls* about 6, the body-whorl strongly convex below the suture, but flattened on the ventral side, flatly rounded and somewhat narrowed toward the base. *Suture* concealed by enamel. *Aperture* slightly oblique, lightly channelled above, very little narrowed below, broadly truncated and deeply notched at the base. *Outer lip* obliquely curved above, then lightly convex or nearly straight, sharply rounded towards the emargination, thin and sharp, with a minute denticle below. *Columella* straight or very lightly concave, vertical, thick and rounded, strongly twisted, and with 3 to 4 flattish oblique plaits below. *Inner lip* narrow on the columella, separated by a narrow oblique groove from the fasciole, extending over the concave parietal wall as a thick callous layer, produced into a thick pad outside the angle of the aperture, and forming a thinner callous layer outside and upon the spire, often very nearly reaching the protoconch.

Height, 15 mm. ; diameter, 8·5 mm. (figure of holotype). Height, 22 mm. ; diameter, 12 mm. (holotype of *A. lata*).

Holotype in the British Museum. *Holotype* and 1 *paratype* of *A. lata* in the Canterbury Museum, Christchurch.

Loc.—Wanganui (Pliocene). Also on record from the Miocene. Recent.

Remark.—The dimensions given by Hutton (length, 1·65 in. ; breadth, 0·9 in.) are evidently wrong; those given above were taken from the holotype in the Canterbury Museum.

Olivella neozelanica (Hutton). Plate IV, figs. 15, 16.

1885. *Oliva neozelanica* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 314, pl. xviii, fig. 1.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 210.
1893. „ „ Hutton, Macleay Mem. Vol., Plioc. Moll., p. 44.

Shell rather large, ovoid-conic, spire high and acuminate, suture canaliculate, columella with anterior plaits only. *Sculpture:* A fine and sharp spiral ridge margins the suture above; on the body-whorl a slight incision separates the central smooth zone from the anterior and posterior callous zones; the anterior columellar folds are continued over part of the base; growth-lines fine, retrocurrent towards the basal band. *Spire* high, conical, outlines lightly convex, about half the height of the aperture. *Protoconch* small, globose. *Whorls* 4 to 5, each of which has an anterior callous band covering nearly half the whorl; body-whorl large, convex, lightly narrowed anteriorly. *Suture* deeply canaliculate. *Aperture* high and narrow, above with a channel which is excavated in the suture; the base is slightly widened and broadly notched. *Outer lip* thick, retrocurrent at the suture. *Columella* oblique, faintly excavated at the middle. *Inner lip* callous, and extending to the basal callous zone, with 4 to 5 unequal oblique plaits below, the upper part smooth.

Height, 38 mm. ; diameter, 15 mm. (holotype).

Holotype and 1 *paratype* in the Canterbury Museum, Christchurch.

Loc.—Patea (Pliocene). It also occurs in the Miocene.

Fam. Marginellidæ.

Marginella hectori T. W. Kirk. Plate VIII, figs. 10, *a*, *b*.

1882. *Marginella hectori* T. W. Kirk, Trans. N.Z. Inst., vol. xiv, 1881, p. 409.
1886. *Marginella attenuata* Reeve: Hutton, Trans. N.Z. Inst., vol. xviii, 1885, p. 350; not of Reeve.
1893. *Marginella attenuata* Reeve: Hutton, Macleay Mem. Vol., Plioc. Moll., p. 46.

Shell small, elongated ovoid, narrowed anteriorly, smooth and polished, outer lip varicose, smooth inside, columella with 4 plaits. *Sculpture:* There is none, the whole surface being smooth and polished. *Spire* short, about one-fourth the height of the aperture, conic. *Protoconch* paucispiral, obtuse. *Whorls* 4, rapidly increasing, lightly convex, the body-whorl large, somewhat ventricose above, slightly attenuated towards the base. *Suture* linear, covered with enamel. *Aperture* oblique, high and narrow, slightly widened towards the base. *Outer lip* rounded, somewhat varicose, extending above over the lower half of the penultimate whorl, broader at the middle; basal lip very narrow, nearly straight. *Columella* with 4 plaits, the uppermost horizontal, the others oblique, of about equal strength, the lower 2 nearer together.

Height, 11·5 mm.; diameter, 5·5 mm. (holotype).

Holotype and 1 *paratype* in the collection of the Geological Survey, Wellington.

Loc.—Petane. Pliocene.

Remarks.—I have been unable to compare this shell with specimens of *M. attenuata* Reeve from Australia. In Tryon's Manual a dorsal view of the shell and a too scanty diagnosis is given; and it no doubt resembles somewhat our fossil shell, but for the present I think it is much safer to consider them as distinct species.

Fam. TURRITIDÆ.

Turris (Hemipleurotoma) nexilis (Hutton).

1885. *Clachurella (?) nexilis* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 317, pl. xviii, fig. 9.
1893. *Pleurotoma nexilis* Hutton, Macleay Mem. Vol., Plioc. Moll., p. 49, pl. vi, fig. 23.

Shell very small, fusiform, with strongly keeled cancellated volutions, rectangular sinus, and short canal. *Sculpture:* Protoconch smooth, the spire-whorls with a prominent spiral keel, slightly above the middle of the whorl, a small cord margining the suture above, and 2 fine spiral liræ on the shoulder—one close to the suture, the other a little above the median keel; body-whorl with 4 strong spiral keels, the second arising from the angle of the aperture, above it, half-way to the median keel of the whorls, there is a fine spiral thread intercalated; the lower 2 keels less prominent and closer together; beak with a few fine spirals; all the post-embryonic whorls ornamented with oblique equidistant axial threads, forming an obtuse angle at the median keel; the points of intersection with the spirals produced into roundish gemmules; the axial riblets extend to the base, and the interspaces are considerably wider than the riblets. *Spire* conical, scalar, somewhat higher than the aperture. *Protoconch* globose, of 2 convex whorls. *Whorls* 6, regularly increasing, the last rather high, lightly concave on the shoulder and below the keel; base contracted. *Suture* not deep, margined above. *Aperture* subvertical, elongately oval, angled above, and produced into a short open canal with truncated base. *Outer lip* convex in outline, denticulated by the spiral keels, with a not very deep, broad, rectangular sinus upon the keel below the suture. *Columella* straight above, slightly turned to the left below. *Inner lip* thin and narrow.

Height, 4·5 mm.; diameter, 2·3 mm (holotype).

Holotype and 2 *paratypes* in the Canterbury Museum, Christchurch.

Loc.—Wanganui (Pliocene). Also Petane.

Turris (Hemipleurotoma) nexilis Hutton n. subsp. bicarinatus. Plate VIII, fig. 11.

Shell in size and form very much like the species, but the *sculpture* is distinct: protoconch smooth, the following spire-whorls with a distinct moniliform cord margining the suture below, succeeded below by 2 strong spiral ribs with an interstice of about the same width; body-whorl with a prominent keel bounding the narrow concave shoulder, followed below by 5 sharp spirals, which, together with the interspaces, diminish in size towards the neck of the canal. Axial sculpture the same as in the species, but less pronounced; form and situation of the sinus also the same.

Height, 4·5 mm.; diameter, 2·3 mm. (holotype).

Holotype and 4 *paratypes* in the Canterbury Museum, Christchurch.

Loc.—Wanganui. Pliocene.

Remarks.—These specimens were mixed up with the type specimens of *T. nexilis*, but they can easily be separated by the quite different spiral sculpture.

Drillia (Crassispira) æquistriata Hutton.

1886. *Drillia æquistriata* Hutton, Trans. N.Z. Inst., vol. xviii, 1885, p. 334.
1886. „ *alabaster* Reeve: Hutton, Trans. N.Z. Inst., vol. xviii, 1885, p. 351; not of Reeve.
1893. *Pleurotoma æquistriata* Hutton, Macleay Mem. Vol., Plioc. Moll., p. 51, pl. vii, fig. 30.
1893. „ *alabaster* Reeve: Hutton, *l.c.*, p. 51, pl. vii, fig. 31; not of Reeve.

Shell moderately large, turreted, axially prominently costate, with fine close spiral liræ, aperture with a short canal, and posteriorly with a deep sinus and a large callosity. *Sculpture:* Protoconch smooth, the succeeding whorls with vertical or slightly oblique axial costæ, 12 to 16 on a whorl, extending from the sinus-area to the suture below, vanishing gradually upon the base; the ribs are high, rounded, the interstices of about the same width; the whole surface adorned with fine, numerous, close spiral striæ, sometimes faint or absent on the sinus-area. *Spire* high, turreted, outlines straight, about 1½ times the height of the aperture with canal. *Protoconch* of 1½ whorls, papillate. *Whorls* 8, gradually increasing, concave on the shoulder, but little convex below; base contracted. *Suture* not much impressed. *Aperture* oval, subvertical, produced into a short open canal below, its base truncated, angled above. *Outer lip* slightly thickened, produced at the middle, with a narrow and rather deep sinus close to the suture, its margin much thickened, and forming a large callus on the upper part of the inner lip. *Columella* straight, bent to the left and tapering below. *Inner lip* moderately broad and callous, smooth.

Height, 19 mm.; diameter, 7 mm. (holotype).

Holotype and 2 *paratypes* in the Canterbury Museum, Christchurch.

Loc.—Petane (Pliocene). Also Wanganui and Matapiro.

Remarks.—The specimens labelled "*D. alabaster* Reeve" are smaller and less distinctly spirally striated specimens, inseparable from *D. æquistriata*, and I do not think they can be assigned to Reeve's species, with very delicate sculpture, from tropical seas.

Drillia (Crassispira) plicatella (Hutton).

1886. *Pleurotoma plicatella* Hutton, Trans. N.Z. Inst., vol. xviii, 1885, p. 333.
1893. „ „ Hutton, Macleay Mem. Vol., Plioc. Moll., p. 50, pl. vi, fig. 27.

Shell moderately large, turreted, with numerous oblique nodulous axial riblets and spiral liræ, suture margined below by a very distinct nodulous band, sinus on the shoulder deep and narrow, canal very short, deeply notched below. *Sculpture* consisting of oblique, rather inconspicuous, axial ribs extending from the angle of the shoulder to the suture below, 15 to 17 on a whorl, cut up into oval nodules by spiral sulci; the whole surface ornamented by spiral riblets, very unequal on the body-whorl, with their interstices bearing 1 or several fine spiral threads; the suture margined below by a very distinct moniliform band; protoconch smooth. *Spire* conical, turreted, with straight outlines, very little higher than the aperture. *Protoconch* of 1 rounded whorl. *Whorls* 8 to 10, regularly increasing, but the body-whorl rather high in proportion, a little excavated on the shoulder, convex below, base contracted. *Suture* impressed, broadly margined below. *Aperture* oval, with a very short and broad canal below, its base deeply notched. *Outer lip* solid, sinuate, with a deep and narrow sinus above the angle of the shoulder. *Columella* straight in the middle, slightly turned to the left towards the canal. *Inner lip* forming a rather thick callous layer upon the pillar, narrow, tapering below.

Height, 24 mm. ; diameter, 9·5 mm. (holotype). A large specimen in my collection measures 39 × 14 mm.

Holotype in the Canterbury Museum, Christchurch.

Loc.—Wanganui. Pliocene.

Surcula pareoraensis (Suter). Plate VIII, fig. 12.

1907. *Pleurotoma pareoraensis* Suter, Proc. Mal. Soc. Lond., vol. vii, p. 208, pl. xviii, fig. 3.

Shell fusiform, thin and fragile, height of aperture less than that of the spire, upper whorls nodulous, body-whorl finely spirally grooved. The *sculpture* consists of small oblique nodules on the upper 3 whorls below the nucleus, but faintly indicated on the following volutions. On the fourth and following whorls shallow, close, spiral grooves adorn the lower half; on the body-whorl a fine spiral groove below the suture is present, and from below the sinus-area subequidistant, somewhat deeper, spiral grooves occur down to the base. *Spire* high, turreted. *Protoconch* lost. *Whorls* about 8 to 9, flatly shouldered, convex below the periphery; body-whorl convex, contracted towards the base. *Suture* distinct, but shallow. *Aperture* oblong, shorter than the spire, produced into a prominent slightly flexuous canal, truncated at the base. *Outer lip* rather thin and sharp. *Columella* slightly sinuous and covered by a thin and narrow callus. *Sinus* distinctly marked by growth-periods, broadly rounded, not deep, situate between the suture and periphery.

Height, about 20–22 mm. ; breadth, 6 mm. (holotype).

Holotype in my collection.

Loc.—White Rock, Pareora River, Canterbury. Labelled "Oamaru Series, Oligocene." Miocene (Professor J. Park, 1905.)

Remarks.—In outline and sculpture this species stands nearest to *Drillia buchanani* (Hutton), which, however, is a more solid shell, much more distinctly shouldered, and with the axial costæ persisting on all the whorls.

On re-examining the shell I find that it has to be classed under the genus *Surcula*.

Surcula fusiformis (Hutton).

1877. *Drillia fusiformis* Hutton, Trans. N.Z. Inst., vol. ix, 1876, p. 595, pl. xvi, fig. 3.
1887. *Pleurotoma fusiformis* Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 213.

Shell fairly large, elongato-fusiform, turreted, with a high spire, high rounded axial ribs below the shoulder, crossed by fine spiral striæ, a narrow deep sinus upon the shoulder, oval aperture with a moderately long straight anterior canal. *Sculpture* consisting of slightly oblique, elevated, roundish axial costæ, 10 in a whorl, but faintly indicated upon the shoulder of the lower whorls, crossed by fine spiral riblets, close together and a stronger thread regularly alternating with a finer one; on the shoulder the spirals are mostly obsolete, and are replaced by sinuous growth-lines which run obliquely over the lower part of the whorls. *Spire high*, turreted, narrowly conical, of about the same height as the aperture with canal. *Protoconch* lost. *Whorls* 8 to 10, regularly increasing, the broad shoulder concave, convex below it, the body-whorl suddenly contracted into the canal. *Suture* not much impressed. *Aperture* oval, vertical, angled above, produced below into a fairly long, open, straight canal, which is truncated at the base. *Outer lip* strongly convex, with a fairly deep narrow sinus on the shoulder of the whorl. *Columella* vertical, bent to the left towards the canal. *Inner lip* rather narrow, and forming a smooth layer upon the columella, tapering to a point below.

Height, 45 mm. ; diameter, 18 mm. (holotype).

Holotype and 1 *paratype* in the Otago Museum, Dunedin.

Loc—Mount Harris. Miocene.

Surcula (Ancistrosyrinx) hamiltoni (Hutton).

1905. *Pleurotoma hamiltoni* Hutton, Trans. N.Z. Inst., vol. xxxvii, 1904, p. 472, pl. xliv, fig. 1.

Shell large, elongato-fusiform, turreted, whorls with nodulous keel and spiral ornamentation, aperture long and narrow, with a long straight canal, anal sinus broadly rounded upon the shoulder. *Sculpture* consisting of a number of spiral striæ on the shoulder of the spire-whorls, which vanish on the lower whorls; about 12 unequal fine cords encircle the whorls below the carina, but become obsolete on the body-whorl; the keel of the upper 8 whorls with small tubercles, about 12 in a whorl; broadly rounded concave growth-lines upon the shoulder are antecurrent upon the carina and are descending obliquely towards the suture, forming irregular sinuous plications on the body-whorl. *Spire* high, acute, turreted, angle about 30°, a little higher than the aperture with canal. *Protoconch* paucispiral, with a sharp nucleus. *Whorls* 12, first slowly, then more rapidly descending, lightly concave upon the shoulder, flat below the keel, but distinctly concave and then convex on the body-whorl, which is contracted towards the canal. *Suture* not deep, with a row of raised points formed by the growth-lines. *Aperture* narrow, triangular, angled above, produced into a long and straight siphonal canal, its base truncated. *Outer lip* thin and sharp, with a broadly rounded, not deep, sinus extending from suture to keel. *Columella* a little excavated. *Inner lip* narrow and thin, tapering below towards the canal.

Height, 115 mm.; diameter, 28 mm.; height of aperture with canal, 54 mm. (holotype).

Holotype in the Canterbury Museum, Christchurch.

Loc.—Waihao Forks (Miocene). Collected by Mr. Harold Hamilton.

Bathytoma haasti (Hutton).

1877. *Clavatula haasti* Hutton, Trans. N.Z. Inst., vol. ix, 1876, p. 595, pl. xvi, fig. 5.
1887. *Pleurotoma haasti* Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 213.
1887. *Surcula atractoides* Tate: Hutton, *t.c.*, p. 480 (should be of Watson, not Tate).
1893. *Dolichotoma angustifrons* Tate and Dennant, Trans. Roy. Soc. South Aust., vol. xvii, p. 221 (list name).
1894. *Genotia angustifrons* Tate, Journ. Roy. Soc. N.S.W., p. 175, pl. x, figs. 7, 7*a–b* (not 7*c*).
1897. *Bathytoma angustifrons* Tate: Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 49.

Shell moderately large, biconic, with sharply keeled whorls, moniliform spiral striation, a deep sinus upon the keel, and a narrow aperture with a short anterior canal. *Sculpture:* Protoconch slightly axially striated anteriorly; shoulder with a double row of moniliform spirals below the suture, followed by very fine and dense moniliform spiral threads down to the keel, which is ornamented by 3 prominent spirals separated into oblique incised gemmules; below these rather distant moniliform spiral riblets follow, which become stronger and more distant on the body-whorl towards the base, the interstices with 1 or 2 spiral lines; the whole surface crossed by fine dense oblique growth-lines, forming a deep rather narrowly angled sinus on the carina. *Spire* turriculate, broadly conic, its height equal to that of the aperture with canal. *Protoconch* of 2 whorls, somewhat oblique. *Whorls* 9, regularly increasing, the last high, the shoulder broad and concave, the keel close to the suture on the earlier whorls; body-whorl moderately convex, contracted towards the base. *Suture* not much impressed, margined. *Aperture* oblique, elongated, narrow, angled above, produced below into a short open canal, truncated at its base. *Outer lip* strongly angled, with a rather deep angular sinus. *Columella* slightly oblique, somewhat twisted and swollen towards the canal. *Inner lip* rather thin, broadly spread over the body-whorl, but forming a thicker callosity upon the lower part of the columella.

Height, 40 mm.; diameter, 20 mm. (holotype).

Holotype in the Otago Museum, Dunedin.

Loc.—Mount Harris. Miocene.

Remarks.—I fully share Hutton's opinion that Tate's *Genotia angustifrons* is identical with *Clavatula haasti* Hutton. The species is very near the type of the genus *Bathytoma: Murex cataphractus* Brocchi, from the Upper Tertiary of Northern Italy and the Vienna Basin; it is also closely allied to *Pleurotoma (Genota) atractoides* Watson, from the Philippine Islands; and to *Bathytoma nodilirata* Murdoch and Suter, from New Zealand. It occurs in the Eocene of Australia and the Miocene of New Zealand.

Bathytoma nodilirata (Murdoch and Suter).

1882. *Pleurotoma tuberculata* T. W. Kirk, Trans. N.Z. Inst., vol. xiv, p. 409; not of Gray.
1893. *Pleurotoma tuberculata* T. W. Kirk: Hutton, Macleay Mem. Vol., Plioc. Moll., p. 50, pl. vi, fig. 29; not of Gray.
1906. *Pleurotoma (Hemipleurotoma) nodilirata* Murdoch and Suter, Trans. N.Z. Inst., vol. xxxviii, 1905, p. 284, pl. xxii, figs. 10, 11.
1908. *Bathytoma nodilirata* Murd. & Sut.: Suter, Trans. N.Z. Inst., vol. xl, 1907, p. 351.
1913. ,, ,, Murd. & Sut.: Suter, Man. N.Z. Moll., p. 493, pl. 21, fig. 19.

Shell fusiform, biconical, with nodulous keeled whorls, pyriform aperture, and short open canal. *Sculpture:* The last whorl with about 20 to 22 tubercles on the keel, and 16 spiral cords below, the uppermost of them a fine thread, the following 6 strong, rounded, the interspaces of equal size or a little broader; those upon the base and canal are smaller and crowded. Above the aperture are 2 spirals, which persist on the whorl above, but disappear in the suture of the next whorl. Monilospiral threadlets adorn the sinus-area, also the tubercles. All the upper whorls, except the protoconch, have tubercles on the keel, and there is a row of small nodules below the suture. The axial sculpture consists of fine rather irregular incremental lines, which, however, become more prominent on the lower whorls, connecting the small tubercles below the suture with the larger ones on the keel. *Spire* conical, about as high as the aperture. *Protoconch* consisting of 1½ whorls, the nucleus globose, smooth, the succeeding half-volution with minute spiral striæ. *Whorls* 7, slowly and regularly increasing, with a strong carina below the middle, excavated above and straight below the keel; base concave, ending in a slightly twisted rather short beak. *Suture* deep, and margined below with a row of small elongate gemmules. *Aperture* pyriform, rather narrow, angular above, terminating in a short open and truncated canal, which has a slight turn to the right. *Outer lip* sharp, strongly angled, and with a well-pronounced rounded sinus at the keel, contracted towards the base. *Columella* nearly straight, with an oblique thickening, slightly sinuated and pointed below. *Inner lip* forming a very thin obliquely finely striated layer on the columella and body

Height, 21 mm.; diameter, 10 mm.; angle of spire, 42° (lectotype).

Lectotype and 7 *syntypes* of *P. tuberculata* Kirk in the collection of the Geological Survey, Wellington.

Loc.—Petane (Pliocene). Recent.

Remarks.—The Recent specimens have stronger tubercles, and they are less numerous; other differences are but very slight.

Mangilia (Clathurella) cincta (Hutton). Plate VIII, fig. 13.

1885. *Clathurella cincta* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 327.
1887. *Peristernia cincta* Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 208.

Shell small, fusiform, turreted, axially costate and spirally lirate, shallow anal sinus, 2 plaits on the columella, and a short canal. *Sculpture* consisting of narrow, sinuate, vertical axial costæ, 13 to 16 on a whorl, the interspaces about twice as broad as the riblets; shoulder of the whorls with 3 fine spiral threads, on the keel and farther down there are 4 to 5 stronger equidistant spirals, base with 5 to 6 spiral cords; the points of intersection on the spire-whorls are a little nodular. *Spire* conical, acute, a little higher than the aperture. *Protoconch* of 2 smooth convex whorls. *Whorls* 7, gradate, the shoulder lightly concave, moderately convex below; base contracted. *Suture* well marked, submargined. *Aperture* ovate, broadly angled above, produced below into a short but distinct canal, which is slightly deflexed. *Outer lip* smooth inside, not callous, with a broadly rounded and shallow sinus. *Columella* straight at the middle, bent a little to the left on reaching the canal. *Inner lip* not very callous, broadly expanded, with 2 equal low oblique plaits at about the middle of the pillar.

Height, 8·2 mm.; diameter, 3·5 mm. (holotype).

Holotype and 4 *paratypes* in the Canterbury Museum, Christchurch.

Loc.—White Rock River. Miocene.

Mangilia (Clathurella) rudis (Hutton). Plate VIII, fig. 14.

1885. *Clathurella rudis* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 328.
1887. *Peristernia cincta* Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 208.

Shell small, fusiform, turreted, with strong rounded axial ribs and spiral striæ, short canal, shallow anal sinus, and 2 plaits on the columella. *Sculpture* consisting of prominent, broad, convex axial ribs, 9 on a whorl, with narrower interspaces; the whole surface crossed by narrow high and convex spiral threads with linear interstices; there are about 9 on a spire-whorl and 20 to 25 on the body-whorl; protoconch smooth. *Spire* turreted, not much higher than the aperture. *Protoconch* globose, paucispiral. *Whorls* 7, strongly shouldered, faintly concave upon the shoulder, convex below it; base somewhat contracted. *Suture* not deep, narrowly margined below. *Aperture* ovate, narrow, angled above, produced below into an open, short, but distinct canal, its base truncate. *Outer lip* not thickened, smooth inside, with a broadly rounded very shallow sinus below the suture. *Columella* straight. *Inner lip* narrow, with 2 oblique (not strong) plaits, the upper one stronger, below the junction of the columella with the body-wall, the lower inconspicuous ridge a short way below the first.

Height, 13 mm.; diameter, 6 mm. (holotype).

Holotype and 4 *paratypes* in the Canterbury Museum, Christchurch.

Loc.—Waihao, in greensand. Miocene.

Mangilia abnormis (Hutton).

1885. *Clathurella abnormis* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 316.
1893. ,, ,, Hutton, Macleay Mem. Vol., Plioc. Moll., p. 53, pl. vii, fig. 36.

Shell very small, biconic, turreted, axially costate, with prominent spiral liræ on the body-whorl, narrow oblique aperture and well-pronounced anal slit. *Sculpture* below the smooth protoconch consisting of distinct oblique axial riblets, 11 to 12 on a whorl, gradually disappearing upon the base, nodose on the carina of the shoulder; the latter bears a spiral cord, and another is situate midway towards the suture below; body-whorl with about 10 rather broad flatly rounded spiral riblets, the interspaces of the same width, bearing 1 or 2 fine spiral threads; growth-lines distinct and sinuate on the shoulder. *Spire* acute, conic, gradate, of the same height as the aperture. *Protoconch* of 1½ globose whorls. *Whorls* 5½, regularly increasing, flat on the shoulder, slightly convex below; base slightly contracted. *Suture* not deep. *Aperture* oblique, narrow, the margins subparallel, produced below into a short open canal, its base truncated. *Outer lip* thickened, with a distinct, moderately deep, and broadly rounded sinus on the shoulder. *Columella* straight in the middle, turned slightly to the left below. *Inner lip* rather thin, narrow, tapering towards the canal.

Height, 6·5 mm.; diameter, 3·5 mm. (lectotype).

Lectotype and 3 *syntypes* in the Canterbury Museum, Christchurch.

Loc.—Petane. Pliocene.

Mangilia dictyota (Hutton).

1885. *Clathurella dictyota* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 316, pl. xviii, fig. 8.
1893. *Clathurella (?) dictyota* Hutton, Macleay Mem. Vol., Plioc. Moll. p. 53, pl. vii, fig. 37.
1913. *Mangilia dictyota* Hutton: Suter, Man. N.Z. Moll., p. 497, pl. 21, fig. 22.

Shell small, elongate-fusiform, turriculate, axially costate and spirally lirate. *Sculpture* consisting of narrow, rounded, straight axial ribs, about 13 on a whorl, extending from suture to suture, continuous over the whorls, extending over the base of the body-whorl, the interstices wider than the ribs, crossed by more or less conspicuous spiral threads, 1 on the carina of the shoulder and another half-way down more prominent than the others, a few hair-like threads upon the shoulder, and 2 or 3 below it; body-whorl generally with 3 or 4 more prominent spiral liræ, the interstices with 1 to 3 fine spiral threads. Sometimes the surface is distinctly cancellated. *Spire* acuminate, turriculate, about 1½ times the height of the aperture. *Protoconch* with a small, papillate, smooth, slightly tilted nucleus, followed by a convex and spirally lirate second volution; sometimes the nucleus is also spirally striated. *Whorls* 6, more or less distinctly shouldered, flatly convex and contracted towards the suture below; base contracted. *Suture* undulating, not deep. *Aperture* subpyriform, angled above, with a short broad and somewhat recurved canal below. *Outer lip* thickened by the last rib, convex, slightly contracted below, with a shallow rounded sinus. *Columella* vertical, lightly arcuate. *Inner lip* narrow, smooth, extending over the straight parietal wall.

Height, 6·5 mm.; diameter, 2·5 mm. (lectotype).

Lectotype and 4 *syntypes* in the Canterbury Museum, Christchurch.

Loc.—Petane, Wanganui (Pliocene). Recent.

Mangilia leptosoma (Hutton). Plate VIII, fig. 15.

1885. *Clathurella leptosoma*, Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 328.
1887. ,, ,, Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 214.

Shell small, elongato-fusiform, turreted, axially costate and spirally lirate. *Sculpture* consisting of about 10 to 11 slightly oblique, roundish axial costæ, vanishing upon the base, crossed by 2 more-prominent spiral cords on the spire-whorls, one on the carina of the shoulder and the second half-way down towards the suture; on the shoulder and in the interstices below are numerous fine spiral threads which are reticulated by fine but distinct growth-lines; body-whorl with about 20 regular and equidistant spiral striæ below the 2 more-prominent cords; protoconch faintly spirally striated. *Spire* acute, conical, not much higher than the aperture. *Protoconch* small, of 2 convex whorls, the nucleus pointed, not tilted. *Whorls* 7, regularly increasing, the last high in proportion, shoulder straight; base somewhat contracted. *Suture* not much impressed. *Aperture* high and narrow, the lips subparallel, angled above, produced below into a short and open canal, truncated at its base. *Outer lip* slightly thickened, with a broadly rounded and rather shallow sinus on the shoulder. *Columella* oblique, lightly convex in the middle. *Inner lip* not thick, narrow, smooth.

Height, 6·5 mm.; diameter, 2·5 mm.

Holotype and 6 *paratypes* in the Canterbury Museum, Christchurch.

Loc.—White Rock River. Miocene.

Remarks.—This species is very near *M. dictyota*, but has a shorter spire and higher aperture; the axial riblets are less numerous, more flattish, and less pronounced; the spirals on the body-whorl are much finer and more numerous; and the protoconch also has a different aspect.

Mangilia protensa (Hutton).

1883. *Pleurotoma (Drillia) awamoaensis* Hutton, Trans. N.Z. Inst., vol. xv, 1882, p. 131; not of Cat. Tert. Moll.

1884. *Drillia (?) amœna* E. A. Smith, Ann. Mag. Nat. Hist. (5), vol. xiv, p. 318.

1885. *Daphnella protensa* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 317.

1893. *Pleurotoma protensa* Hutton, Macleay Mem. Vol., Plioc. Moll., p. 49, pl. vi, fig. 25.

1913. *Mangilia protensa* Hutton: Suter, Man. N.Z. Moll., p. 502, pl. 22, fig. 5.

Shell fusiform, elongated, turreted, thin and fragile, lightly axially costate and spirally lirate. *Sculpture* consisting of subequidistant fine axial riblets, obsolete on the shoulder and below the periphery of the last whorl, 15 to 20 on the body-whorl, the interstices of about the same width or slightly broader than the riblets; crossed and reticulated by fine spiral threads, 3 very fine and close together on the shoulder, 5 from the angle to the suture, occasionally with a few very fine interstitial threads, 15 to 20 on the body-whorl; the crossing-points sometimes slightly nodulous; fasciole on the beak finely striated. Sometimes the spiral sculpture is predominant, the spirals becoming much stronger, crossed only by flexuous axial striæ. *Spire* high, conic, turreted, about $1\frac{1}{2}$ times the height of the aperture. *Protoconch* of $2\frac{1}{2}$ smooth convex whorls. *Whorls* 7 to 8, markedly convex, the base contracted. *Suture* well marked. *Aperture* slightly oblique, oval, angled above, produced into an oblique short and open canal, truncated below. *Outer lip* thin, sometimes strengthened by the last axial riblet, with a shallow rounded infrasutural sinus. *Columella* slightly concave above, convex and curved to the left below, where it is drawn out to a fine point. *Inner lip* narrow and thin.

Height, 11 mm.; diameter, 3·5 mm. (lectotype).

Lectotype and 9 *syntypes* in the Canterbury Museum, Christchurch.

Loc.—Petane. Pliocene. Recent.

Daphnella lacunosa Hutton.

1885. *Daphnella lacunosa* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 317.

1893. ,, ,, Hutton, Macleay Mem. Vol., Plioc. Moll., p. 52, pl. vii, fig. 34.

Shell minute, subfusiform, lightly gradate, spirally lirate, cancellated by growth-striæ, with short canal and very shallow sutural sinus. *Sculpture:* The protoconch smooth, the succeeding whorls of the spire with 5 cinguli, one margining the suture below, the second on the middle of the shoulder, the third on the carina, and two others below it; these last 3 spirals stronger than the others; body-whorl with about 13 cinguli, the interspace between the third and fourth riblet broader than any of the others, but they diminish gradually in width towards the base; interstices with fine growth-striæ. *Spire* turreted, a little higher than the aperture. *Protoconch* of 2 smooth convex whorls. *Whorls* 5, regularly increasing, the shoulder flat, lightly convex below it; the base moderately contracted. *Suture* well marked, lightly margined below. *Aperture* ovate, oblique, angled above and produced below into a short, broadly open, truncated canal. *Outer lip* convex, thin and sharp, smooth inside, with an almost obsolete broad sutural sinus. *Columella* sinuate, deflexed below. *Inner lip* narrow, thin, smooth.

Height, 3 mm.; diameter, 1·2 mm. (holotype).

Holotype and 1 *paratype* in the Canterbury Museum, Christchurch.

Loc.—Wanganui. Pliocene.

Daphnella striata (Hutton).

1873. *Bela striata* Hutton, Cat. Tert. Moll., p. 5.
1887. *Daphnella striata* Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 214.
1893. ,, ,, Hutton, Macleay Mem. Vol., Plioc. Moll., p. 52, pl. vii, fig. 33.
1897. ,, ,, Hutton : Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 63.
1910. *Mitromorpha striata* Hutton : Suter, Trans. N.Z. Inst., vol. xlii, p. 11.
1885. *Siphonalia (?) cingulata* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 315.
1893. ,, ,, Hutton, Macleay Mem. Vol., Plioc. Moll., p. 41.
1913. *Mitromorpha striata* Hutton : Suter, Man. N.Z. Moll., p. 488, pl. 46, fig. 27.
1913. *Daphnella striata* Hutton : Suter, *t.c.*, p. 1084.

On examining the type specimens of *Siphonalia* (?) *cingulata* Hutton, in the Canterbury Museum, Christchurch, I found them to be undoubted examples of *Daphnella striata* Hutton, being young forms of the latter.

Having now examined a series of *D. striata* I have convinced myself that the species cannot be classed under *Mitromorpha*, but that its proper place is under *Daphnella*.

Four type specimens of *Siphonalia* (?) *cingulata* Hutton are in the Canterbury Museum, Christchurch.

Loc.—Wanganui. Pliocene. Recent.

The type specimen of *Bela striata* Hutton is missing.

Genota excavata (Hutton).

1877. *Defranchia excavata* Hutton, Trans. N.Z. Inst., vol. ix, 1886, pl. xvi, fig. 6.
1887. *Pleurotoma excavata* Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 213.

Shell very small, fusiform, turreted, whorls with a very prominent keel and some spiral liræ, slightly trellised by growth-lines, outer lip with a broad (not deep) sinus upon the shoulder of the whorl, columella cylindrical, canal short. *Sculpture :* Protoconch smooth, the following whorls with a sharp keel near the suture below, fine spirals on the shoulder increasing from 1 to 3, which are trellised by oblique distant growth-lines ; body-whorl with distinct spiral cords, greatly varying in number. *Spire* sharp, conical, slightly higher than the aperture with canal. *Protoconch* polygyrate, of 2½ convex whorls, the nucleus small and flattened. *Whorls* 8, regularly increasing, strongly keeled, the broad shoulder straight ; body-whorl contracted below. *Suture* well impressed, the sharp keel giving it the appearance of being excavated. *Aperture* vertical, narrowly ovate, angled above, produced below into a short open canal, slightly sinuate at its base and recurved. *Outer lip* angled above, with a rather shallow broad sinus above the keel. *Columella* straight, cylindrical, turned to the left towards the canal. *Inner lip* thin above, more callous and drawn out to a point below, smooth ; neck of the canal with a distinct fasciole.

Height, 9 mm. ; diameter, 3·5 mm. (holotype). Height, 9 mm. ; diameter, 4·1 mm. (paratype).

Holotype and 2 *paratypes* in the Otago Museum, Dunedin.

Loc.—White Rock River. Miocene.

Genota (Pseudotoma) robusta (Hutton).

1877. *Bela (?) robusta* Hutton, Trans. N.Z. Inst., vol. ix, 1886, p. 595, pl. xvi, fig. 4.
1887. *Pleurotoma robusta* Hutton, P.L.S. N.S.W. (2), vol. i, p. 213.

Shell fairly large, ovato-fusiform, turreted, axially costate on the upper whorls, with prominent spiral liræ and very much developed growth-striæ, sinus not deep, broadly rounded, situate upon the shoulder ; aperture elongated, with a short canal, sinuate at its base. *Sculpture :* Protoconch smooth, the succeeding 3 or 4 whorls with axial costæ which disappear on the following volutions ; the shoulder with very fine spiral threads, slightly decussated by growth-striæ; below the angle of the whorls stronger spiral riblets appear, the interspaces broader than the riblets and usually adorned with 1 or 2 fine spiral threads; the strong growth-lines faintly decussate the spiral sculpture. *Spire* rather short, conoidal, about the height of the aperture without canal. *Protoconch* of 2½ convex whorls, the nucleus somewhat depressed. *Whorls* 7, regularly increasing, the last somewhat ventricose, concave on the shoulder, a little convex below it; base very little contracted. *Suture* inconspicuous. *Aperture* elongated, narrowly angled above, produced below into a very short and open canal, sinuate at the base and with a fasciole upon the neck. *Outer lip* angled above, with a rather shallow rounded sinus, its upper margin antecurrent at the suture. *Columella* vertical, but a little turned to the left below. *Inner lip* thin above, not very broad, thicker towards the base, smooth

Height, 36 mm.; diameter, 16 mm. (holotype).

Holotype and 1 *paratype* in the Otago Museum, Dunedin.

Loc.—White Rock River. Miocene.

Fam. Terebridæ.

Terebra biplex Hutton. Plate IV, figs. 17, 18.

1885. *Terebra biplexa* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 327.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 212.

Shell rather small, subulate and turreted, with sharp axial ribs slightly depressed in the middle. *Sculpture* consisting of 13 to 14 sharp, straight, or slightly curved axial ribs, continuous over the whorls, higher at each end than in the middle, especially on the anterior whorls of the shell; on the body-whorl they are slightly tubercular at each end, low on the shoulder, and not extended over the base; the body-whorl shows very fine irregular spiral striation. *Spire* high, subulate, the lower whorls turreted, outlines straight, about twice the height of the aperture. *Protoconch* lost in both specimens. *Whorls* 9 or 10, regularly increasing, flattened, the lower ones with a narrow shoulder. *Suture* not deep. *Aperture* oval, narrow, with a faint upper sinus, produced below into a short slightly oblique canal, open in front, and somewhat notched at the base. *Outer lip* convex, but straightened on its upper part. *Columella* short, vertical. *Inner lip* forming a narrow and thin callosity, tapering to a point below. *Siphonal fasciole* distinct.

Height, 17 mm.; diameter, 5 mm. (holotype).

Holotype and 1 *paratype* in the Canterbury Museum, Christchurch.

Loc.—Pareora. Miocene.

Terebra catenifera Tate. Plate IV, fig. 19.

1885. *Cerithium bicorona* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 328.
1886. *Terebra catenifera* Tate, "Southern Science Record," Jan. 1886, p. 5.
1889. „ „ Tate, Trans. Roy. Soc. South Aust., vol. xi, p. 160, pl. viii, fig. 14.
1897. „ „ Tate: Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 24.

Shell pyramidal, elongate, of many polished whorls, ending in a papillary pullus of 2 rather large smooth convex turns. *Whorls* convexly flattened, slightly overlapping; double-banded and nodulose in front of the suture, the posterior band rather the broader, and separated by a shallow sulcus, in the centre of which winds a subangular ridge defined by linear grooves; about 20 pairs of nodulations on the penultimate whorl; anterior half of each whorl distantly and superficially spirally ridged; the whole surface arcuately striated by lines of growth; base spirally ridged and transversely wrinkled.

Length of 17 whorls, 38 mm.; breadth of last whorl, 7 mm. (Tate).

Holotype of *Cerithium bicorona* Hutton in the Canterbury Museum, Christchurch.

Loc.—Tutaekuri (Miocene). A common fossil in the upper beds at Muddy Creek (Miocene), Victoria.

Remarks.—Hutton's type specimen consists of the 2½ lowest whorls only. Though his name has priority, yet it was not accompanied by a figure, and I give preference to Tate's name. The New Zealand specimen agrees with Tate's description and figure.

According to Tate the species has much resemblance to the Japanese *T. serotina* Adams and Reeve. Harris says that it may be compared with the living *T. mariesi* E. A. Smith, of Japan.

Terebra costata Hutton.

1885. *Terebra costata* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 315, pl. xviii, fig. 6.
1887. ,, ,, Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 212.
1893. ,, ,, Hutton, Macleay Mem. Vol., Plioc. Moll., p. 47, pl. vi, fig. 20.

Shell small, subulate, solid, axially costate, with a short notched canal. *Sculpture:* Protoconch smooth, the other whorls with 11 to 15 sharp axial ribs, the interstices deeply excavated, concave; a triangular siphonal fasciole upon the neck of the canal; there is no sutural groove, nor spiral sculpture. *Spire* high, subulate, about 3 times the height of the aperture, outlines straight. *Protoconch* of 2 whorls, small, globose. *Whorls* 10, regularly increasing, lightly convex; base convexly contracted. *Suture* not much impressed. *Aperture* ovate, angled above, produced below into a short and slightly oblique canal, notched at its base. *Outer lip* convex, sharp. *Columella* straight, somewhat twisted below. *Inner lip* forming a narrow callosity over the columella, drawn out to a point towards the canal.

Height, 14 mm.; diameter, 4 mm. (holotype).

Holotype and 1 *paratype* in the Canterbury Museum, Christchurch.

Loc.—Wanganui (Pliocene). Also recorded from the Miocene.

Fam. Acteonidæ.

Acteon ovalis (Hutton). Plate VIII, fig. 16.

1885. *Tornatellina ovalis* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 325.
1887. ,, ,, Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 207.

Shell small, ovate, rather thin, spirally lirate with reticulated interspaces, columella with one fold. *Sculpture:* Protoconch smooth, the succeeding whorls with flattish spiral riblets, about 15 on the body-whorl and 6 on the penultimate whorl; the grooves are narrower than the riblets, decreasing in width towards the base, sometimes they are linear; these interspaces are ornamented by close numerous radial riblets, passing but faintly over the cinguli, the interspaces linear. *Spire* conical, of about the same height as the aperture, outlines slightly convex. *Protoconch* with obtuse apex, of 1½ whorls. *Whorls* 5, flattishly convex, base narrowed. *Suture* impressed. *Aperture* ovate, pointed above, effuse below. *Columella* slightly concave, with a single strong sharp oblique fold above.

Height, 5·5 mm.; diameter, 2·5 mm. (lectotype).

Lectotype and 2 *syntypes* in the Canterbury Museum, Christchurch.

Loc.—White Rock River, South Canterbury. Miocene.

Remarks.—All three specimens are no doubt young examples, the lectotype being the largest, but having the outer lip broken off. The Recent *A. craticulatus* Murdoch and Suter (Trans. N.Z. Inst., vol. xxxviii, p. 281, pl. xxi, fig. 6) is very nearly allied to this species, though distinct; it may be considered as a descendant of the fossil species.

Acteon sulcatus (Hutton).

1885. *Odostomia sulcata* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 319, pl. xviii, fig. 15.
1893. *Tornatella sulcata* Hutton, Macleay Mem. Vol., Plioc. Moll. p. 37, pl. vi, fig. 1.

Shell moderately large, perforated, ovato-elongated, spire slightly gradated, spirally ribbed, with a single columellar fold. *Sculpture* consisting of prominent, regular, flattish spiral liræ, separated by rather deep linear grooves, the groove below the posterior rib of the volutions usually broader than the others; body-whorl with 20, the penultimate whorl with 8 spirals; the whole surface ornamented by fine oblique growth-lines; protoconch smooth. *Spire* high, slightly gradated, outlines a little convex, twice the height of the aperture. *Protoconch* of 1 papillate whorl. *Whorls* 8, first slowly, then more rapidly increasing, flatly convex; base narrowed and convex. *Suture* impressed, subcanaliculate. *Aperture* ovate, pointed above, rounded and effuse below. *Outer lip* convex, sharp. *Columella* short, sinuate; *inner lip* forming a thick callosity upon the columella, with an oblique, not very prominent posterior fold, and, in adult specimens only, a small anterior tubercle. *Umbilicus* marked by a distinct chink.

Height, 28 mm.; diameter, 11·5 mm. (lectotype).

Lectotype and 3 *syntypes* in the Canterbury Museum, Christchurch.

Loc.—Wanganui (Pleistocene and Pliocene). It also occurs at Turanganui (Gisborne), and on the Watchman's Island, Napier Harbour.

Fam. Ringiculidæ.

Ringicula uniplicata Hutton.

1885. *Ringicula uniplicata* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 313.
1900. *Ringicula uniplicata* Hutton: Murdoch, Trans. N.Z. Inst., vol. xxxii, 1899, p. 216, pl. xx, fig. 6.

Shell minute, ovate, densely spirally ribbed, columella with a strong anterior and a smaller posterior plait, outer lip callous, imperforate. *Sculpture:* Protoconch smooth, the following whorls ornamented with close flat spiral liræ, about 18 on the body-whorl and 8 to 9 on the penultimate whorl; the interstices about half the width of the riblets; the whole surface finely striate with microscopic growth-lines. *Spire* conical, about the same height as the aperture. *Protoconch* consisting of 2 whorls, the nucleus papillate. *Whorls* 4, convex, the last large, ventricose, base convex. *Suture* deep. *Aperture* narrow, obliquely notched in front, narrowly angled above. *Outer lip* much thickened, rounded and reflexed, with a few inconspicuous rugosities upon it. *Columella* short, with 2 plaits, the anterior much stronger, curved and somewhat reflexed, the posterior plait much smaller, connected with the other by an excavated callosity; a thick callous rib extends from the insertion of the outer lip some distance down the parietal wall. *Inner lip* callous, narrow.

Height, 2 mm.; diameter, 1·4 mm.

Holotype in the Canterbury Museum, Christchurch.

Loc.—Petane. Pliocene.

Remarks.—The Recent *R. delecta* Murdoch and Suter (Trans. N.Z. Inst., vol. xxxviii, p. 280, pl. xxi, fig. 5) is much larger, finer spirally lirate, with a much less callous outer lip and differently arranged columellar plaits, the upper plait being much larger in proportion.

Fam. Tornatinidæ.

Volvulella reflexa (Hutton).

1886. *Cylichna (Volvula) reflexa* Hutton, Trans. N.Z. Inst., vol. xviii, 1885, p. 333.
1887. *Volvula reflexa* Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 207.
1913. *Volvulella reflexa* Hutton: Suter, Man. N.Z. Moll., p. 529, pl. 23, fig. 2.

Shell small, subcylindrical, with a sharply pointed vertex and narrowly rounded base, polished, spirally striate. *Sculpture* consisting of a few distant spiral lines on the base and vertex, with inconspicuous fine spiral lines at the middle, which are much closer together; growth-lines fine. Only 1 *whorl* visible, which is produced to a sharp point above, flattened at the middle, narrowed at the base. *Aperture* as long as the shell, very narrow above, widened below. *Outer lip* simple, sharp, extending above to the vertex. *Basal lip* narrowly convex, slightly effuse. *Columella* short, oblique, with an indistinct fold. *Inner lip* strongly reflected over the columella and parietal wall, a very thin glaze extending over the inner half of the ventral side of the body-whorl.

Height, 3·5 mm.; diameter, 1·4 mm.

Holotype in the Canterbury Museum, Christchurch.

Loc.—White Rock River, South Canterbury. Miocene. Recent.

Remarks.—This species has not yet been recorded from our Pliocene; but Mr. R. Murdoch, of Wanganui, first discovered it in material dredged by Captain Bollons in about 40 fathoms near Cuvier Island. Recent specimens are somewhat larger, 5 by 1·7 mm., but otherwise they fully agree with the type.

Fam. AMPHIBOLIDÆ.

Amphibola crenata (Martyn).

1784. *Limax crenata* Martyn, "Universal Conchologist," pl. lxix.
1886. *Cyclostrema obliquata* Hutton, Trans. N.Z. Inst., vol. xviii, 1885, p. 335.
1893. ,, ,, Hutton, Macleay Mem. Vol., Plioc. Moll., p. 71.
1897. *Amphibola avellana* Bruguière: Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 5.
1913. ,, *crenata* Martyn: Suter, Man. N.Z. Moll., p. 596, pl. 49, fig. 9.

The type specimen of *Cyclostrema obliquata* Hutton is a half-grown worn specimen of our very variable *Amphibola crenata.* The umbilicus is wider than is usually the case, but I have specimens in my collection showing the same peculiarity. The callosity on the inner lip is not yet developed.

Holotype of *C. obliquata* in the Canterbury Museum, Christchurch.

Loc.—Wanganui (Pliocene). Recent.

CHAPTER II.

Class PELECYPODA.

Fam. Ledidæ.

Leda semiteres Hutton. Plate VIII, fig. 18.

1865. *Leda* sp. Zittel, Voy. "Novara," Palæ., vol. ii, p. 47, pl. xv, fig. 2.
1877. „ *semiteres* Hutton, Trans. N.Z. Inst., vol. ix, p. 598.
1887. „ *fastidiosa* Adams: Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 230; not of A. Adams.
1887. „ sp. Zittel: Hutton, *t.c.*, p. 230.
1893. „ *fastidiosa* Adams: Hutton, Macleay Mem. Vol., Plioc. Moll., p. 86; not of A. Adams.
1905. *Leda fastidiosa* Clarke, Trans. N.Z. Inst., vol. xxxvii, 1904, p. 416, pl. xxxii, fig. 3; not of A. Adams.

Shell rather small, elongately oval, with a blunt posterior beak, equivalve, inequilateral, concentrically sharply costate. *Beaks* slightly in front of the middle, approximate. *Anterior end* shorter, the proportion to the posterior end being 1 to 1·4, convex, the dorsal margin straight, slowly descending. *Posterior end* with a rather blunt beak, the dorsal margin very slowly descending, but faintly concave; basal margin regularly arched. *Lunule* obsolete. *Escutcheon* distinct, lanceolate, not deep, no keel formed by the dorsal margin of the valves, limited by a rounded ridge. *Sculpture* consisting of close fairly regular concentric riblets, reduced to fine striæ on the escutcheon.

Length, 12 mm.; height, 7 mm.; diameter, 5 mm. (holotype).

Holotype in the Otago Museum, Dunedin.

Loc.—Waihao. Miocene.

Remarks.—This species is certainly not *L. fastidiosa* A. Adams. I have no doubt that Zittel's *Leda* sp. is identical with Hutton's species, and the same applies to E. de C. Clarke's *L. fastidiosa.* I am under great obligation to the latter gentleman for the loan of his plesiotype.

Poroleda lanceolata (Hutton).

1885. *Scaphula (?) lanceolata* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 332.
1893. *Poroleda lanceolata* Hutton, Macleay Mem. Vol., Plioc. Moll., p. 86; not of Tate, 1894.
1906. „ „ Hutton: Hedley, Trans. N.Z. Inst., vol. xxxviii, 1905, p. 71, pl. ii, fig. 7.
1913. „ „ Hutton: Suter, Man. N.Z. Moll., p. 839, pl. 51, fig. 5.

Shell small, thin, compressed, smooth, much elongated, not carinated behind, equivalve, very inequilateral, the anterior portion short; valves gaping posteriorly. *Beaks* situate at the anterior fourth, minute, approximate. *Anterior end* short, narrowly rounded. *Posterior end* elongated, very gradually tapering, truncated at the end, the dorsal margin straight; basal margin lightly convex; dorsal areas not differentiated. *Sculpture:* Surface smooth, with fine concentric growth-lines; 2 very inconspicuous ridges extend from the umbo to the upper and lower angle of the posterior truncation of the valves. *Interior* polished, finely radially striate. *Margins* smooth. *Hinge-plate* very narrow and long, curved anteriorly, straight behind, with 2 series of teeth; the anterior teeth are V-shaped, and number 5 to 7; the posterior teeth are very long and narrow, imbricating, and their number is usually 11. The 2 series of teeth are separated by a narrow and very oblique resilifer, directed backwards. *Adductor-scars* inconspicuous. *Pallial line* simple, with a tongue-shaped posterior sinus.

Length, 18 mm.; height, 6·2 mm. (holotype, right valve).

Holotype in the Canterbury Museum, Christchurch.

Loc.—Petane (Pliocene). Recent.

Fam. ANOMIIDÆ.

Anomia trigonopsis Hutton. Plate VI, figs. 1, *a*, *b*.

1877. *Anomia trigonopsis* Hutton, Trans. N.Z. Inst., vol. ix, 1876, p. 598.
1887. ,, ,, Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 236.

Shell subtrigonal, the upper or left valve gibbous, thin but solid, rather smooth, with concentric periods of rest and indications of radiate plications. *Beak* small, incurved, convex. *Anterior end* regularly convex. *Posterior end* with an angular notch above, lightly convex below; basal margin lightly arched and a little wavy. *Sculpture* consisting of concentric distant rest-periods, and somewhat irregular rounded radial plications. *Interior* slightly nacreous. *Hinge-plate* with an indistinct transverse fossette. *Disc* white, elongate, the upper byssus-adductor largest, nearly round, but flattened below; lower byssus-adductor smaller, immediately below the upper one, trigonal, the apex angular and pointing downward, the angles of the base rounded; the lowest impression, the adductor-scar of the valves, of the same size and shape as the middle impression, but the apex pointed upward.

Height, 32·5 mm.; length, 27 mm. (plesiotype).

Holotype lost. *Plesiotype* in the collection of the New Zealand Geological Survey.

Loc.—White Rock River. Miocene.

Remark.—The specimen here described and figured seems to agree with Hutton's species, the type of which cannot be found in the Otago Museum; both are from the same locality.

Anomia undata Hutton.

1873. *Anomia cytæum* Gray: Hutton, Cat. Mar. Moll., p. 83; not of Gray.
1878. ,, ,, Gray: Hutton, Journ. de Conch., vol. xxvi, p. 55; not of Gray.
1880. ,, ,, Gray: Hutton, Man. N.Z. Moll., p. 174; not of Gray.
1885. ,, ,, Gray: Hutton, P.L.S. N.S.W., vol. ix, p. 532; not of Gray.
1885. ,, *undata* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 324.
1893. ,, ,, Hutton, Macleay Mem. Vol., Plioc. Moll., p. 90, pl. ix, fig. 95.
1913. ,, ,, Hutton: Suter, Man. N.Z. Mol., p. 843, pl. 57, fig. 9.

Shell broadly oval to round, rather thin, especially the right valve, slightly inequilateral, inequivalve, with subparallel undulations on the left valve. *Beak* small, inconspicuous, median or anterior. *Sculpture* of left valve consisting of concentric lamellæ and broad rather shallow and subparallel grooves, nearly vertical or oblique; right valve with V-shaped deep impressions. *Interior* pearly, the impressions of the surface sculpture distinctly visible. *Margins* of left valve thin, lamellate; of right valve very thin, indented. *Ligament* of the left valve in the umbonal cavity, transversely triangular; the upper *byssus-scar* tongue-shaped, slightly sinuate below; the second below it tangential, oval; the *adductor-scar* below and behind the latter, very close to it, subcircular. *Foramen* of the right valve very large, concave in front and below, straight and thickened behind; the processes approaching, but leaving a fairly wide space between the two.

Length, 21 mm.; height, 17 mm. (holotype, left valve).

Holotype (left valve) in the Canterbury Museum, Christchurch.

Loc.—Petane (Pliocene). Also in the Miocene. Recent.

Fam. PARALLELODONTIDÆ.

Cucullæa australis (Hutton). Plate IV, fig. 20.

1885. *Macrodon (Cucullaria) australis* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 331.
1887. ,, *australis* Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 230.

Shell small, fragile, transversely suboval, inequilateral, moderately inflated, radiately finely ribbed. *Beaks* rather anterior incurved, slightly separated. *Anterior end* a little shorter, convex, receding, the dorsal margin horizontal, straight. *Posterior end* perpendicular, lightly convex; the dorsal margin similar to the anterior, but a little longer; basal margin broadly rounded. *Cardinal area* narrow, crossed obliquely by 1 anterior and 1 posterior line radiating from the umbo. *Sculpture* consisting of fine radiating riblets, about 60 near the margin, but many die out towards the umbo; they are crossed by fine concentric lines which render them slightly scaly. *Margins* crenated. *Hinge-line* very slightly curved; 2 or 3 small teeth below the umbo, in front of which are 4 and behind it 5 teeth, all of which are nearly parallel to the hinge-line—making about 12 teeth in all.

Length, 14 mm.; height, 10 mm.; diameter, 4 mm. (holotype, right valve).

Holotype in the Canterbury Museum, Christchurch.

Loc.—White Rock River. Miocene.

Cucullæa attenuata Hutton. Plate II, figs. 1, *a*, *b*.

1873. *Cucullœa attenuata* Hutton, Cat. Tert. Moll., p. 28.
1886. „ „ Hutton: Hector, Outline Geol. N.Z., p. 54, fig. 15, No 12.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 231.
1897. „ „ Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 338.

Shell large, solid, rather ventricose, much longer than high, equivalve inequilateral, much attenuated posteriorly, with flattish radiating ribs. *Umbones* broad, distant, incurved. *Anterior end* much shorter, its dorsal margin straight, slightly descending, forming a sharp angle with the broadly convex median margin. *Posterior end* much longer, attenuated, the dorsal margin about the same length as the anterior, straight, horizontal, forming an angle with the straight descending median margin, which farther down is narrowly rounded off towards the broadly convex basal margin, almost straight at the middle. *Area* broad and long, with a number of triangular sulci. *Sculpture* consisting of closely-set radiating costæ, somewhat unequal in width, broadest posteriorly, with a narrow rib in the interstice, but anteriorly these intercostal riblets vanish; the costæ are flat, and crossed by fine and close concentric striæ; the anterior part of the valve has the radiate ribs narrow and obsolete, and the posterior upper part, separated as a triangular area by a ridge descending from the umbo, has only faint indications of fine radiate ribs, the concentric ridges predominating. *Hinge* with a narrow cardinal border, the anterior and posterior teeth large, the anterior ones oblique, but the posterior teeth nearly horizontal.

Height, 76 mm.; length, 114 mm.; diameter, 42 (× 2) mm. (right valve).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Lake Wakatipu. Miocene.

Note on **Glycimeris chambersi** Marshall.

1909. *Glycimeris chambersi* Marshall, "The Subantarctic Islands of New Zealand," vol. ii, p. 701.

At my request Professor P. Marshall most obligingly sent me the type specimen of this shell, which proved to be a well-preserved piece of 2½ valves. A careful examination and comparison with Recent examples fully convinced me that Dr. Marshall's species cannot be separated from *Glycymeris laticostata* Q. & G., being the ovate form described by Quoy and Gaimard as a distinct species under the name of *Pectunculus ovatus*.

The species is found in the Tertiary of New Zealand, Tasmania, South Australia, and Victoria, but Recent it is only known from New Zealand, the Chatham, and the Kermadec Islands.

Fam. PHILOBRYIDÆ.

Philobrya trigonopsis (Hutton).

1885. *Mytilicardia trigonopsis* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 324.
1893. ,, ,, Hutton, Macleay Mem. Vol., Plioc. Moll., p. 85, pl. ix, fig. 94.
1898. *Philobrya trigonopsis* Hutton: Tate, Trans. Roy. Soc. South Aust., vol. 22, p. 87, pl. 4.

Shell small, thick, ventricose, inequilateral, subquadrangular, radiately ribbed and concentrically striated. *Beaks* approximate, with an indistinct, smooth, convex prodissoconch, inclined towards the inner and posterior sides. *Anterior end* long, lightly convex, the dorsal margin short straight, forming an indistinct angle with the anterior margin. *Posterior end* short, slightly excavated above and convex towards the regularly curved ventral margin. *Sculpture* consisting of 11 to 12 equidistant, broadly convex radial ribs which usually bear a distinct median keel, the interstices almost of the same width as the costæ, the whole crossed by fine strong concentric threads. *Interior* faintly radiately striated. *Margins* crenulate. *Hinge-plate* narrow, with a long crenellated posterior ridge; below the anterior portion of the beak there is a short triangular area with a few tubercles in front. *Ligament* below the umbo. *Adductor-scars* small, indistinct. *Pallial line* simple.

Length, 3·5 mm.; height, 5 mm.; diameter, 4 mm. (lectotype).

Lectotype and *syntypes* (3 valves) in the Canterbury Museum, Christchurch.

Loc.—Petane (Pliocene). Also Wanganui (Pliocene).

Remarks.—This species is allied to *P. costata* Bernard, but it is much larger; the prodissoconch is indistinct and convex; the costæ are not grooved, but keeled; and the concentric threads are not wavy, but straight.

Fam. TRIGONIIDÆ.

Trigonia neozelanica, n. sp. Plate V, fig. 3.

1873. *Trigonia pectinata* Lamarck: Hutton, Cat. Tert. Moll., p. 27; not of Lamarck.

Shell subtrigonal, rather small, inequilateral, with close smooth radiating ribs. The posterior half of valve with narrow, rounded radial ribs, the interstices deep and much narrower than the ribs; a little in front of the middle there are 5 much narrower ribs, but towards the anterior end the ribs are getting a little broader, without, however, attaining the same thickness as the ribs on the posterior end; fine concentric growth-lines are ornamenting the surface, getting very conspicuous towards the basal margin, where the posterior costæ are distinctly transversely grooved; there are no tubercles nor spines upon the ribs.

Height, 22 mm.; length, 23 mm. (imperfect left valve).

Holotype in the collection of the Geological Survey, Wellington.

Loc.—Hampden. Miocene.

Remarks.—The original specimen, which Hutton considered to be *T. pectinata*, was part of a valve embedded in a mudstone, so that only the inside was visible. Dr. J. Allan Thomson has now worked it out from the matrix and exposed the outer side. It proves to be quite distinct from *T. margaritacea* Lam. (= *pectinata* Lam.).

Fam. MYTILIDÆ.

Mytilus (Aulacomya) striatus Hutton. Plate IV, fig. 21.

1885. *Mytilus striatus* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 332.
1887. ,, ,, Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 232.

Shell rather small, elongated, inflated anteriorly, compressed posteriorly, winged above at about the middle, radiately finely ribbed. *Beaks* acute, terminal, compressed, strongly curved ventrally. *Anterior end* narrowly rounded, the dorsal margin rapidly ascending, then slowly descending towards the posterior end, the ventral margin slightly undulating. *Posterior end* truncated, broadly rounded. *Sculpture* consisting of fine radial riblets, the interstices of about the same width, crossed by concentric rugose growth-marks.

Length, 29 mm ; height, 14 mm. ; diameter, 10 mm. (holotype, right valve).

Holotype in the Canterbury Museum, Christchurch.

Loc.—Broken River. Miocene.

Modiolaria elongata (Hutton). Plate I, fig. 4.

1873. *Crenella elongata* Hutton, Cat. Tert. Moll., p. 25.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 232.

Shell small, elongato-oblong, umbones quite anterior, the anterior part rather inflated, radiately striated, with a smooth area in front of the middle. *Beaks* approximate, rounded, extending a little beyond the anterior margin, the radial sculpture worn off. *Anterior end* lightly convex, narrowly rounded towards the straight basal margin. *Posterior end* compressed, truncated, its dorsal margin slightly arched. *Sculpture* consisting of fine radiate riblets, those on the dorsum finer, those on the anterior end slightly thicker, the interspaces of about the same width as the riblets; there is a median smooth area of about one-third of the length.

Length, 15·5 mm. ; height, 9 mm. ; diameter, 6·2 mm. (lost holotype, *fide* Hutton). Length, 14 mm. ; height, 9 mm. ; diameter, 7 mm. (one of the topotypes).

Six *topotypes* in the collection of the Geological Survey.

Loc.—Broken River (holotype). Whitewater Creek, Trelissik Basin (topotypes). Miocene.

Remark.—The figure here produced is from a drawing made by the late Mr. Buchanan after the holotype.

Fam. Amusiidæ.

Amusium papakurense Clarke.

1905. *Amussium papakurense* Clarke, Trans. N.Z. Inst., vol. xxxvii, 1904, p. 418, pl. xxxii, fig. 4.

Shell rather small, thin and fragile, very inequilateral, produced posteriorly, surface finely decussated, inside with 9 narrow radiate ribs. *Beak* anterior, small, rather sharp. *Ears* small, smooth. *Anterior end* shorter, subangled, the dorsal margin straight, descending, below the angle the margin is arcuately slanting backwards and uniting with the more convex basal margin. *Posterior end* produced, broadly convex, the dorsal margin a little straightened. *Sculpture* of the left valve consisting of distinct fine and sharp concentric threads, about 5 per millimetre, decussated by much less conspicuous radiate threads; inside of valve with 9 narrow, distant radiate ribs, not extending to the margin, the 2 anterior and the 2 posterior ribs closer together than the others.

Height, 24 mm. ; diameter, 21 mm. : height, 27 mm. ; diameter, 24 mm. (holotype).

Holotype and 2 *paratypes* in the collection of the Auckland University College.

Loc.—On the Waiwera–Warkworth Road, a few hundred yards beyond the Puhoi Bridge (Miocene). The paratypes are from Reid's quarry, on the Papakura – Wairoa South Road, and Symonds Stream, near Slippery Creek.

Fam. Pectinidæ.

Pecten (Chlamys) aldingensis Tate. Plate V, fig. 5.

1886. *Pecten aldingensis* Tate, Trans. Roy. Soc. South Aust., vol. viii, p. 109, pl. vii, figs. 1*a*–1*c*.

Shell orbicular, or a little longer than high, thin, subequilateral, inequivalve. Right valve moderately convex, left valve flatter, ears unequal; both valves ornamented with about 50 narrow, rounded, subdepressed ribs, straight or slightly flexuous, with narrower interspaces, which are sculptured with oblique linear sulci and punctures; towards the front margin a few indistinct concentric lamellæ cross the ribs. *Right valve* with the ears very unequal, the anterior aliiform, radially and concentrically scaly-striated, ventral margin sinuated for the passage of a byssus; posterior ear triangular, vertically and radially scaly-striated. *Left valve* with unequal ears, the posterior one the smaller; both triangular, and radially costed and scaly (Tate).

Length and height, 32 mm. (type). Length, 64 mm.; height, 58 mm. (specimen from Wharekauri).

Loc.—Wharekauri, Waitaki Valley, Otago. Oligocene?

Remarks.—Hutton was certainly mistaken when he took this species for a synonym of *Pecten williamsoni* Zittel (P.L.S. N.S.W. (2), vol. i, p. 482), for the two are quite distinct. The New Zealand specimens, though much larger than the Australian specimen, agree very well with the diagnosis and figures of Tate. It adds another species of *Pecten* to our fossil fauna. The two specimens from Wharekauri are in the collection of the Geological Survey.

Pecten (Chlamys) dendyi Hutton.

1902. *Pecten dendyi* Hutton, Trans. N.Z. Inst., vol. xxxiv, 1901, p. 196, pl. viii.

There is nothing to be added to Captain Hutton's comprehensive diagnosis.

Holotype in the Canterbury Museum, Christchurch.

Loc.—In calcareous sandstone, Chatham Island. It is probably of Miocene age.

Pecten (Chlamys) hilli Hutton.

1905. *Pecten hilli* Hutton, Trans. N.Z. Inst., vol. xxxvii, 1904, p. 473, pl. xliv.

Nothing is to be added to Captain Hutton's diagnosis.

Holotype in the Canterbury Museum, Christchurch.

Loc.—Napier. Miocene.

Pecten (Chlamys) semiplicatus Hutton. Plate I, fig. 7; Plate VI, fig. 4.

1873. *Pecten semiplicata* Hutton, Cat. Tert. Moll., p. 30.
1887. ,, *semiplicatus* Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 234.
1893. ,, ,, Hutton, Macleay Mem. Vol., Plioc. Moll., p. 89.
1897. ,, ,, Hutton: Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 319.

Shell suborbicular, compressed, equilateral, with 5 or 6 plications which get obsolete towards the margin, radially finely ribbed and closely concentrically striated. *Right valve: Beak* median, narrowly rounded, flat. *Ears* rather large, the anterior slightly larger, with a small byssal sinus. *Anterior end* angled, the dorsal margin lightly convex, descending, forming an angle with the convex anterior margin. *Posterior end* similar to the anterior, but the dorsal margin a little longer and less angled on meeting the posterior margin; basal margin regularly convex. *Sculpture:* There are 5 to 6 plications, with deep interspaces from the beak to about the middle of the valve, but towards the margin they become much shallower; the whole surface with fine, flat, very unequal radiate riblets, the interspaces linear; close sharp concentric threads are distinctly marked in the interstices; ears with about 7 nodulous radiate riblets, crossed by concentric fine lines.

Height, 54 mm.; length, 53 mm.; diameter, 4 mm. (plesiotype).

Plesiotype in the collection of the Geological Survey.

Loc.—Castlepoint.

Remarks.—The lost holotype was from Napier, and a figure drawn after it by the late Mr. Buchanan is here reproduced. The species is found in the Miocene and Pliocene.

Addendum.

The holotype having been returned, a few descriptive notes are here offered. The specimen is a fragment of a left valve. The anterior ear is imperfect, the posterior ear is fairly large, with 4 radiate ribs and dense concentric striæ. There are 7 plications, the anterior and posterior one inconspicuous, which gradually disappear as the ventral margin, in the adult, is reached; the whole surface is ornamented with small radiating ribs of rather unequal strength, and more or less inequidistant, narrow and rounded near the summit, but getting broader and flattish towards the basal margin; the whole surface with regular, close, concentric striæ.

Loc.—Napier. Miocene.

Fam. OSTREIDÆ.

Ostrea incurva Hutton. Plate III, fig. 1; Plate VII, figs. 2, *a*, *b*.

1873. *Ostrea incurva* Hutton, Cat. Tert. Moll., p. 35.
1887. „ „ Hutton, P.L.S. N.S.W. (2), vol. i, p. 237.

Left valve large, ovate, very thick and heavy, convex, with incurved beak and distant concentric laminæ. *Beak* forming a flat disc, incurved, slightly directed forward. *Anterior end* with the upper third of the margin broadly concave, the lower two-thirds convex. *Posterior end* somewhat straightened above, convex below; the basal margin very little arched. *Sculpture* consisting of concentric imbricating rather distant laminæ. *Margins* rather sharp, foliated in some places, no crenature. *Hinge-plate* short and broad, triangular, bounded on each side by a shallow sulcus, transversely striated, the resilifer somewhat oblique, deeply hollowed, triangular. *Adductor-scar* obliquely sunk, of moderate size, lunate, situate at the middle of the height, but nearer the posterior end.

Height, 138 mm.; length, 102 mm.; diameter, 65 mm. (holotype).

Holotype in the collection of the Geological Survey.

Loc.—Oamaru. Miocene.

Ostrea (Eostrea) wuellerstorfi Zittel. Plate VII, fig. 3.

1865. *Ostrea wüllerstorfi* Zittel, Voy. "Novara," Palæ., p. 54, pl. xi, fig. 6.
1873. „ *wullerstorfii* Zittel: Hutton, Cat. Tert. Moll., p. 34.
1887. „ *wuellerstorfii* Zittel: Hutton, P.L.S. N.S.W. (2), vol. i, p. 237.
1897. „ *wullerstorfi* Zittel: Harris, Cat. Tert. Moll. Brit. Mus., pt. 1, p. 301.

In the collection of the Geological Survey there is a left valve of this species which shows a character not mentioned by the author, or by Hutton or Harris. The posterior dorsal margin from the umbo down for a length of about 40 mm. is flattened to a width of about 7 mm., and this is conspicuously transversely crenate; the anterior dorsal margin is not flattened, with a rather sharp edge, but bears on the inside rather coarse plications. The crenate or plicate margin is characteristic of the subgenus *Eostrea* Ihering (Anales Museo Nac. Buenos Aires, vol. xiv, 1907, p. 42), to which this species has to be assigned. Ihering mentions that all the *Eogene* Patagonian *Ostreæ* belong to this subgenus.

The dimensions of the specimen are: Length, 155 mm.; height, 158 mm.

Loc.—Kawau Island. Miocene.

Fam. PINNIDÆ.

Note on **Pinna plicata** Hutton.

1873. *Pinna plicata* Hutton, Cat. Tert. Moll., p. 26.

Dr. J. Allan Thomson informed me that the fossil in the collection of the Geological Survey under the above name was not a shell, but a fan-shaped Fucoid. I have since seen the specimen, and I share Dr. Thomson's opinion.

The species therefore has to be struck off the list of our fossil *Mollusca*.

Fam. CARDITIDÆ.

Venericardia difficilis Deshayes var. benhami. (J. A. Thomson.)

1908. *Cardita benhami* J. A. Thomson, Trans. N.Z. Inst., vol. xl, 1907, p. 102.

Dr. J. Allan Thomson kindly sent me a number of specimens of this shell collected by himself at Kakanui. On examining them I found that they generally agreed very well with *V. difficilis*, and the only difference constantly turning up is the number of radiate costæ. In the species they usually vary from 22 to 24, but in the variety their number is from 26 to 30. Otherwise the character of the ribs is the same, they are of course a little more slender on valves of the same size, but the proportion between the width of the ribs and the interspaces is the same as in the species. The lunule is exactly alike in the two forms.

Length, 22·2 mm; height, 22·2 mm. (holotype).

Holotype should be in the Otago Museum, Dunedin, but Professor Benham told me that he was unable to find it. *Ideotypes* are in the collection of the Geological Survey, Wellington.

Loc.—Fossiliferous layers of the tuff underlying the limestone on the cliffs, North Shore, Kakanui. Miocene.

Fam. LUCINIDÆ.

Loripes concinna Hutton.

1885. *Loripes concinna* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 323.
1886. ,, ,, Hutton, *op. cit.*, vol. xviii, p. 363.
1893. ,, ,, Hutton, Macleay Mem. Vol., Plioc. Moll., p. 83, pl. ix, fig. 90.
1906. ,, ,, Hutton: Hedley, Trans. N.Z. Inst., vol. xxxviii, 1905, p. 74.
1913. ,, ,, Hutton: Suter, Man. N.Z. Moll., p. 912, pl. 63, fig. 8.

Shell small, suborbicular, the beaks turned forward, concentrically finely ribbed, slightly inequilateral. *Beaks* slightly raised, convex, incurved. *Anterior end* a little longer, semicircular, the dorsal margin narrowly concave in front of the umbones. *Posterior end* truncated at the middle, dorsal margin sloping, lightly convex; basal margin broadly rounded. *Lunule* lanceolate, the left half narrower. *Sculpture* consisting of regular, fine, and sharp concentric riblets, the interspaces of about the same width. *Interior* porcellanous, the area inside the pallial line radially striate. *Margins* finely crenate. *Hinge:* Right valve with a large triangular and oblique cardinal, occasionally bifid, and an anterior and posterior feeble lateral tooth; left valve with 2 diverging cardinal teeth, a triangular socket between them, lateral teeth obsolete. *Ligament* partly external, with a shorter resilium. *Adductor-scars:* The anterior larger, elongated. *Pallial line* distinct, simple.

Length 7·5 mm.; height, 7 mm.; diameter, 4 mm. (holotype).

Holotype and *paratypes* (6 right and 2 left valves) in the Canterbury Museum, Christchurch.

Loc.—Wanganui (Pliocene). Also at Petane, and in the Miocene. Recent.

Loripes laminata Hutton. Plate VIII, figs. 19, *a*, *b*.

1885. *Loripes laminata* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 331.
1887. ,, ,, Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 228.

Shell small, orbicular, compressed, finely distantly laminated and radiately striated between the lamellæ, equilateral. *Beaks* turned forwards, not inflated, pointed. *Anterior end* regularly convex, the dorsal margin rather short, concave. *Posterior end* broadly convex, subangled towards the straight and slowly descending dorsal margin; basal margin rounded. *Lunule* lanceolate, sunken. *Sculpture* consisting of fine, distant, sharply raised concentric lamellæ, closer together on the upper third of the valves, the interstices with distinct, fine, and close radiate striæ. *Interior* porcellanous, faintly radiately striated. *Margins* smooth. *Hinge:* Right valve with a triangular cardinal under the umbo, a short distant anterior lateral, and a long posterior lateral; left valve with 2 diverging cardinals, a triangular fossette between them, distant and rather short anterior and posterior laterals. *Ligament* partly external. *Adductor-scars* oval. *Pallial line* simple, well impressed.

Length, 7 mm.; height, 6·8 mm.; diameter, 1·6 mm. (left valve of holotype).

Holotype in the Canterbury Museum, Christchurch.

Loc.—White Rock River. Miocene.

Fam. DIPLODONTIDÆ.

Diplodonta ampla (Hutton).

1885. *Mysia ampla* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 323.
1893. ,, ,, Hutton, Macleay Mem. Vol., Plioc. Moll., p. 83, pl. ix, fig. 91.

Shell large, suborbicular, rather thick, somewhat inequilateral and inflated, concentrically striated. *Beaks* slightly in front of the middle, directed forwards, approximate, incurved, pointed. *Anterior end* shorter, convex, the dorsal margin excavated near the umbo, straight and slowly descending beyond. *Posterior end* a little longer, broadly rounded, the dorsal margin straight, less steep than the anterior dorsal margin; basal margin convex, ascending anteriorly. *Sculpture* consisting of very irregular, more or less flattish concentric bands. *Interior* rough, slightly radially striated. *Margins* smooth. *Hinge:* Right valve with 2 diverging cardinal teeth, the posterior of which is grooved; lateral teeth obsolete. *Ligament* moderately long, lanceolate. *Adductor-scars:* The anterior elongate, the posterior ovate. *Pallial line* simple, distinct.

Length, 39 mm.; height, 37 mm.; diameter, 12 mm. (holotype, right valve).

Holotype in the Canterbury Museum, Christchurch.

Loc.—Wanganui. Pliocene.

Remark.—Larger, thicker, and more strongly striated than *D. zelandica* Gray.

Fam. LEPTONIDÆ.

Neolepton effosum (Hutton).

1885. *Kellia effosa* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 323.
1893. ,, ,, Hutton, Macleay Mem. Vol., Plioc. Moll., p. 84, pl. ix, fig. 93.

Shell small, oblongo-triangular, nearly equilateral, rather swollen, sharply and rather coarsely irregularly concentrically striated. *Beaks* prominent, somewhat inflated, approximate, directed forwards. *Anterior end* a little longer, narrowly convex, the long and nearly straight dorsal margin gradually descending. *Posterior end* rounded, the convex dorsal margin slightly steeper than the anterior; basal margin almost straight. *Sculpture* consisting of somewhat irregular sharply raised concentric riblets with slightly narrower interstices, sometimes obsolete towards the beaks. *Margins* smooth. *Hinge:* Right valve with a large triangular anterior cardinal and a fine lamella above it, both coalescent near the resilifer under the beak, and 2 posterior lamellæ; left valve with an anterior elongated lamella, hooked near the resilifer, and with an oval tooth below, behind the middle an elongated and triangularly raised lamella.

Length, 3·2 mm.; height, 2·6 mm.; diameter, 1 mm. (left valve of holotype).

Holotype and 3 *paratypes* (left valves) in the Canterbury Museum, Christchurch.

Loc.—Petane. Pliocene.

Neolepton robustum (Hutton).

1885. *Kellia robusta* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 323.
1893. ,, ,, Hutton, Macleay Mem. Vol., Plioc. Moll., p. 84, pl. ix. fig. 92.

Shell small, orbiculo-triangular, nearly as high as long, compressed, nearly equilateral, very delicately regularly concentrically striated. *Beaks* rather prominent, contiguous, very slightly inclined forwards. *Anterior end* very little shorter, narrowly convex, the lightly convex dorsal margin steeper than the posterior dorsal margin. *Posterior end* somewhat broader rounded; basal margin regularly arched. *Sculpture* consisting of very fine, flattish, subequal concentric riblets with linear interspaces; there is no radial sculpture. *Margins* smooth. *Hinge:* Right valve with an anterior triangular tooth and a hooked lamella above it, the resilifer beneath the beak, and behind it 2 rather large lamellæ.

Length, 3·4 mm.; height, 2·9 mm.; diameter, 1 mm. (right valve, holotype).

Holotype and 1 *paratype* (both right valves) in the Canterbury Museum, Christchurch.

Loc.—Petane. Pliocene.

Remark.—Nearly allied to the Recent forms, but more solid and larger.

Fam. Unionidæ.

Diplodon inflatus (Hutton). Plate I, figs. 1, *a*, *b*.

1873. *Unio inflata* Hutton, Cat. Tert. Moll., p. 25.
1887. ,, ,, Hutton, P.L.S. N.S.W. (2), vol. i, p. 229.

Shell rather small, oval, ventricose, inequilateral, concentrically striated, the umbones much corroded. *Beaks* at about the anterior third of length, directed forwards and incurved, inflated. *Anterior end* short, narrowly rounded, the dorsal margin slightly convex. *Posterior end* about twice as long as the anterior, and more broadly convex, the dorsal margin straight, slowly descending, basal margin broadly rounded. *Sculpture* consisting of fine and close, somewhat unequal concentric striæ, interrupted by more conspicuous periods of rest; the umbones corroded, smooth, with a few diverging ridges produced by pressure upon the thin pliable layer. *Hinge* unknown.

Height, 32 mm.; length, 49 mm.; diameter, 27 mm.

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Morley Creek, Southland. Miocene.

Remarks.—Recent specimens of *Diplodon menziesi* Gray, from the Western Springs, Auckland, are sometimes much inflated, but not to such an extent as in *D. inflatus*.

Fam. Tellinidæ.

Tellina (s. str.) eugonia Suter.

1885. *Tellina angulata* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 322; not of Gmelin.
1893. ,, ,, Hutton, Macleay Mem. Vol., Plioc. Moll., p. 80, pl. ix, fig. 86
1906. ,, ,, Hutton: Suter, Trans. N.Z. Inst., vol. xxxviii, 1905, p. 318.
1913. ,, *eugonia* Suter, Man. N.Z. Moll., p. 949, pl. 59, fig. 12.

Shell ovato-trigonal, transverse, compressed, inequilateral, anterior end longer, regularly concentrically ribbed. *Beaks* not much raised, contiguous, sharply pointed, incurved. *Anterior end* somewhat longer, regularly rounded, the dorsal margin lightly convex and very slowly descending. *Posterior end* attenuate, shortly truncated, the dorsal margin straight or lightly excavated, basal margin broadly rounded, ascending posteriorly. *Sculpture* consisting of equidistant, close, obliquely raised, sharp concentric ribs, the interstices with fine microscopic radiate striæ; right valve with a posterior fold, left valve with 2 posterior folds, separated by a broad groove; at these folds the ribs are partly getting obsolete, and the remaining ones are somewhat lamellate. *Interior* shining, radially faintly striated, and showing to some extent the sculpture of the outside. *Hinge:* Right valve with 2 cardinals, the posterior bifid, and 2 laterals, the anterior nearer the cardinal than the posterior; left valve with 2 cardinals, the anterior bifid, the posterior very small, and 2 laterals. *Ligament* rather short. *Adductor-scars* unequal, the anterior high, the posterior smaller, rounded. *Pallial sinus* large, extending to within close proximity of the anterior scar.

Length, 33 mm.; height, 22 mm.; diameter, 9 mm. (holotype).

Holotype (right valve) in the Canterbury Museum, Christchurch.

Loc.—Wanganui (Pliocene). Also in the Miocene and Recent.

Fam. Semelidæ.

Leptomya lintea (Hutton).

1873. *Tellina decussata* Lamarck: Hutton, Cat. Mar. Moll., p. 67; not of Lamarck.
1873. ,, *lintea* Hutton, *op. cit.*, p. 67.
1873. ,, *subovata* Sowerby: Hutton, *op. cit.*, p. 67; not of Sowerby.
1878. ,, *strangei* Deshayes: Hutton, Journ. de Conch., vol. xxvi, p. 47; not of Deshayes.
1885. ,, *retiaria* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 322.
1893. ,, *strangei* Deshayes: Hutton, Macleay Mem. Vol., Plioc. Moll., p. 80; not of Deshayes.
1907. *Leptomya lintea* Hutton: Suter, Proc. Mal. Soc. Lond., vol. vii, p. 213, pl. xviii, fig. 10.
1913. ,, ,, Hutton: Suter, Man. N.Z. Moll., p. 956, pl. 54, figs. 14, *a–c*.

Shell oval, thin, somewhat pellucid, more or less inequilateral, angular behind, concentrically and radially striated. *Beaks* prominent, approximate, curved inwards. *Anterior end* regularly rounded, the dorsal margin straight, very little descending. *Posterior end* narrowed, sometimes a little longer, subangular, slightly folded, the dorsal margin convex, oblique; basal margin broadly rounded. *Lunule* clearly defined, lanceolate, with oblique sublamellar folds, devoid of radiate sculpture. *Escutcheon* ill defined. *Sculpture* consisting of fine subequidistant concentric striæ, with better-marked periods of rest, sometimes lamellar at the posterior end, where a distinct fold runs down from the beaks; this concentric sculpture is reticulated by exceedingly fine and close-set radiate striæ. *Interior* porcellanous, the margins smooth. *Hinge-plate* narrow and short; the right valve with 2 simple slightly triangular cardinals, the anterior oblique; posteriorly a narrow and very oblique resilifer; left valve with 1 stout bifid or trifid cardinal, in front of which is sometimes, but not always, a small lateral tooth. *Ligament* short, with very slender nymphæ. The anterior *adductor-scar* is oblong, not very distinct, the posterior scar round or oval, and well impressed. *Pallial sinus* deep and broad, rounded in front, not coalescent at the base with the pallial line.

Length, 14·5 mm.; height, 11·5 mm.; diameter of left valve, 3 mm. (holotype of *T. retiaria*).

Holotype of *Tellina lintea* in the Dominion Museum, Wellington. *Holotype* of *Tellina retiaria* in the Canterbury Museum, Christchurch.

Loc.—Wanganui (Pliocene). Recent.

Fam. Mactridæ.

Mactra (Mactroderma) crassa (Hutton).

1885. *Hemimactra crassa* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 322.
1893. *Mactra crassa* Hutton: Macleay Mem. Vol., Plioc. Moll., p. 77, pl. viii, fig. 82.

Shell trigonal, sometimes nearly as high as long, massive, inequilateral, rude. *Beaks* more or less anterior, rounded, incurved. *Anterior end* short, narrowly convex, the dorsal margin straight, or slightly concave. *Posterior end* longer than the anterior end, narrowly rounded or angled, the dorsal margin slightly convex, the posterior slope barely skeeled. *Basal margin* curved. *Sculpture* consisting of rather coarse concentric plications. *Margins* of valves smooth inside. *Hinge-plate* triangular, the *left valve* with a mall bifid cardinal tooth in front of the resilifer, an anterior and posterior lateral lamina; *resilifer* rather large, triangular. *Ligament* small, in a triangular pit beneath the beak. *Right valve* (?). *Adductor-scars* subequal. *Pallial sinus* small, tongue-shaped.

Length, 39 mm.; height, 35 mm.; diameter of left valve, 15 mm. (holotype).

Holotype and 1 *paratype* (left valves) in the Canterbury Museum, Christchurch.

Loc.—Wanganui. Pliocene.

Mactra (Mactrotoma) ovata (Gray).

1843. *Spisula ovata* Gray in Dieffenbach's N.Z., vol. ii, p. 251.
1873. *Mactra inflata* Hutton, Cat. Tert. Moll., p. 18.
1885. „ *lavata* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 331.
1893. „ „ Hutton, Macleay Mem. Vol., Plioc. Moll., p. 76, pl. viii, fig. 81.
1913. „ *ovata* Gray: Suter, Man. N.Z. Moll., p. 966, pl. 60, fig. 3.

Hutton's *Mactra lavata* is a Recent shell, collected by Mr. A. Hamilton, and not a fossil. It is identical with *M. ovata* Gray.

Holotype and 4 *paratypes* of *M. lavata* in the Canterbury Museum, Christchurch.

M. ovata is found fossil in the Pliocene and Miocene.

Fam. Veneridæ.

Cytherea (Circomphalus) sulcata (Hutton).

1875. *Venus (?) sulcata* Hutton, Trans. N.Z. Inst., vol. vii, 1874, p. 458, pl. xxi.
1887. *Venus sulcata* Hutton, P.L.S. N.S.W. (2), vol. i, p. 226.

Shell moderately large, subequilateral, ovate, somewhat ventricose, with broad concentric ribs and no radial sculpture. *Beak* incurved, directed forward. *Anterior end* shorter, regularly convex, the dorsal margin slightly concave, descending. *Posterior end* indistinctly obliquely truncated, dorsal margin almost straight, descending; basal margin convex. *Sculpture* consisting of rather broad concentric ribs which are sharply keeled, the interstices narrower than the ribs; there is no trace of radiate striæ.

Length, 61 mm.; height, 48 mm.; diameter, 16 mm. (holotype, right valve).

Holotype in the Otago Museum, Dunedin.

Loc.—Napier, in limestone. Miocene.

Fam. Cardiidæ.

Cardium huttoni Ihering. Plate VI, fig. 5.

1887. *Cardium multiradiatum* Sowerby: Hutton, P.L.S. N.S.W. (2), vol. i, p. 227; not of Sowerby.
1907. „ *huttoni* Ihering, Anales Museo Nac. Buenos Aires, vol. xiv, p. 291.

Shell large, subtrigonal, somewhat ventricose, inequilateral, with numerous radiating ribs, which are usually smooth. Right valve: *Beak* slightly in front of the middle, incurved, convex. *Anterior end* shorter, ventricose, the dorsal margin elevated and pressed against the umbo, the median margin regularly rounded. *Posterior end* flattened, compressed, the dorsal margin straightened, the median margin very broadly convex; basal margin regularly rounded. *Sculpture* consisting of smooth, flatly convex radiate ribs, the interstices nearly as broad as the ribs; they are finer and more crowded on the posterior end, whilst the 6 to 7 anterior ribs bear very often a few tubercles; the anterior half of the valve has about 25 ribs.

Height, 85 mm.; length, 103 mm. (topotype).

Holotype in the Museum Paulista, Sao Paulo, Brazil. *Topotype* in the Canterbury Museum, Christchurch.

Loc.—Waipara. Miocene.

Remark.—The photograph reproduced is taken from a specimen (topotype) in the Museum labelled by the late Captain Hutton as *C. multiradiatum* Sow.

Cardium (Trachycardium) waitakiense Suter. Plate VIII, fig. 20.

1907. *Cardium (Trachycardium) waitakiense* Suter, Proc. Mal. Soc. Lond., vol. vii, p. 209, pl. xviii, fig. 6.

There being only the central part of a right valve in my possession, the description must for the present remain fragmentary.

Shell solid, ventricose, radiately very finely ribbed; the ribs number about 60; they are flat, smooth, the sulci slightly narrower than the ribs. A few concentric low ridges are visible on the posterior part of the shell, forming low nodules on crossing the ribs. This seems to imply that towards the margin the ribs may have been granulate, squamose, or spinous. *Umbo* elevated, incurved, and slightly prosogyrate. The *hinge-plate* is rounded, elevated, and bent over towards the rather long and straight nympha, forming a deep groove for the insertion of the ligament. There are 2 smooth cardinals reaching as high as the top of the umbo; the posterior tooth is stouter, conical, united on the outside with the smaller anterior tooth, leaving a deep socket between them. Part of a posterior lateral tooth is present. The anterior part of the shell is most likely much shorter than the posterior, and the length of the valve may have been between 40 and 50 mm.

Holotype in my collection.

Loc.—Waitaki Valley, North Otago. Wharekauri greensands. Labelled " Oamaru Series, Oligocene." Miocene (Professor J. Park, 1905).

Remark.—Dr. W. H. Dall wrote about this species: " A *Cardium*, belonging to the section *Trachycardium*, and related to *C. gigas* Defr., of the Paris Basin Eocene."

Cardium greyi Hutton. Plate I, fig. 3.

1873. *Cardium greyi* Hutton, Cat. Tert. Moll., p. 23.
1887. ,, ,, Hutton, P.L.S. N.S.W. (2), vol. i, p. 227.

Shell convex, slightly ventricose, subequilateral, with numerous narrow, rounded radiate ribs. *Umbo* nearly median, elevated, inflated, incurved and slightly turned forwards. *Anterior end* convex, the dorsal margin somewhat excavated. *Posterior end* rounded, the dorsal margin descending. *Sculpture* consisting of about 50 narrow, flatly rounded radial ribs, of $1\frac{1}{2}$ mm. width near the basal margin, the interstices of about half the width of the ribs; anteriorly the costæ are slightly stronger, faintly keeled, the interstices of about the same width, and there are traces of concentric, faintly scaly laminations. *Hinge* unknown.

Height, 57 mm.; length, 62 mm.; diameter, 21 mm. (× 2).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Kawau, North Island. Miocene.

Remark.—The type specimen is, I think, a right valve, but in a somewhat unsatisfactory condition.

Fam. Chamidæ.

Chama huttoni Hector. Plate VI, fig. 3.

1886. *Chama huttoni* Hector, Outline of the Geol. of N.Z., p. 50, fig. 7, No. 7.
1887. ,, ,, Hector MSS.: Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 228.

Shell somewhat irregularly ovate, inequivalve, solid, fixed with 1 valve, coarsely lamellose. *Beaks* subspiral, prosogyrate, unequal in the 2 valves. *Anterior end* usually somewhat produced above, narrowly rounded. *Posterior end* regularly convex, as is also the basal margin. *Sculpture* consisting of sharply raised concentric lamellæ, usually closer together on the free valve. *Margins* smooth inside. *Hinge-plate* thick. *Sessile valve* with a strong, triangular, and crenulated anterior cardinal tooth, a fossette behind it, followed by a narrow oblong tooth, separated from the nymph by a groove; *free valve* with an anterior crenulated cardinal fossette and a small cardinal tooth behind it. *Ligament* in a groove extending to the beaks. *Adductor-scars* large, oval, smooth. *Pallial line* simple.

Height, 46 mm.; length, .40 mm.; diameter, 23 mm. (holotype, sessile left valve).

Holotype in the collection of the Geological Survey; also a number of *paratypes*.

Loc.—Castlepoint, Wellington. Miocene.

Fam. Corbulidæ.

Corbula canaliculata Hutton.

1877. *Corbula sulcata* Hutton, Trans. N.Z. Inst., vol. ix, 1876, p. 598, pl. xvi, fig. 14; not of Lamarck.

1887. *Corbula canaliculata* Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 223.

Shell small, fairly solid, trigonal, gibbous, slightly inequilateral, broadly concentrically ribbed. *Beak* slightly in front of the middle, inflated, incurved and slightly turned forwards. *Anterior end* slightly shorter, narrowly rounded, dorsal margin faintly convex. *Posterior end* narrowly truncated, the dorsal margin nearly straight, descending; basal margin very little convex. *Sculpture* consisting of close concentric ribs, fine and close together below the smooth prodissoconch, then increasing in strength towards the base; at the middle of the valve they are broadly convex, with a rather sharp upper edge, narrower in front and broader posteriorly, the deep interstices of about the same width as the riblets. *Hinge:* Right valve with a prominent tooth beneath the beak, and a deep resilifer behind it.

Length, 9 mm.; height, 7·7 mm.; diameter, 5 mm. (right valve, holotype).

Holotype (r.v.) in the Otago Museum, Dunedin.

Loc.—Mount Harris. Miocene.

Corbula humerosa Hutton. Plate VIII, figs. 21, *a*, *b*.

1885. *Corbula humerosa* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 330.

1887. ,, ,, Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 223.

Shell small, ovato-trigonal, much inflated, concentrically striated, somewhat inequilateral. *Beak* slightly in front of the middle, roundly inflated, incurved, approaching the dorsal margin. *Anterior end* shorter, narrowly rounded, the dorsal margin faintly convex, descending. *Posterior end* slightly produced, narrowly rounded, not carinated, dorsal margin straight, slowly descending; basal margin very slightly arcuate. *Sculpture* of right valve consisting of concentric striæ, a few periods of rest, and 3 central radiate ridges. *Hinge* of right valve with a large tooth just in front of the beak, and a resiliary pit behind it. *Pallial line* without a sinus.

Length, 6 mm.; height, 4·9 mm.; diameter, 3 mm. (right valve, holotype).

Holotype in the Canterbury Museum, Christchurch.

Loc.—White Rock River. Miocene.

Corbula pumila Hutton. Plate VIII, figs. 22, *a*, *b*.

1885. *Corbula pumila* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 330.

1887. ,, ,, Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 223.

Shell small, thin, subequilateral, both valves convex, truncated behind, with close concentric ribs. *Beaks* a little in front of the middle, not inflated, approximate, incurved. *Anterior end* slightly shorter, narrowly convex, the dorsal margin straight, slowly descending. *Posterior end* truncated, an inconspicuous keel descending from the umbo to the lower angle of the truncation, dorsal margin faintly convex and less inclined than the anterior dorsal margin; basal margin very broadly convex. *Sculpture* of right valve consisting of close, rounded, concentric ribs, increasing in width towards the base, interstices linear; the ribs on the left valve are narrower, and with much wider interstices on the lower part of the valve. *Hinge:* Right valve with a prominent tooth and a deep resilifer behind it; left valve with a socket for the reception of the tooth of the right valve.

Length, 8 mm.; height, 5·8 mm.; diameter, 2 mm. (right valve, holotype).

Holotype (2 valves) and 1 *paratype* (1 left valve) in the Canterbury Museum, Christchurch.

Loc.—White Rock River. Miocene.

Remarks.—This species is shorter than *C. macilenta* Hutton, much thinner than *C. zelandica* Q. & G., and differs from both in the regular concentric ribs.

Fam. Saxicavidæ.

Panopea orbita Hutton. Plate III, figs. 2, *a*, *b*.

1873. *Panopæa plicata* Hutton, Cat. Tert. Moll., p. 17; not of Sowerby.
1885. ,, *orbita* Hutton, Quart. Journ. Geol. Soc., vol. xli, p. 551.
1887. ,, ,, Hutton, P.L.S. N.S.W. (2), vol. i, p. 223.

Shell oblong, height a little more than half the length, equivalve, inequilateral, gaping at both ends, with concentric deeply sulcated plications. *Beaks* at about the anterior third of length, pointed, incurved, directed forwards, approximate. *Anterior end* short, rounded, its dorsal margin slightly convex, a ridge descending from the umbones towards the lower part of the anterior margin, but getting obsolete half-way down. *Posterior end* produced, rounded, its dorsal margin horizontal, nearly straight; an inconspicuous ridge extending from the umbones towards the lower part of the posterior margin; basal margin nearly straight. *Sculpture* consisting of very strong rounded concentric plications, close together on the umbones, but getting gradually more distant towards the base, separated by concave grooves. *Hinge* unknown.

Height, 34 mm.; length, 62 mm.; diameter, 30 mm.

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Raglan. Miocene.

Fam. Teredinidæ.

Teredo heaphyi Zittel.

1865. *Teredo heaphyi* Zittel, Voy. "Novara," Palæ., p. 45, pl. xiv, figs. 4*a*, *b*.
1877. *Cladopoda directa* Hutton, Trans. N.Z. Inst., vol. ix, 1876, p. 597, pl. xvi, fig. 13.
1887. *Teredo heaphyi* Zittel: Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 223.

Valves and *pallets* unknown. *Tubes* elongate, round, straight or twisted, sometimes with distinct constrictions, usually in great numbers together; anterior end closed, convex; posterior end open, section circular.

Diameter of the tubes variable, 5 to 10 mm.

Type in the K. K. Hofmuseum, Vienna. The type of Hutton's species is lost.

Loc.—Rodney Point (Miocene). Hutton gives no locality for his species.

Fam. Pholadomyidæ.

Pholadomya neozelanica Hutton. Plate VI, fig. 2 ; Plate VII, fig. 1.

1885. *Pholadomya neozelanica* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 330.
1887. ,, ,, Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 224.

Shell oblong, very inequilateral, moderately ventricose, concentrically ribbed and on the central portion radiately costate, with distinct lunule and escutcheon. *Beak* near the anterior end, prosogyrate, incurved. *Anterior end* short, flatly rounded, the dorsal margin short. *Posterior end* compressed, regularly arched, long, the dorsal margin slightly concave, slowly descending; ventral margin flatly rounded. *Lunule* large, lanceolate, elevated and circumscribed by a groove. *Escutcheon* long and narrowly lanceolate, deep-seated. *Sculpture* consisting of concentric ribs, about 12 to an inch, rounded, broader than the grooves; central portion radiately ribbed, ribs moniliform, not so strong as the concentric ornamentation; about 20 in number, the 2 anterior farther apart.

Length, 66 mm. ; height, 51 mm. ; diameter, 16 mm. (right valve, holotype).

Holotype in the Otago Museum, Dunedin.

Loc.—Oamaru. Miocene.

EXPLANATION OF PLATES.

[All figures natural size, unless the contrary is stated.]

Plate I.

Fig. 1, *a*, *b*. *Diplodon inflatus* (Hutton). Holotype. Morley Creek, Southland. The umbones have been restored in the figure.
Fig. 2. *Cypræa ficoides* (Hutton). Holotype. Oamaru.
Fig. 3. *Cardium greyi* Hutton. Holotype. Kawau.
Fig. 4. *Modiolaria elongata* (Hutton). Plesiotype. Whitewater Creek, Trelissick Basin.
Fig. 5. *Vexillum apicale* (Hutton). Plesiotype. Awamoa.
Fig. 6. *Galeodea muricata* (Hector). Holotype. Komiti Point, Kaipara.
Fig. 7. *Pecten (Chlamys) semiplicatus* Hutton. Holotype. Napier.
Fig. 8. *Melanopsis trifasciata* Gray. Plesiotype. Holotype of *Ancillaria pomahaka* Hutton. Pomahaka, Otago.
Fig. 9. *Epitonium (Acirsa) ornatum* (Hutton). Holotype. Pomahaka, Otago.

Plate II.

Fig. 1, *a*, *b*. *Cucullæa attenuata* Hutton. Holotype. Lake Wakatipu.

Plate III.

Fig. 1. *Ostrea incurva* Hutton. Left valve. Holotype. Oamaru.
Fig. 2, *a*, *b*. *Panopea orbita* Hutton. Holotype. Raglan.

Plate IV.

Fig. 1. *Trochus (Cœlotrochus) conicus* (Hutton). Holotype. Wanganui. Enlarged 1½ diameters.
Fig. 2. *Trochus nodosus* Hutton. Ideotype. Broken River. Nearly natural size.
Fig. 3. *Struthiolaria (Pelicaria) obesa* Hutton. Holotype. Shepherd's Hut, Waipara. Natural size.
Fig. 4. *Struthiolaria parva* Suter. Holotype. Enlarged nearly 2 diameters.
Fig. 5. *Polinices (Euspira) cinctus* (Hutton). Holotype. Wanganui. Enlarged nearly 2 diameters.
Fig. 6. *Epitonium marginatum* (Hutton). Holotype. Curiosity Shop. Slightly enlarged.
Fig. 7. *Mitra inconspicua* Hutton. Holotype. Mount Harris. Enlarged nearly 2 diameters.
Fig. 8. *Siphonalia orbita* Hutton. Holotype. Greta. Slightly enlarged.
Fig. 9. *Euthria media* (Hutton). Holotype. Waikari. Slightly enlarged.
Fig. 10. *Euthria media* (Hutton). Paratype. Waikari. Slightly enlarged.
Fig. 11. *Cominella monilifera* Hutton. Holotype. Shepherd's Hut, Waipara.
Fig. 12. *Phos cingulatus* (Hutton). Holotype. Greta. Slightly enlarged.
Fig. 13. *Phos incisus* (Hutton). Holotype. Te Aute, Hawke's Bay. Enlarged 2 diameters.
Fig. 14. *Fulguraria (Alcithoe) aculeata* (Hutton). Holotype. White Rock River. Enlarged 1½ diameters.
Fig. 15. *Olivella neozelanica* (Hutton). Holotype. Patea. Slightly enlarged.
Fig. 16. *Olivella neozelanica* (Hutton). Paratype. Patea. Slightly enlarged.
Fig. 17. *Terebra biplex* Hutton. Holotype. Pareora. Enlarged nearly 2 diameters.
Fig. 18. *Terebra biplex* Hutton. Paratype. Pareora. Enlarged nearly 2 diameters.
Fig. 19. *Terebra catenifera* Tate. Plesiotype. Holotype of *Cerithium bicorona* Hutton. Tutaekuri, Hawke's Bay. Enlarged.
Fig. 20. *Cucullæa australis* (Hutton). Holotype. White Rock River. Enlarged nearly 2 diameters.
Fig. 21. *Mytilus (Aulacomya) striatus* Hutton. Holotype. Broken River. Enlarged nearly 2 diameters.

Plate V.

Fig. 1. *Polinices gibbosus* (Hutton). Holotype. Broken River.
Fig. 2. *Polinices gibbosus* (Hutton). Paratype. Broken River.
Fig. 3. *Trigonia neozelanica* Suter. Holotype. Hampden.
Fig. 4. *Turritella (Colpospira) concava* Hutton. Holotype. White Rock River. Enlarged 1½ diameters.
Fig. 5. *Pecten (Chlamys) aldingensis* Tate. Plesiotype. Wharekauri.
Fig. 6. *Volutospina (Athleta) huttoni pseudorarispina* Suter. Holotype. Broken River. Slightly enlarged.

Plate VI.

Fig. 1, *a*, *b*. *Anomia trigonopsis* Hutton. Plesiotype. White Rock River.
Fig. 2. *Pholadomya neozelanica* Hutton. Ideotype.
Fig. 3. *Chama huttoni* Hector. Holotype. Castlepoint.
Fig. 4. *Pecten (Chlamys) semiplicatus* Hutton. Plesiotype. Castlepoint.
Fig. 5. *Cardium huttoni* Ihering. Plesiotype. Waipara.

Plate VII.

Fig. 1. *Pholadomya neozelanica* Hutton. Holotype. Oamaru.
Fig. 2, *a*, *b*. *Ostrea incurva* Hutton. Holotype. Oamaru. Half natural size.
Fig. 3. *Ostrea (Eostrea) wuellerstorfi* Zittel. Plesiotype. Kawau Island. Half natural size

Plate VIII.

Fig. 1, *a*, *b*, *c*. *Circulus helicoides* (Hutton). Holotype. White Rock River. Enlarged 7 diameters.
Fig. 2, *a*, *b*, *c*. *Ampullina carinata* (Hutton). Holotype. White Rock River. Enlarged nearly 7 diameters.
Fig. 3, *a*, *b*. *Trivia zealandica* Kirk. Lectotype. Petane. Enlarged 2 diameters.
Fig. 4. *Eglisia striolata* Hutton. Lectotype. White Rock River. Enlarged 6 diameters.
Fig. 5. *Eulima* sp. White Rock River. Enlarged 2½ diameters.
Fig. 6. *Fusinus tegens* (Hutton). Holotype. White Rock River. Enlarged 3 diameters.
Fig. 7, *a*, *b*. *Exilia dalli* Suter. Holotype. White Rock, Pareora River. Enlarged nearly 2 diameters.
Fig. 8. *Vexillum linctum* (Hutton).
Fig. 9. *Alcira angustata* (Hutton). Holotype. Petane. Enlarged 2 diameters.
Fig. 10, *a*, *b*. *Marginella hectori* Kirk. Holotype. Petane. Enlarged 2½ diameters.
Fig. 11. *Turris (Hemipleurotoma) nexilis bicarinatus* (Hutton) Suter. Holotype of subspecies. Enlarged 6 diameters.
Fig. 12. *Surcula pareoraensis* (Suter). Holotype. White Rock, Pareora River. Enlarged 1⅔ diameters.
Fig. 13. *Mangilia (Clathurella)* (Hutton). Holotype. White Rock River. Enlarged 2⅔ diameters.
Fig. 14. *Mangilia (Clathurella)* (Hutton). Holotype. Waihao. Enlarged 2 diameters.
Fig. 15. *Mangilia leptosoma* (Hutton). Holotype. White Rock River. Enlarged 7 diameters.
Fig. 16. *Acteon ovalis* Hutton. Lectotype. White Rock River. Enlarged 6 diameters.
Fig. 17. *Odostomia (Jordaniella) sherriffi* Hutton. Holotype. Wanganui. Enlarged nearly 6 diameters.
Fig. 18. *Leda semiteres* Hutton. Holotype. Waihao. Enlarged 2½ diameters.
Fig. 19, *a*, *b*. *Loripes laminata* Hutton. Holotype. White Rock River. Enlarged nearly 2½ diameters.
Fig. 20. *Cardium (Trachycardium) waitakiense* Suter. Holotype. Wharekauri greensands, Waitaki Valley.
Fig. 21, *a*, *b*. *Corbula humerosa* Hutton. Holotype. White Rock River. Enlarged 2 diameters.
Fig. 22, *a*, *b*. *Corbula pumila* Hutton. Holotype. White Rock River. Enlarged 2⅓ diameters.

Plate IX.

Fig. 1, *a*, *b*. *Galeodea senex* (Hutton). Homœotype. Waihao River. Enlarged 2 diameters.

INDEXES.

INDEX TO GENERA AND SPECIES.

(The synonyms are in italics.)

A.

B.

C.

INDEX TO LOCALITIES.

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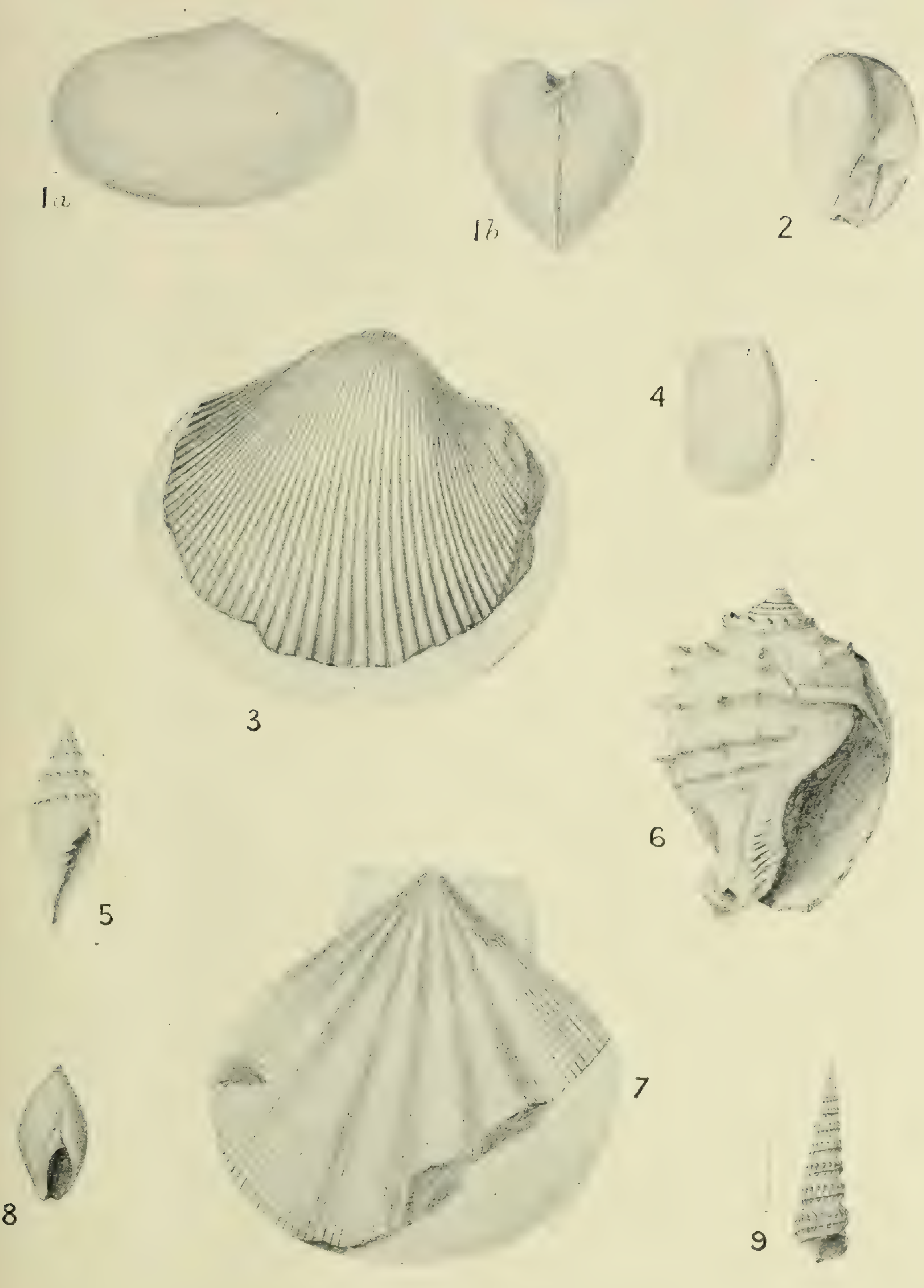
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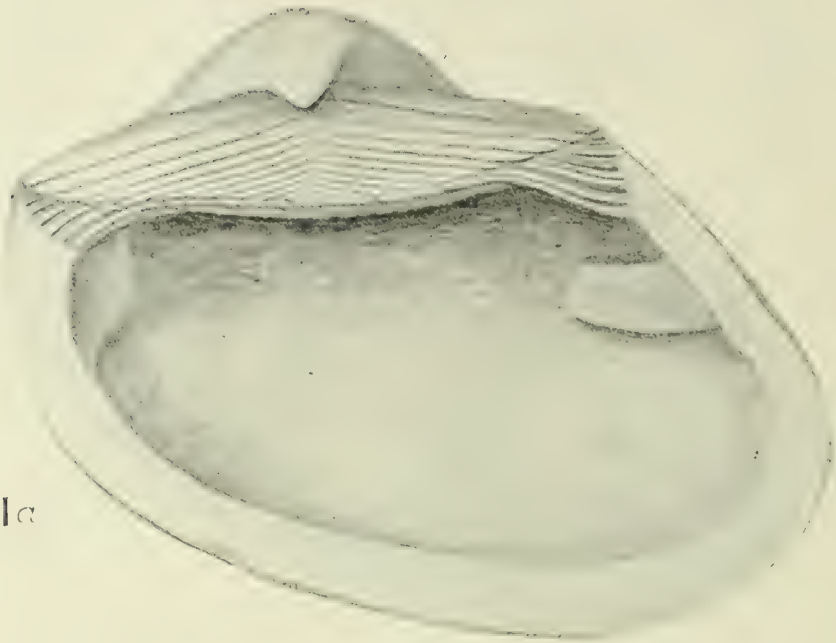

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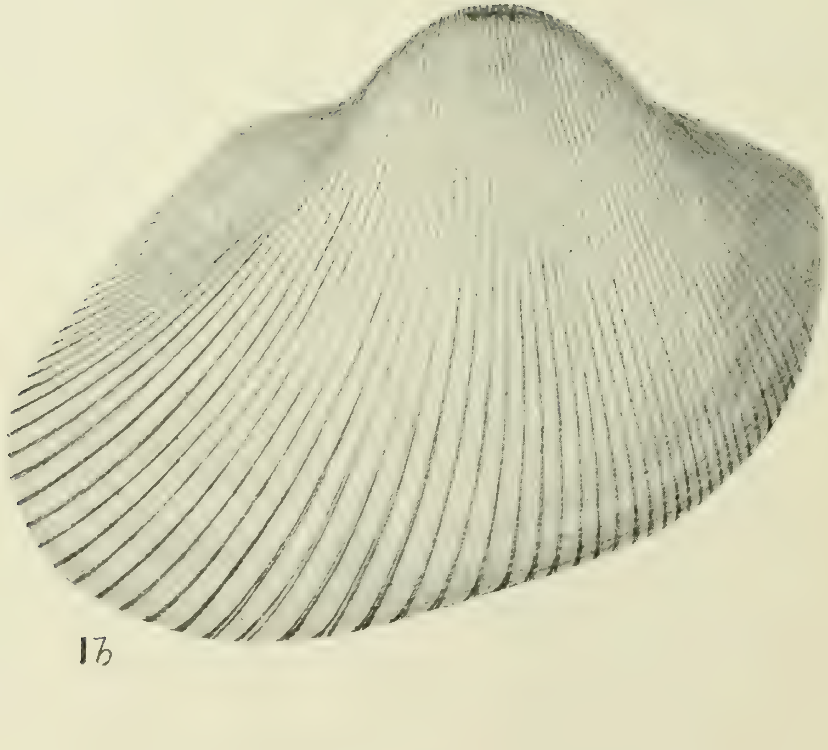

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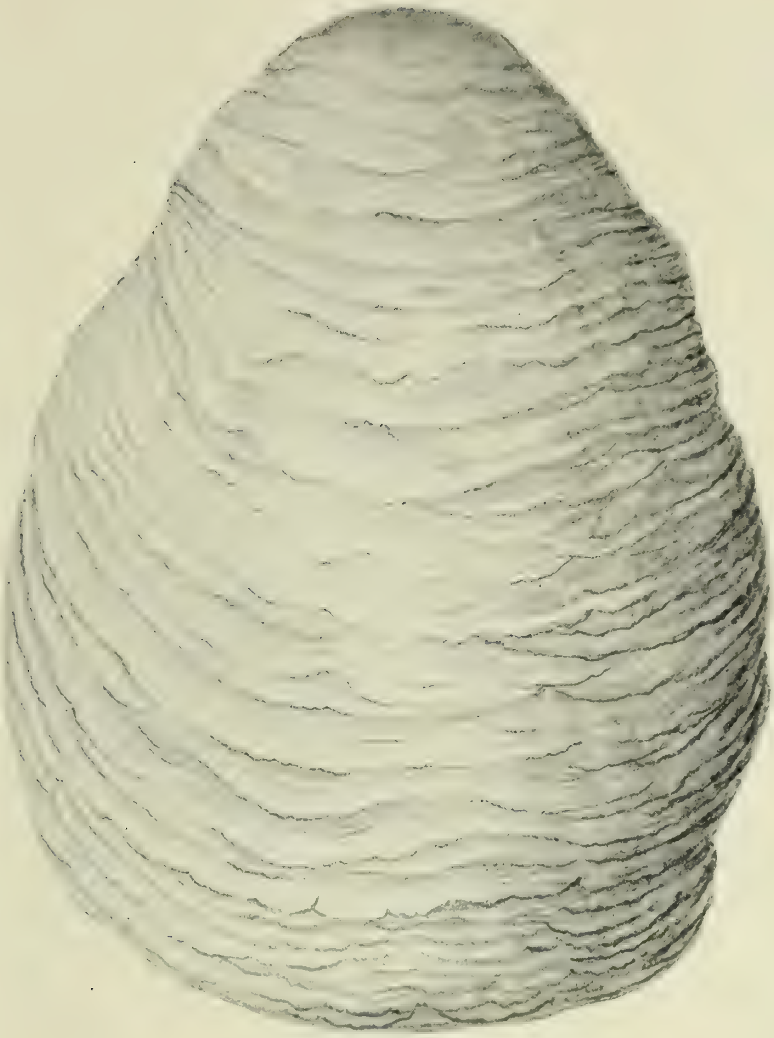

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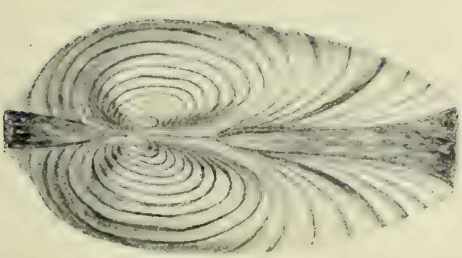

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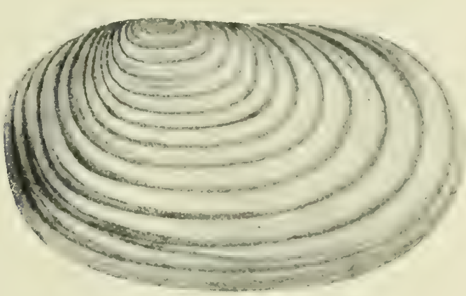

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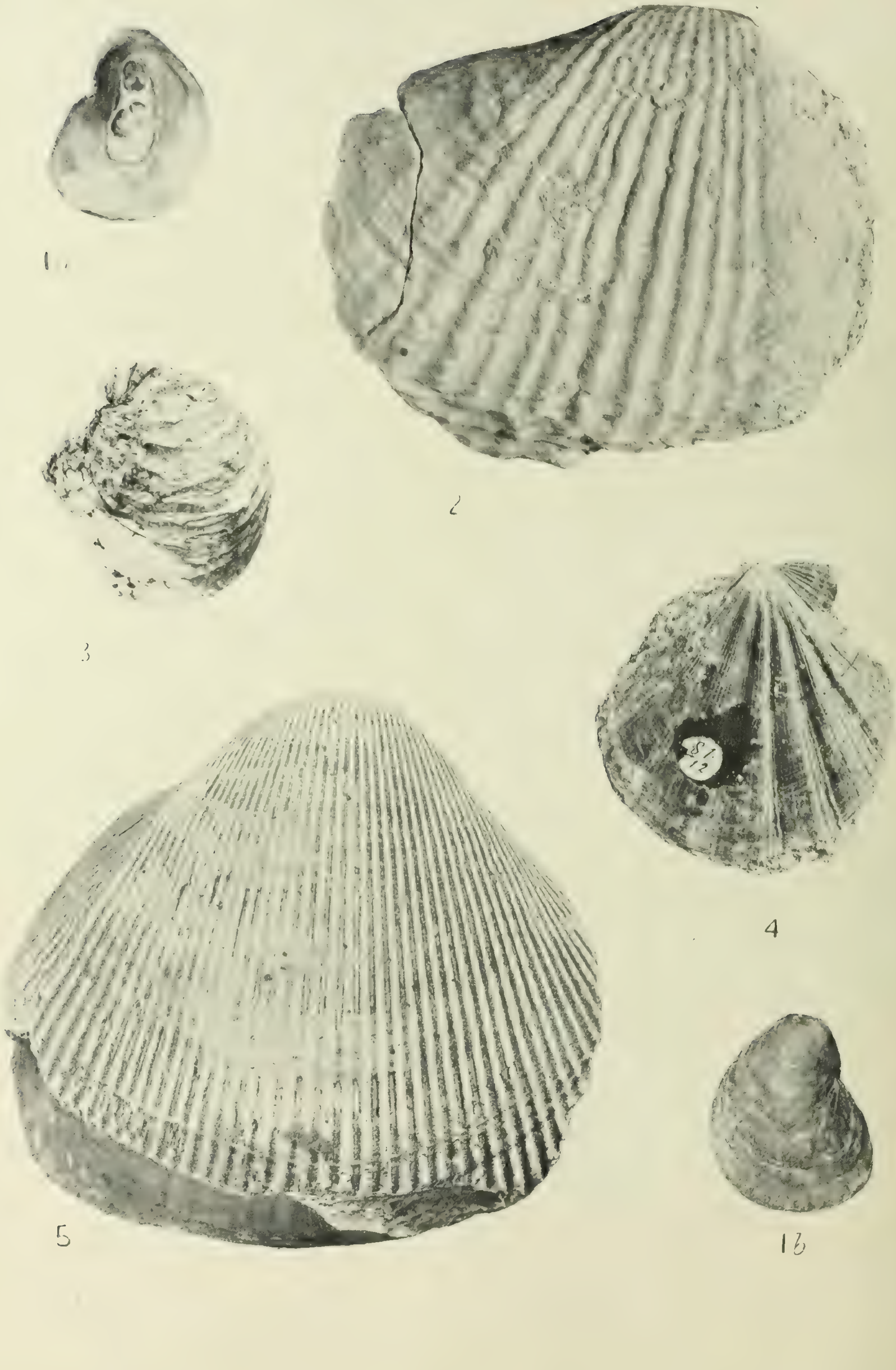
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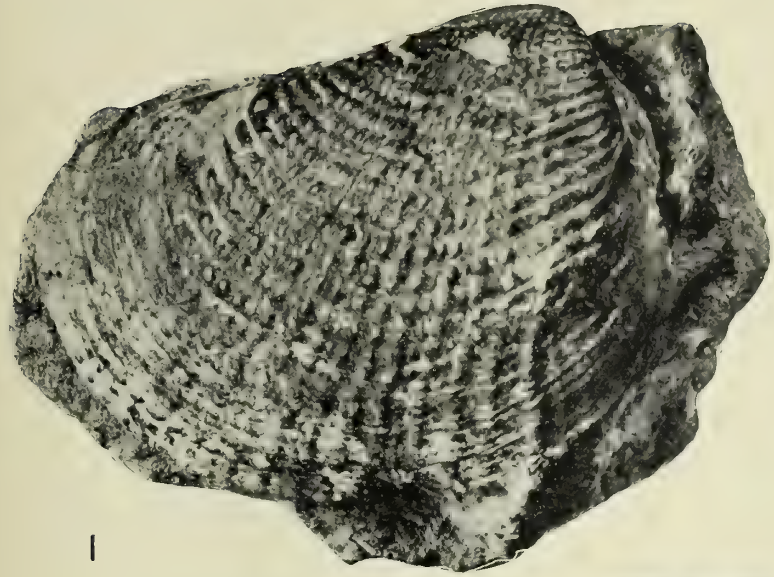

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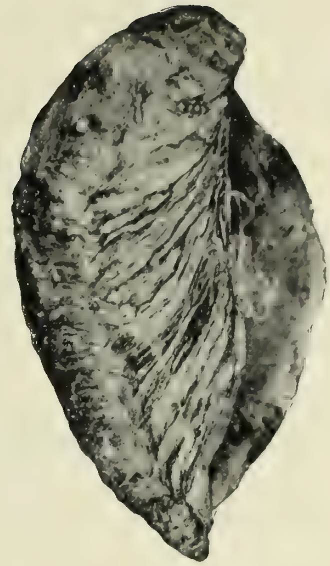

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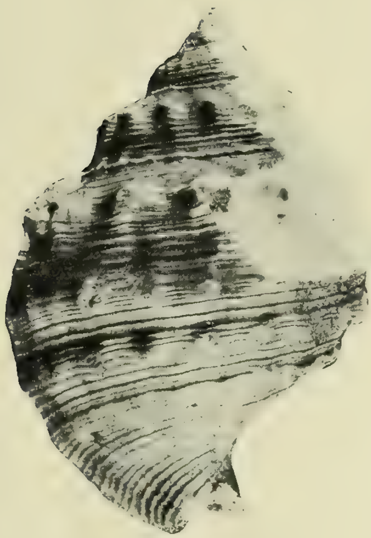

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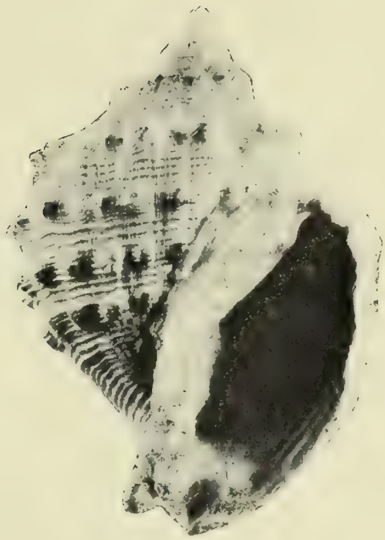

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NEW ZEALAND.

Department of Mines.

NEW ZEALAND GEOLOGICAL SURVEY.

(P. G. MORGAN, Director.)

PALÆONTOLOGICAL BULLETIN No. 4.

THE CRETACEOUS FAUNAS OF THE NORTH-EASTERN PART OF THE SOUTH ISLAND OF NEW ZEALAND.

BY

HENRY WOODS, M.A., F.R.S.,
Lecturer in Palæozoology in the University of Cambridge.

ISSUED UNDER THE AUTHORITY OF THE HON. W. D. S. MacDONALD, MINISTER OF MINES

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1917.

LETTER OF TRANSMITTAL.

Geological Survey Office,
Wellington, 1st December, 1916.

Sir,—

I have the honour to submit herewith Palæontological Bulletin No. 4, entitled "The Cretaceous Faunas of the North-eastern Part of the South Island of New Zealand." This important memoir is the work of Mr. Henry Woods, M.A., F.R.S., Lecturer in Palæozoology in the University of Cambridge, England, the author of a standard text-book on Invertebrate Palæontology, of a monograph on English Cretaceous Lamellibranchs, and of numerous scientific papers. It contains forty-one pages of letterpress, and is illustrated by two maps and twenty collotype plates.

New Zealand has indeed been fortunate in securing the entirely voluntary services of so eminent an authority as Mr. Woods. The results he has achieved in the almost untouched field of New Zealand Cretaceous palæontology are most valuable, and will interest the whole scientific world. Our thanks to Mr. Woods include also the acknowledgment of a debt of gratitude to the University of Cambridge, which, with its libraries, museums, laboratories, and association of trained workers, affords the facilities for research and encourages the love of learning that have formed so large a factor in the production of this and other memoirs on the fossils of southern lands.

I have the honour to be,
Sir,
Your obedient servant,
P. G. MORGAN,
Director, New Zealand Geological Survey.

The Hon. W. D. S. MacDonald,
Minister of Mines, Wellington.

PREFACE.

In February, 1912, Mr. Henry Woods, the author of this memoir, expressed his willingness to determine and describe a representative collection of New Zealand Cretaceous fossils. In May a few ammonites and belemnites were sent to him, and these were followed two months later by fairly representative collections of the lamellibranchs. In 1913 further material collected by Dr. J. Allan Thomson was forwarded.

The area from which the faunas described in this memoir have been obtained includes most of the well-known localities for Cretaceous fossils in New Zealand, but it should be clearly understood that both in the southern part of the South Island and in the North Island there are other localities with fossiliferous Upper Mesozoic strata. It was considered that the study of the cretaceous faunas would be best commenced by the description of the Mollusca contained in the rocks associated with the well-known Saurian beds or underlying the Amuri limestone, and therefore the selection sent to Mr. Woods was restricted to the Canterbury and Marlborough districts.

Owing to being engaged with his monograph on the Cretaceous Lamellibranchs of England, Mr. Woods was unable to begin work on the New Zealand material until 1913. His memoir was completed before the end of 1914, and was received in New Zealand early in 1915. Considerable delay ensued before it was decided to have the letterpress printed in New Zealand and the illustrations collotyped in Great Britain. Unfortunately, owing to war conditions, further delay occurred, and a crowning misfortune was the loss of the plates in the wreck of the "Tongariro" off the New Zealand coast last August. Instructions, however, were given to have the plates reproduced from the original blocks; and it is expected that the reprints, though not to hand at the date of writing, will arrive in time to enable Mr. Woods's memoir to be published early in 1917.

The galley proofs of this bulletin were personally read and corrected by Mr. Woods, whilst the reading of the final proofs has been done by Dr. Thomson. The indexes were prepared by myself, and checked by Dr. Thomson. It is therefore hoped that, although the author was necessarily unable to supervise the last stages, no error or misprint of any consequence will be found in the letterpress.

P. G. MORGAN

TABLE OF CONTENTS.

PALÆONTOLOGICAL BULLETIN No. 4.

THE CRETACEOUS FAUNAS

OF THE

NORTH-EASTERN PART OF THE SOUTH ISLAND OF NEW ZEALAND.

The Cretaceous fossils described in this memoir were collected in the provinces of Canterbury and Marlborough by Mr. Alexander McKay and other officers of the Geological Survey of New Zealand. They were obtained at various places between the Malvern Hills (west of Christchurch) and Coverham (in the Clarence Valley), a distance of nearly 150 miles.

Two faunas are represented, and may conveniently be considered separately. The older, of Lower Utatúr age, is found in the northern part of the region; the newer, of Upper Senonian age, is found at Amuri Bluff and other places farther south.

PART I.—CRETACEOUS ROCKS OF EAST MARLBOROUGH, NORTH OF AMURI BLUFF.

North of Amuri Bluff (fig. 1) Cretaceous deposits outcrop between the Kaikoura Peninsula and Cape Campbell.* One strip runs either along or near the coast, and is continuous in the north, with another long strip in the middle of the Clarence Valley between the Kaikoura Range and the Seaward Kaikouras; this strip has been faulted down, and older rocks occur on either side. The fault is on the north-west of the strip, and on the south-east side the basal Cretaceous conglomerates rest unconformably on older rocks. Other outcrops of Cretaceous rocks occur in the upper part of the Awatere Valley.

* A geological map of this region is given in McKay's Report on the Eastern Part of Marlborough: Reports Geol. Explor. during 1885, Colon. Mus. and Geol. Surv. N.Z., No. 17, 1886, p. 27, and *ibid*, No. 20, 1890, p. 96.

At present very little is known of the palæontology of this region, and the deposits appear to vary rapidly in character. A few fossils have been obtained from places in the Clarence Valley and the upper part of the Awatere Valley.

1. The Clarence Valley.

Near Coverham, in the northern part of the Clarence Valley (Ouse River and its tributaries—the Swale, the Nidd, and the Wharf), the following section has been given by Dr. Allan Thomson (fig. 2). It extends along the Sawpit Gully, across the Nidd, the Cover, and the Wharf. The thickness of the beds, if correctly estimated, is very great.

Amuri limestone (top) Flint-beds (replaced limestone)	} 2,500 ft.

Sawpit Gully mudstones (3,200 ft.).
Nidd sandstones and mudstones (550 ft.).
Cover Creek mudstones (2,000 ft.).
Wharf Gorge sandstones (450 ft.).
Wharf mudstones (1,550 ft.).
Basal conglomerates (200 ft.).

Only a few species of fossils have been found in these beds. *Gaudryceras Sacya* occurs in the Sawpit Gully mudstones, and *Turrilites circumtæniatus* in the Cover Creek mudstones; both of these species are found in the Lower Utatúr Group of Southern India, so that we may refer the beds from Cover Creek mudstones to the Sawpit Gully mudstones to the Lower Utatúr, which is of about the same age as the Upper Gault and Upper Greensand of England.*

This view of the age of the beds near Coverham is supported by the presence in the Cover Creek mudstones of *Inoceramus concentricus* and *Belemnites superstes*, and also by the occurrence in the Sawpit Gully mudstones of *I. concentricus* var. *porrectus* var. nov. which is found in the Lower Utatúr beds of Southern India. Further, *Aucellina euglypha* sp. nov., which is allied to *A. aptiensis* (d'Orbigny) from the Lower and perhaps Middle Gault of Northern Europe, is found in the Sawpit Gully mudstones.

In the Wharf mudstones *Aucellina euglypha*, a large form of *Inoceramus*, and *Belemnites superstes* have been found; no other species has been recognized, so that we can only say that these mudstones are probably of Lower Utatúr age, but may be slightly earlier. The Wharf Gorge sandstones have yielded no fossils except wood and poorly preserved plants. The Nidd sandstones contain large *Inocerami*.

In the section near Coverham the Amuri Group and the Greensand Group of Amuri Bluff do not appear to be represented, consequently we must infer that there is an unconformity at the base of the Amuri limestone; for even if the Cretaceous beds of Amuri Bluff are represented by part of the Amuri limestone, which in East Marlborough is much thicker (about 2,500 ft.) than at Amuri Bluff (about 600 ft.), there are still beds of intervening age (Cenomanian and Turonian), which have not been recognized in the district, to be accounted for.

In the Clarence Valley (fig. 1) fossils have also been obtained at Bluff River, about twenty miles south-west of Coverham, and at Seymour River, ten miles south-

* F. Kossmat, Rec. Geol. Surv. India, vol. xxviii (1895), p. 40; and Beitr. z. Paläont. u. Geol. Österr.-Ungarns u.d. Orients, vol. xi (1898), p. 130; A. de Grossouvre, Recherches sur la Craie Supér. (1901), p. 715, tab. xxxii.

west of Bluff River. The following succession of beds has been observed* in the Clarence Gorge, just below the junction of the Bluff River:—

Limestones and grey marls (top).
Volcanic rocks.
Sandstones, conglomerates, and shales.
Volcanic rocks, 50–200 ft.
Sandstones and conglomerates with fossils.

In the lower sandstones, which are fine-grained and of light colour, the following fossils were found: *Trigonia glyptica* sp. nov., *Inoceramus* sp., "*Modiola*" *kaikourensis* sp. nov., *Thracia* sp., and *Belemnites superstes*.

At Seymour (or Herring) River, McKay† gives the following section:—

Amuri limestone (top).
Greensands.
Sands and sandstones with concretions.
Basaltic rock.
Soft sandstones and grits, with bands of ironstone and discontinuous coal-seams.

In a conglomerate belonging to the lower division the following fossils were found: *Trigonia glyptica*, *T. meridiana* sp. nov., "*Modiola*" *kaikourensis*, *Inoceramus* sp., and *Belemnites superstes*. The conglomerate consists of rounded pebbles of a brown ferruginous tuff, a few fragments of basaltic rock, numerous grains of fresh feldspar, and fragments of *Inoceramus* and other shells; the whole is cemented by calcite, in which a few crystals of dolomite have been developed.

2. The Awatere Valley.

In the Upper Awatere Valley, which runs parallel with the Clarence Valley, but farther inland, fossils have been found at Gladstone and Middlehurst Runs (mainly from Limestone Creek), chiefly in a dark volcanic sandstone, but some also in shales. The volcanic sandstone consists of rounded grains and pebbles of glassy basalt, and fragments of augite, with a few grains of olivine; the cementing material is calcareous.

The fossils from this locality include *Arca (Barbatia)* sp., *Trigonia meridiana*, *Spondylus* sp., *Pecten (Syncyclonema)* sp., *P. (Camptonectes)* sp., *Lima marlburiensis* sp. nov., *Aucellina euglypha*, *Inoceramus concentricus* var. *porrectus*, *Panopea awaterensis* sp. nov., and *Belemnites superstes*.

There is no information available as to the field relationships of the deposits at Gladstone and Middlehurst Runs to those at Bluff River and Seymour River, but it is probable that the beds at these places are of approximately the same age. This is indicated by the occurrence of *Trigonia meridiana* and *Belemnites superstes* at both Seymour River and Gladstone and Middlehurst Runs, and by the presence of *Trigonia glyptica*, "*Modiola*" *kaikourensis*, and *Belemnites superstes* at Seymour River and Bluff River.

The occurrence at Gladstone and Middlehurst Runs of *Inocerami* similar to those of the Sawpit Gully and Cover Creek mudstones, as well as the presence of *Aucellina euglypha* and *Belemnites superstes*, makes it probable that the deposit is of the age of some part of the series of beds at Coverham; whilst the other fossils (*Arca*, *Pecten*, *Spondylus*), although not found at Coverham, present points of resemblance to species of Lower Utatúr age from other regions.

* McKay, Reports Geol. Explor. during 1885 (Geol. Surv. N.Z., 1886), p. 97.

† *Ibid.*, p. 103. This locality is given in McKay's reports as "Seymour River," but is more generally known by the alternative name of "Herring River."

Since the two species of *Trigonia* found in this region cannot be identified with any forms already known elsewhere, they do not give any definite evidence of the age of the deposits. From general considerations, however, the characters of the two species seem at first to suggest an earlier age than the Lower Utatúr for these deposits, for, as Dr. F. L. Kitchin has pointed out, the degeneration of the ornamentation on the costate *Trigoniæ* (as in *T. meridiana*) and the development of the *v-scripta* type of ribbing (as in *T. glyptica*) were prevalent in the *Trigoniæ* of India and South Africa in Lower Cretaceous times. The occurrence of species with a *v-scripta* kind of ornamentation in the Gault of British Columbia (*T. diversicostata* Whit.) and in the Upper Greensand and Cenomanian of England (*e.g.*, *T. pennata* Sow.) shows, however, that this feature continued to be developed up to at least the Lower Utatúr period; and according to Wilckens it also occurred in the Senonian (*T. hyriiformis* Wilck.). Similarly, examples of *Trigoniæ* in which the costate ornament has degenerated are found abundantly in beds of Gault or Cenomanian age in Shikoku, Japan (*T. kikuchiana* Yokoy., *T. rotundata* Yokoy.).

In the Upper Awatere Valley, near Gladstone, the Amuri limestone is very thin, and lies on volcanic tuffs containing fragments of *Inoceramus*, indicating that they are of Cretaceous age. Somewhat farther up the same valley there is a great development of volcanic rocks forming Mouat's Lookout. According to McKay the horizon of these volcanic rocks is below the Amuri limestone. They rest on a thick series of mudstones and muddy sandstones, from which Dr. Allan Thomson obtained *Inoceramus* and *Aucellina euglypha* in the upper part of the Winterton River (just under Mouat's Lookout), indicating that the beds belong to some part of the Coverham Series. Below these beds come massive sandstones containing imperfect remains of plants; these in turn rest on the basal conglomerates of the Cretaceous Series.

The fauna of the Utatúr beds, which is so widely distributed in the Indo-Pacific region, has not hitherto been recognized in New Zealand.* The fossils now described show that the Lower Utatúr stage is represented in the deposits of the Clarence and Awatere Valleys, but the number of species at present known is not sufficient for a detailed comparison to be made with the corresponding faunas of other regions. The species include such widely distributed forms as *Gaudryceras Sacya*, *Turrilites circumtæniatus*, and *Inoceramus concentricus;* the other fossils are lamellibranchs, which cannot yet be definitely identified with forms already known in other regions, but which—in some cases, at any rate—are related to species of Lower Utatúr age.

Around the Pacific the Lower Utatúr fauna has been found in Japan, the Queen Charlotte Islands, California, Peru, probably in Graham Land, and seems to be represented in the upper part of the Rolling Downs beds of Queensland; around the Indian Ocean this fauna is found in Trichinopoli, Conducia, Madagascar, Zululand, and other places.

The beds of Lower Utatúr age in New Zealand rest on deposits of much earlier date, showing that the widespread "Cenomanian overlap" extended to this remote region. Here the overlap begins in the Lower Utatúr period, as it does in Zululand, Pondichéry, and Japan; but in some other regions it started at a somewhat earlier period. The deposition of the beds of Lower Utatúr age in New Zealand was apparently followed by an uplift, since the Middle Utatúr beds with *Acanthoceras* (Lower Chalk), which occur in Pondichéry, Madagascar, Zululand, and Japan, are not known to be represented here.

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* Its supposed absence has been noted by Lemoine, Études géol. dans le Nord de Madagascar (1906), p. 392.

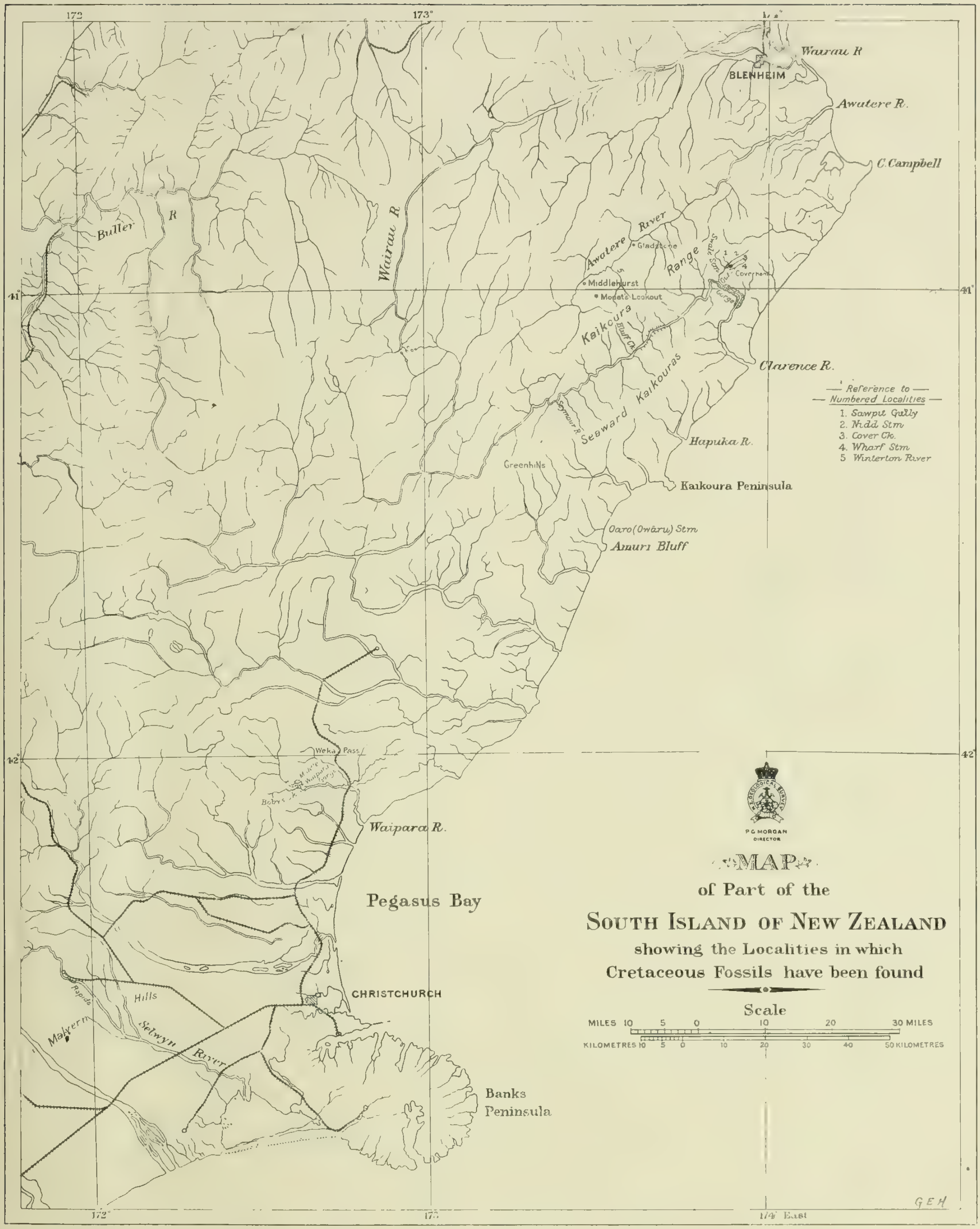

Fig. 1.

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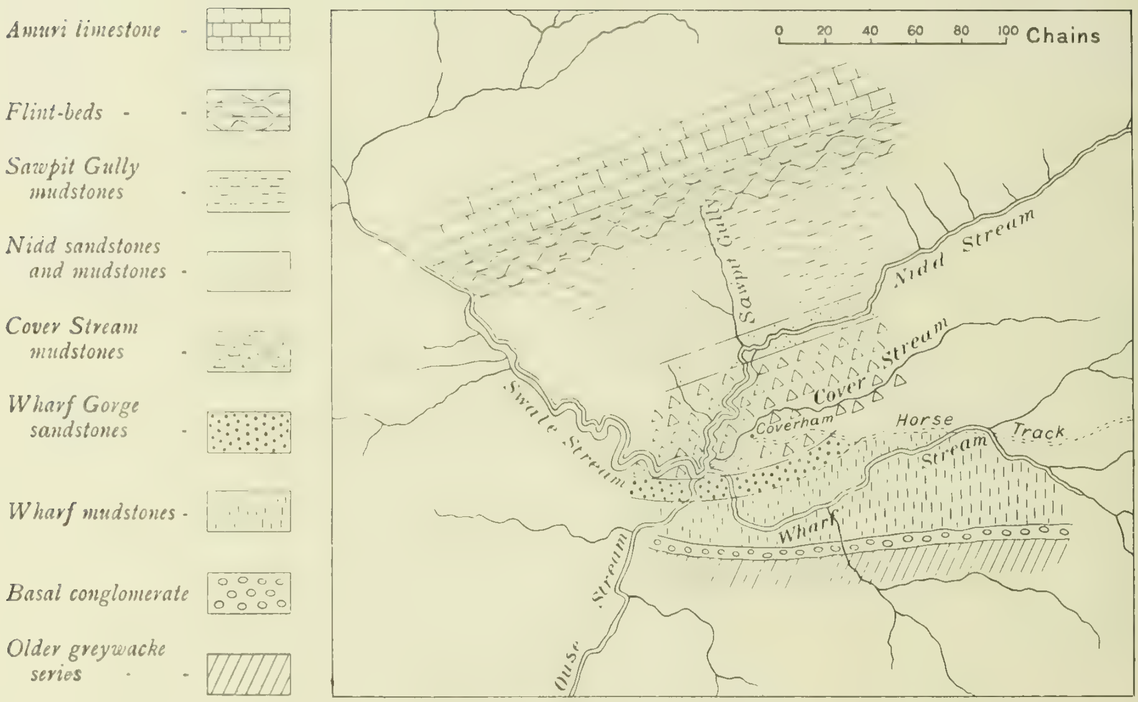

FIG. 2. GEOLOGICAL SKETCH-MAP OF THE NEIGHBOURHOOD OF COVERHAM BY DR. J. ALLAN THOMSON.

[To face page 5.

Table showing the Distribution of Species in the Clarence and Awatere Valleys.

—	Wharf Mudstones.	Cover Creek Mudstones.	Sawpit Gully Mudstones.	Bluff River.	Seymour River.	Gladstone and Middlehurst Runs.	Remarks.
Arca (Barbatia) sp.	..	..	..	..	..	x	*Cf. B. marullensis* (d'Orb.) Gault.
Trigonia meridiana sp. nov.	..	..	..	..	x	x	
,, *glyptica* sp. nov.	..	..	..	x	x	..	
"*Modiola*" *kaikourensis* sp. nov.	..	..	..	x	x	..	Also from Cherwell Downs.
Spondylus sp.	..	..	..	..	..	x	*Cf. S. striatus* Sow., Upper Greensand and Cenomanian.
Pecten (Camptonectes) sp.	..	..	..	..	..	x	
,, *(Syncyclonema)* sp.	..	..	..	..	..	x	*Cf. P. orbicularis* Sow.
Lima marlburiensis sp. nov.	..	..	...	..	..	x	
Aucellina euglypha sp. nov.	x	..	x	..	..	x	*Cf. A. aptiensis* (d'Orb.) Gault.
Inoceramus concentricus Park.	..	x	..	..	..	..	Gault and Upper Greensand.
Inoceramus concentricus Park., var. *porrectus* var. nov.	..	..	x	..	..	x	Lower Utatúr, Southern India.
Panopea awaterensis sp. nov.	..	..	..	..	..	x	
Thracia sp.	..	..	..	x	..	..	
Turrilites circumtæniatus Kossm.	..	x	..	..	..	..	Lower Utatúr, Pondichéry, and Madagascar.
Gaudryceras Sacya (Forb.)	..	..	x	..	..	..	Saghalien, Japan, Queen Charlotte Is., California.
Belemnites superstes Hect.	x	x	..	x	x	x	

Description of the Species.

LAMELLIBRANCHIA.

Genus Arca Linnæus.

Arca (Barbatia) sp. Plate I, fig. 1 *a–c*.

An imperfectly preserved specimen of *Arca* resembles *Barbatia marullensis* (d'Orbigny)* in form and in the general character of the ornamentation, but the valves are rather more convex, and the shell somewhat more inequilateral. *B. marullensis* is found in the Gault and the upper part of the Lower Greensand.

Distribution.—Dark volcanic sandstone, Gladstone and Middlehurst Runs, Upper Awatere Valley (741).†

* For references see Woods, Mon. Cret. Lamellibr. England, vol. i (1899), p. 38, pl. vii, figs. 4–7.

† The numbers in parentheses are those attached to the specimens. A list of these, giving the localities and horizons, is published in Reports Geol. Explor. 1890–91, No. 21 (1892), p. 122. See also N.Z. Geol. Surv. Pal. Bull. No. 1, 1913, pp. 76 *et seq.*

Genus Trigonia Bruguière.

Trigonia meridiana sp. nov. Plate I, figs. 2–7.

Description.—Shell with oval or suboval outline, usually rather elongate, but becoming relatively higher in large specimens. Umbo at about two-fifths of the length of the shell from the front of the anterior margin.

Anterior margin convex, passing gradually into the slightly convex ventral margin, the posterior part of which curves upwards. Posterior margin short, rounded or sometimes nearly straight. Postero-dorsal margin long, with a gradual slope from the umbo to the posterior end.

On the early part of the shell (up to about 8 mm. from the umbo) strong concentric ribs are present on the flanks, radial ribs are seen on the area, and a sharp carina is developed. On the later parts of the shell this ornamentation is absent, and the shell is smooth, but is marked by regular concentric furrows, which are usually separated by wide slightly convex interspaces; near the ventral margin in the larger specimens the furrows become closer together. In most examples a broad shallow ante-carinal furrow extends from the neighbourhood of the umbo to the postero-ventral extremity, and causes a slight undulation in the course of the concentric furrows.

Affinities.—At present it is difficult to point to any form to which this species is probably related. The ornamentation found on the earliest part of the shell seems to indicate that this species is derived from a form belonging to the costate section of *Trigonia*. Similar degeneration of the costate ornamentation is seen in species from the Oomia beds of Cutch, described by Dr. F. L. Kitchin,* and in *T. kikuchiana* Yokoy., and *T. rotundata*, Yokoy., which are abundant in beds of Gault or early Cenomanian age in Shikoku, Japan.†

Remarks.—Eighteen specimens have been examined. In most of them the surface is rather poorly preserved, and the character of the early stages cannot be seen, but two small specimens have the umbonal part sufficiently well preserved to leave no doubt as to the costate character of the ornament in the young shell. One specimen shows the teeth of the left valve, but not sufficiently well for figuring. The proportion of the length of the shell to the height appears to be rather variable, and also the degree of development of the ante-carinal furrow; it is just possible that a larger amount of material might indicate the existence of two species.

Distribution.—Dark volcanic sandstone, Gladstone and Middlehurst Runs, Upper Awatere Valley (741); conglomerate of Seymour River, Clarence Valley (570).

Trigonia glyptica, sp. nov. Plate I, figs. 8 *a*, *b*; Plate II, figs. 1 *a*, *b*, 2.

Description.—Shell elongate, more or less oval, moderately inequilateral, with compressed flanks. Antero-dorsal margin sloping obliquely forwards. Anterior margin convex, passing gradually into the slightly or moderately convex ventral margin, which curves upwards to join the short rounded posterior margin. Postero-dorsal margin long, slightly curved, sloping gradually backward. Umbones broad, not much elevated, curved inwards, situated at a distance from the anterior end of the shell equal to a third, or less than a third, of the length of the shell. Near the umbo the area is bounded by a carina, but this soon becomes rounded and, towards the posterior end, obsolete. The escutcheon is either not separated or only indistinctly delimited from the area. The area is at first ornamented with a few small oblique curved costellæ,

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* Palæont. Indica, Jur. Fauna Cutch, vol. iii, pt. 2, No. 1 (1903), pp. 39–60.

† M. Yokoyama, Journ. Coll. Sci. Imper. Univ. Japan, vol. iv (1891), p. 357. S. Yehara, Cret. Trigoniæ from Miyako and Hokkaido, Science Reports Tôhoku Imp. Univ., ser. 2 (Geol.), vol. ii (1915), p. 44, pl. ii, figs. 1–9.

but is smooth posteriorly. For some distance from the umbo the area slopes steeply from the carina to the margin of the valve, but posteriorly its slope gradually decreases.

The flanks of the shell are ornamented with strong, rounded, dorso-ventral ribs, which are divided into an anterior and a posterior series by a line passing slightly forward from the umbo to the opposite margin; along this line some of the ribs of the two series meet at a very acute angle. The anterior ribs slope backwards from the antero-dorsal margin to the dorso-ventral line or to the anterior part of the ventral margin. On a narrow strip of the shell, near the anterior margin, ribs extend from the margin backwards for a short distance. The ribs of the posterior series cover about three-quarters of the valve, and are rather broader than the anterior ribs, but decrease in breadth towards the posterior end; they are separated by rounded furrows which may be narrower or wider than the ribs. The more anterior of these ribs are nearly straight and almost vertical, but the posterior ribs slope obliquely from the area to the posterior part of the ventral margin. In the later stages of large specimens the ribs may be divided transversely by concentric growth-furrows.

Affinities.—*Trigonia glyptica* resembles *T. v-scripta* Kitchin,* from the Oomia *Trigonia* bed (Lower Cretaceous) of Goonaree, Cutch, but is distinguished from that species by—(1) the smaller slope of the antero-dorsal margin and less elevated umbonal region; (2) the more anterior position of the dorso-ventral line separating the two series of ribs; (3) the more acute angle made by the two series of ribs; (4) the narrower, more numerous, and more closely placed ribs of the posterior series, and the smaller difference between the size of the anterior and posterior ribs; (5) the more nearly vertical direction of the anterior ribs of the posterior series; (6) the presence of ribs on the posterior part of the shell; (7) the absence or indistinct nature of the separation of the escutcheon from the area; and (8) the shortness (or possible absence) of the stage with concentric ribbing on the early part of the shell.

T. glyptica is distinguished from *T. hyriiformis* Wilckens† by—(1) the more acute angle made by the two series of ribs; (2) the more anterior position of the dorso-ventral line separating the two series of ribs; (3) the more closely placed anterior ribs, and the smaller curvature of those near the front margin. *T. hyriiformis* is at present imperfectly known; it was found at Snow Hill Island, Graham Land, and is stated by Wilckens to be of Campanian (Upper Senonian) age.

Remarks.—Only six valves, most of which are more or less imperfect, have been seen, so that the nature and extent of the variation cannot be determined. In all the specimens the shell near the umbo is abraded or imperfect, so that it is not possible to determine definitely if the earliest ribs were concentric, but it is possible that such may have been the case for a short period. Until the early stages in the development of *T. glyptica* have been made out, it is difficult to determine whether this species is really related to *T. v-scripta* or *T. hyriiformis*, or has been derived from an independent stock.

The occurrence of *T. diversicostata* Whiteaves,‡ in the Gault of British Columbia, and of *T. pennata* Sowerby,§ in the Upper Greensand and Cenomanian of England, is of interest, since they possess V-shaped ribs, but they do not appear to be allied to *T. glyptica*.

Distribution.—Conglomerate of Seymour River, Middle Clarence Valley (570); sandstone of Bluff River, at junction of the Clarence (615).

* Palæont. Indica, ser. ix, Jur. Fauna Cutch, vol. iii, pt. 2, No. 1, Genus *Trigonia* (1903), p. 70, pl. vii, figs. 6–8; pl. viii, figs. 1–3.

† Die Annelid., Bivalv. u. Gastrop. d. Antarkt. Kreideformat. (Schwedisch. Südpol.-Expedit., vol. iii, pt. 12, 1910), p. 47, pl. ii, fig. 27.

‡ Mesoz. Foss., vol. i (Geol. Surv. Canada, 1876–1900), pp. 68, 230, 292, pl. x, fig. 1. Compare also *T. flexicostata*, Burwash, Proc. & Trans. R. Soc. Canada, ser. 3, vol. vii, section 4 (1914), p. 82, pl. iii, fig. 3.

§ Lycett, Brit. Foss. *Trigoniæ* (1875), p. 133, pl. xxiv, figs. 4, 5; pl. xxxvii, fig. 4.

Genus Modiola Lamarck.

"Modiola" kaikourensis sp. nov. Plate II, figs. 3–5.

Description.—Shell small, elongate, inflated but becoming gradually compressed towards the postero-ventral extremity; antero-ventral part flattened or concave, and sloping steeply toward the margin. Umbones terminal, slightly curved. Hinge-margin nearly straight, making a very obtuse angle with the posterior margin, which is nearly straight and almost parallel with the antero-ventral margin. Posterior extremity rounded. Surface with growth-ridges.

Remarks.—This species resembles in form the smaller examples of *Septifer lineatus* (Sow.), but there is nothing to show whether an umbonal plate is present or not; and the radial ornamentation appears to be absent, for although some specimens show fine radial lines they do not appear to represent ribs, since they are not visible when the surface of the shell is well preserved. The generic position of this species must therefore, for the present, be regarded as uncertain.

Distribution.—Conglomerate of Seymour River, Clarence Valley (570); sandstone of Bluff River, at junction with the Clarence (615); sandstone in cliff above lake, near Cherwell Downs, Greenhills district.

Genus Spondylus Linnæus.

Spondylus sp. Plate II, fig. 6.

A valve of *Spondylus* is not sufficiently well preserved for exact determination, but is of interest, since it appears to belong to the same type as *S. striatus* (Sowerby),* found in the Upper Greensand and Cenomanian of England. The fine and uniform ribbing is also similar to that of *S. subcostulatus* Stoliczka,† from the Utatúr Group of Southern India.

Distribution.—Dark volcanic sandstone of Gladstone and Middlehurst Runs (741).

Genus Pecten Müller.

Pecten (Camptonectes) sp. Plate III, figs. 1 *a*, *b*, 2.

Three right valves and one left valve were found in the dark volcanic sandstone of Gladstone and Middlehurst Runs (741). The surface of the shell is very imperfect, but one specimen shows fine radial ribs near the ventral margin.

Pecten (Syncyclonema) sp.

Two very imperfect valves of *Syncyclonema* may perhaps be examples of *P. (Syncyclonema) orbicularis* Sow.

From the dark volcanic sandstone of Gladstone and Middlehurst Runs (741).

Genus Lima Bruguière.

Lima marlburiensis sp. nov. Plate III, fig. 3.

Description.—Shell semi-oval, much higher than long, convex between the umbo and the ventral margin, sloping steeply to the anterior margin, and gradually compressed towards the posterior and postero-ventral margins. Anterior margin nearly straight; ventral margin rounded; posterior margin slightly convex, its dorsal part curving rapidly towards the umbo. Ornamentation consists of narrow radial grooves (probably with pits), separated by broad nearly flat interspaces. The direction of the ribs sometimes changes where they cross a strong growth-ring.

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* Woods, Mon. Cret. Lamellibr. England, vol. i (1901), p. 119, pl. xxi, figs. 1–5.

† Cret. Fauna S. India, vol. iii (1871), p. 449, pl. xxxiii, fig. 8; pl. xxxiv, fig. 2.

Affinities.—This species is at present imperfectly known, but appears to be distinct from any form already described. The character of the area and ears cannot be seen. The species may belong to the subgenus *Acesta*.

Distribution.—Dark volcanic sandstone of Gladstone and Middlehurst Runs (741).

Genus AUCELLINA Pompeckji.

Aucellina euglypha sp. nov. Plate III, figs. 4–8.

Description.—Right valve oval or nearly circular in outline, slightly inequilateral, the anterior part sometimes projecting forwards. Hinge-line straight. Right valve slightly, sometimes moderately convex, the anterior part usually flattened and less convex than the median and posterior parts. Anterior ear long, byssal sinus deep, curved. Posterior ear indistinct. Umbo small, nearly median.

Left valve inflated, inequilateral, with rounded outline, the posterior part projecting; dorsal part of posterior margin oblique. Umbo large, prominent, incurved, projecting over the hinge-margin. A broad shallow sulcus usually extends from the posterior side of the umbo to the posterior margin. Ears small, the posterior obtusely triangular. Ornamentation consists of strong radial ribs, separated by broad interspaces; both are crossed by numerous linear concentric ridges, which sometimes become laminar.

Affinities.—This species is allied to *Aucellina aptiensis* (d'Orbigny),* but the radial ribs are more distinct, less numerous, and more widely separated. *A. aptiensis* is found in the lower Gault, and probably also the middle Gault, of Hanover, Brunswick, Hildesheim, Méouille (Basse-Alpes), &c. *Aucellina* is represented in the Rolling Downs formation of Queensland and New South Wales by *A. hughendensis* (Etheridge),† but in that species the left valve is much more inequilateral than in *A. euglypha*.

In Southern India *Aucellina parva* (Stol.)‡ occurs in the Utatúr Group.

Remarks.—This species was gregarious, numerous examples being found close together. The specimens usually occur in hard calcareous concretions, and it is difficult to separate them from the matrix, consequently the form of the entire shell cannot often be determined satisfactorily, and the area and hinge have not been exposed in any specimen.

Distribution.—Wharf mudstones, cliff on left bank of Wharf River at half a mile below pack-track crossing; Sawpit Gully mudstones of Swale River, cliff on left side of river, the first exposure below the Amuri limestone; mudstones of Upper Winterton River, east of Mouat's Lookout, Upper Awatere Valley; shale and light sandstone of Gladstone and Middlehurst Runs, Upper Awatere Valley (741).

Genus INOCERAMUS Sowerby.

Inoceramus concentricus Parkinson. Plate III, figs. 9, 10 *a*, *b*.

Specimens of *Inoceramus* agree closely in essential characters with *I. concentricus*,§ but are of a larger size than the majority of the examples of that species found in England. An exact comparison with the larger specimens sometimes found in the Gault of England is difficult, since the latter occur in soft clay, and consequently the form of the shell is usually imperfectly preserved.

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* Pompeckji, Neues Jahrb. für Min. &c., Beil.-bd. xiv (1901), p. 352, pl. xvi, figs. 1–3 (compare also figs. 4, 5); Wollemann, Jahrb. d.k. Preuss. Geol. Landesanst., vol. xxvii (1906), p. 269, pl. vi, figs. 6–8; Pavlow, Enchaînement des Aucelles (1907), p. 87, pl. vi, figs. 28–32.

† Quart. Journ. Geol. Soc., vol. xxviii (1872), p. 346, pl. xxv, fig. 3; Jack and Etheridge, Geol. and Palæont. Queensland and New Guinea (1892), p. 460, pl. xxv, figs. 1–6; Etheridge, Mon. Cret. Invert. Fauna New South Wales (1902), p. 16, pl. v, figs. 6, 7.

‡ Stoliczka, Cret. Fauna S. India, vol. iii (1871), p. 404, pl. xxxiii, figs. 2, 3.

§ For the synonymy of this species see Woods, Mon. Cret. Lamellibr. England, vol. ii (1910), p. 265.

Although only a few examples of this species from New Zealand are available for study it is evident that variation was rather extensive, and was similar in character to that seen in English specimens; thus there are considerable differences in the extent of the curvature of the left umbo, and also in its breadth; variation is also seen in the size of the concave anterior part of the valves, and in the convexity of the right valve. Whilst the study of a larger series of specimens may, in the future, reveal some characters which would serve to distinguish the New Zealand form as a geographical variety of *I. concentricus*, at present it is difficult to point to any difference as great even as those which are seen between specimens found in different types of deposit in England.

I. concentricus is common in the Gault and Upper Greensand of Europe. Whiteaves* has recorded it from Queen Charlotte Islands (British Columbia), and specimens which I have seen from that locality enable me to confirm that identification. This species has also been recognized in the Vraconnian of Peru.†

Distribution.—Calcareous concretions in Cover Creek mudstones of Cover Creek, near Coverham.

Inoceramus concentricus var. porrectus var. nov. Plate IV, figs. 1 *a*, *b*, 2.

Specimens found in the Sawpit Gully mudstones agree in most respects with *I. concentricus*, but the left valve is less convex, its umbo is less prominent and projects to only a small extent beyond the hinge-margin; the posterior part of the valve is flattened and more extended. Fragments show that some examples attained a large size. In one specimen (fig. 1) the ribs are rather numerous and small, but in others (fig. 2) they are fewer, stronger, and more widely separated. A specimen similar in form but with rather fewer ribs occurs in the dark volcanic sandstone of Gladstone and Middlehurst Runs (741) (Plate IV, fig. 3), and probably belongs to this variety.

The form here described has evidently been derived from *I. concentricus;* for the present, with only a small amount of material available, it seems best to consider it as a variety of that species.

Inoceramus aff. *concentricus*, described and figured by Spengler‡ from the Lower Utatúr Group of Southern India, appears to be an example of this variety; it possesses a similarly flattened left valve, with an inconspicuous umbo, and the ribs show a similar curvature.

Some small specimens of *Inoceramus* found in the Cover Creek mudstones and the volcanic sandstone of Gladstone and Middlehurst Runs are of the *concentricus* type, and their small left umbo resembles the variety here described, but the valve appears to be relatively more convex.

Genus Panopea Ménard de la Groye.

Panopea awaterensis sp. nov. Plate IV, fig. 4 *a*, *b*.

Description.—Shell elongate-oval, inequilateral, moderately convex dorsally, less convex ventrally. Umbones small, inconspicuous, situated at about two-fifths of the length of the shell from the front margin. Dorsal margin nearly straight, and nearly parallel with the slightly curved ventral margin. Anterior and posterior margins rounded. Surface smooth except for inconspicuous growth-lines, and very fine radial ridges on the posterior part.

Remarks.—There is only one example of this species in the collection. I do not know any form to which it shows any close resemblance. Its principal characters are the little prominence of the umbones, and the nearly parallel dorsal and ventral margins.

* Mesoz. Foss., vol. i (Geol. Surv. Canada, 1876–1910), pp. 79, 241, 297.
† Schlagintweit, Neues Jahrb. für Min., &c., Beil.-bd. xxxiii (1911), p. 94.
‡ Beitr. z. Paläont. u. Geol. Österr.-Ungarns u.d. Orients, vol. xxvi (1913), p. 235, pl. xv, fig. 18.

Distribution.—Dark volcanic sandstone, Gladstone and Middlehurst Runs, Upper Awatere Valley (741).

Genus THRACIA Leach.

Thracia sp. Plate V, fig. 1.

A species of *Thracia* is represented by a left valve from the light sandstone of Bluff River (615).

CEPHALOPODA.

Genus TURRILITES Lamarck.

Turrilites circumtæniatus Kossmat. Plate V, figs. 2 *a*, *b*, 3.

1866. *Turrilites Gresslyi* F. Stoliczka, Ceph. Cret. S. India, p. 186, pl. lxxxvii, figs. 1–5.
1895. *Turrilites circumtœniatus* F. Kossmat, Südind. Kreidef. (Beitr. z. Paläont. u. Geol. Österr.-Ungarns u.d. Orients, vol. ix), p. 141, pl. xviii, figs. 4, 5.

Remarks.—Portions of three specimens of *Turrilites* were found by Dr. Allan Thomson in a calcareous concretion. They agree closely with the smaller examples figured by Stoliczka as *T. Gresslyi* (pl. lxxxvii, figs. 1, 2); in those the ribs joining the tubercles are either indistinct or not developed. On account of the character of the ribbing which is developed in later stages of growth the species from the Utatúr Group is regarded by Kossmat as probably distinct from *T. Gresslyi* Pict. & Camp.; but as only small examples of this species are figured by Pictet and Campiche it is possible that it may be only an incompletely grown form of *T. circumtœniatus*.

T. circumtœniatus is found in the Lower Utatúr Group of Pondichéry, and in beds referred to the Cenomanian in northern Madagascar.* *T. Gresslyi* Pict. & Camp.† is found in the "Grés verts supérieur" of Ste. Croix, and is recorded from the Cenomanian of Madagascar. An allied form, *T. acutus* Passy,‡ occurs in the Cenomanian of England, France, and Zululand. In the larger of the two New Zealand specimens the siphuncle is preserved, and occurs on the upper slope of the whorls, above the upper row of tubercles.§

Distribution.—Cover Creek mudstones, at a quarter mile above Coverham station.

Genus GAUDRYCERAS Grossouvre (1893) emend. Kossmat (1895).

Gaudryceras Sacya (Forbes). Plate V, figs. 4 *a*, *b*.

1846. *Ammonites Sacya* E. Forbes, Trans. Geol. Soc., ser. 2, vol. vii, p. 113, pl. xiv, fig. 10.
1846. „ *Buddha* Forbes, *ibid.*, p. 112, pl. xiv, fig. 9.
1865. *Ammonites Sacya* F. Stoliczka, Ceph. Cret. S. India, p. 154, pl. lxxv, figs. 5–7; pl. lxxvi, figs. 2, 3.
1873. *Ammonites Sacya* var. *sachalinensis* F. Schmidt, Petrefakt. d. Kreidef. v. Sachalin (Mém. Acad. Impér. St. Pétersb., sér. 7, vol. ix), p. 15 (*partim*), pl. ii, figs. 3, 4.
1876. *Ammonites filicinctus* J. F. Whiteaves, Mesoz. Foss., vol. i (Geol. Surv. Canada), p. 43, pl. ii, figs. 2, 3.
1884. *Lytoceras Sacya* Whiteaves, *ibid.*, p. 203, pl. xxv.
1890. „ „ M. Yokoyama, Palæontographica, vol. xxxvi, p. 178, pl. xviii, fig. 12 (13 ?).
1894. „ „ K. Jimbo, Palæont. Abhandl., vol. vi, p. 34, pl. vi, fig. 1.
1895. *Lytoceras (Gaudryceras) Sacya* F. Kossmat, Südind. Kreidef. (Beitr. z. Paläont. u. Geol. Österr.-Ungarns u.d. Orients, ix), p. 119 (23).
1902. *Lytoceras (Gaudryceras) Sacya* F. M. Anderson, Cret. Dep. Pacific Coast (Proc. California Acad. Sci., ser. 3, vol. ii), p. 82.

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* Boule, Lemoine and Thevenin, Ann. de Paléont., vol. i (1906), p. 57, pl. xiii, fig. 4.
† Foss. Terr. Crét. Ste. Croix (Matér. Pal. Suisse, ser. 3, 1861), p. 132, pl. lvii, figs. 11–13.
‡ For references see Crick, Cret. Foss. Natal (3rd Ann. Rep. Geol. Survey, Natal and Zululand, 1907), p. 176, pl. xi, figs. 3, 4. This species is known in England as *T. Wiesti* Sharpe.
§ *Cf.* Diener, Lebensweise und Verbreitung des Ammoniten. Neues Jahrb. für Min., &c., Bd. ii (1912), p 67.

A well-preserved specimen of this species, having a diameter of 50 mm., was found by Dr. Allan Thomson in a calcareous concretion in the Sawpit Gully mudstones. The shell is preserved, except on the last whorl; and shows clearly the character of the fine ribbing. The suture agrees closely with the one figured by Stoliczka.

G. Sacya is a widely distributed species in the Indo-Pacific region. The type, which is now in the British Museum (Geological Society Collection), came from the Lower Utatúr Group of Pondichéry. The species has also been found in Saghalien (Japan), Queen Charlotte Islands (British Columbia), and in the Upper Horsetown and Lower Chico beds of California; whilst forms which either belong to this species or are closely allied to it have been recorded from Conducia,* the north of Madagascar,† and Zululand.‡

Distribution.—Sawpit Gully mudstones, about 300 ft. below the flint-beds of Sawpit Gully.

Belemnites.

Belemnites superstes Hector. Plate V, figs. 5–7.

1886. *Belemnites superstes* J. Hector, Catal. Indian and Colon. Exhibit., New Zealand Court, Geol. Exhibits, p. 57, fig. 19a, 7.
1886. *Belemnites superstes* Hector, Rep. Geol. Explor., 1885, p. xxxii.
1890. ,, ,, Hector and McKay, *ibid.*, 1888–89, pp. xlvii, 159.

Remarks.—This species belongs to the same group as ***Belemnites seclusus*** Blanford,§ from the Lower Utatúr Group of Trichinopoli, which, as Spengler|| has pointed out, is sharply distinguished from the other species of ***Belemnites*** found in the Cretaceous rocks of India. In ***B. superstes*** the two grooves at the ventro-lateral margins extend backwards from the alveolar margin to a greater distance than in ***B. seclusus***—sometimes to more than half the length of the guard. At first these grooves are deep, but when traced backwards they become gradually narrower and shallower. The guard in ***B. superstes*** is compressed dorso-ventrally, but in ***B. seclusus*** it is compressed laterally. Further comparison of the two species is difficult on account of the much larger size attained by ***B. superstes*** (see also p. 36).

Type.—The type came from the mudstones near Coverham, but cannot be identified, since Hector gave only an outline figure, without description of the species.

Distribution.—Wharf mudstones of Wharf River, below pack-track crossing; Cover Creek mudstones, of Cover Creek; sandstone of Bluff River, at junction with the Clarence (615); dark volcanic sandstone of Gladstone and Middlehurst Runs, Upper Awatere Valley (741); conglomerate of Seymour River (570).

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* P. Choffat, Contrib. Conn. géol. Col. Portugaises d'Afrique. Crét. de Conducia (1903), p. 14, pl. i, figs. 2, 3.

† M. Boule, Lemoine and Thevenin, Ann. de Paléont., vol. i (1906), p. 184 [12], pl. ii, fig. 2.

‡ G. C. Crick, 3rd Rep. Geol. Survey, Natal and Zululand (1907), p. 170, pl. x, fig. 13.

§ H. F. Blanford and F. Stoliczka, Ceph. Cret. S. India (Palæont. Indica, 1861, 1866), pp. 4, 202, pl. i, figs. 43–51; pl. ii, fig. 8.

|| E. Spengler, Beitr. z. Paläont. u. Geol. Österr.-Ungarns u.d. Orients, vol. xxiii (1910), p. 153, pl. xiv, fig. 7.

PART II.—THE CRETACEOUS ROCKS OF AMURI BLUFF, WAIPARA AND WEKA PASS, AND THE MALVERN HILLS.

In the southern part of the district (South Marlborough and North-east Canterbury) fossils have been obtained in the Cretaceous deposits of—(I) Amuri Bluff, (II) Waipara and the Weka Pass, and (III) the Malvern Hills (fig. 1).

I. Amuri Bluff.

Amuri Bluff* is about fifteen miles south-west of the Kaikoura Peninsula, on the east coast of Marlborough. The beds exposed here below the Amuri limestone are divided into two main groups: (1) the Amuri Group at the bottom, and (2) the Greensand Group at the top, above which comes the Amuri limestone.

1. The Amuri Group.

At Amuri Bluff the Amuri Group has, according to McKay, a thickness varying from 360 ft. to 585 ft. It rests unconformably on older beds, believed to be of Jurassic age, and consists of the following divisions, from above downwards:—

Black grit.
Greensands.
Grey sands.
Lower black grit.

Calcareous conglomerate	*Aporrhais* bed. *Trigonia* bed. Belemnite bed.

Lower or wood sands.

(a.) The Calcareous Conglomerate.—Nearly all the fossils from Amuri Bluff which are determinable come from the calcareous conglomerate, which contains a rich fauna. This conglomerate was divided by Hector and McKay into the Belemnite, the *Trigonia*, and the *Aporrhais* beds, but these beds evidently belong to one zone, and have no strati graphical value; moreover, it is now known† that they are not persistent even within the limits of the Amuri Bluff district.

In the calcareous conglomerate, Cephalopods, with the exception of *Belemnites*, are not common, but examples of *Kossmaticeras*, *Gaudryceras*, *Baculites*, *Hamites*, and *Nautilus* have been found. Lamellibranchs and Gasteropods‡ are numerous, and indicate that the deposit was laid down in shallow water. The most abundant genera of Lamellibranchs are *Trigonia*, *Ostrea*, *Pecten*, *Callista*, *Cucullœa*, and *Astarte (Eriphyla)*. Echinoderms, Brachiopods, corals, and sponges are rare or absent. A few fishes have been found—viz., *Ischyodus Thurmanni* Pict. & Camp., *Notidanus dentatus* Woodw., and *Scapanorhynchus(?) subulatus* (Ag.).

Only a small number of the fossils can be actually identified with species found in other parts of the world, but these and the affinities of the other species show that the fauna is of the Indo-Pacific type, and is of Upper Senonian age. Similar faunas occur

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* A geological map of this region by McKay is published in Reports of Geol. Explor. 1874–76 (1877), p. 178.
† J. A. Thomson, N.Z. Geol. Surv., 6th Ann. Rep. (1912), p. 8.
‡ The Gasteropods were sent before the war to Professor Otto Wilckens, of Strassburg i E, for study.

in Southern India (Ariyalúr beds), Madagascar, South Africa (Umzamba beds), Japan, Vancouver,* Quiriquina (Chile), Southern Patagonia, and Graham Land.

Kossmaticeras is a genus which shows a great development in southern regions, and is represented in the Amuri Group by *K. (Madrasites) haumuriensis* (Hect.), which is allied to *K. (Madrasites) Bhavani* (Stol.) from the Trichinopoli and Ariyalúr groups. A variety of this species occurs in the Upper Senonian of Seymour Island, where the genus is profusely represented. A closely allied form is found in the Senonian of Vancouver. A species of *Gaudryceras* is allied to a form found in the Senonian of Vancouver—*G. Jukesi* (Whiteaves)—which is probably identical with *G. Kayei* (Forb.) from the Valudayúr beds. *Baculites* is represented by a species of the type of *B. vagina* found in the Ariyalúr Group. *Belemnites* are numerous, and belong to a group characteristic of Southern India and Australasia.

Trigonia pseudocundata Hector is abundant, and belongs to a type found in India and other southern regions; it is similar to *T. tuberculifera* Stol., but the relationship is not sufficiently close to indicate the same horizon. *Trigonia Hanetiana* d'Orb. is also common, and is one of the characteristic species of the Quiriquina beds (Upper Senonian) of Chile; a similar form (*T. ecplecta* Wilck.) is found in the Senonian of Southern Patagonia. *Cucullæa* sp. shows some resemblance to *C. antarctica* Wilck., from the Senonian of the same region.

A species of *Modiola* is either identical with or closely allied to *M. typica* Forb., from the Trichinopoli Group of Southern India and the Senonian of Gosau and other places. *Modiola flagellifera* Forb. occurs in the Valudayúr beds (Upper Senonian) of Pondichéry, but has also been recorded from lower horizons elsewhere. *Pecten (Syncyclonema) membranaceus* Nilss. is abundant, and is found in the Senonian of Sweden, Rügen, Aachen, Gosau, &c.; and a form which may belong to this species was found in the Senonian of Cockburn Island. This or a closely allied species occurs in the Ariyalúr Group of Southern India. The *Inocerami* cannot be identified with known forms, but have affinities with Senonian types. *Astarte (Eriphyla) meridiana* sp. nov. is abundant in the calcareous conglomerate, and shows some resemblance to *A. Forbesiana* Stol., from the Ariyalúr Group, and also to *A. (Eriphyla) lenticularis* Goldf., which occurs in India, South Africa, and Europe. *Anthonya elongata* sp. nov. is fairly common, and is distinct from any known species; but the genus is represented in the Chico Group of Martinez. *Callista (Callistina) Wilckensi* sp. nov. is abundant, and resembles *C. sculpturata* (Stol.) from the Ariyalúr Group. A species of *Cardium* is probably related to *C. acuticostatum* d'Orb., one of the characteristic fossils of the Quiriquina beds. *Panopea* is common, and appears to belong to a species found in the Senonian of Seymour Island and Snow Hill Island (*P. clausa* Wilck.).

The few forms found in the Amuri Group which occur in Europe, or are allied to European species, are chiefly widely distributed types, such as *Pecten (Syncyclonema) membranaceus*, *Modiola typica*, and *Dreissensia lanceolata*.

(b.) Upper part of the Amuri Group (above the Calcareous Conglomerate).—The only species which have been recognized in the part of the Amuri Group above the calcareous conglomerate are *Pecten (Syncyclonema) membranaceus* Nilss., which occurs in the black grit and the greensand below it, and the following which occur in the black grit: *Pecten (Camptonectes) Hectori* sp. nov., *Inoceramus australis* sp. nov., *Synechodus sulcatus* (Davis), and *Callorhynchus Hectori* Newton. Examples of *Ostrea* and *Belemnites* are also found, but are not sufficiently perfect for determination. There is consequently very little evidence of the palæontological character of these beds, but in all probability they belong to the same zone as the calcareous conglomerate.

* The name Vancouver here and elsewhere refers to Vancouver and other islands off the coast of British Columbia, not to the town of that name. [P. G. Morgan].

2. *The Greensand Group.*

The Amuri Group is succeeded by the Greensand Group, above which comes the Amuri limestone. The Greensand Group has a thickness of from 485 ft. to 681 ft., and consists of the following divisions :—

Teredo limestone.
Greensands.
Grey sandstone.
Lower *Teredo* limestone.
Concretionary greensands.
Saurian beds.

(a.) Saurian Beds.—From the Saurian beds of Amuri Bluff the following species of reptiles have been obtained* : *Cimoliosaurus australis* (Owen), *C. caudalis* Hutton, *C. Haasti* (Hect.), *C. Holmesi* (Hect.), *C. Hoodi* (Owen), *C. latibrachialis* (Hect.), *C. Mackayi* (Hect.), *C. tenuis* (Hect.), *Leiodon haumuriensis* Hector, and *Platecarpus Oweni* (Hect.). Dr. C. W. Andrews informs me that this assemblage of species certainly indicates a horizon near the top of the Cretaceous, and that it is very similar to the reptilian fauna of the Niobrara chalk of the United States, which is of Senonian age.

(b.) Concretionary Greensands—Belemnites and Lamellibranchs occur in the concretionary greensands, but the only species which can be recognized are *Pecten (Syncyclonema) membranaceus* and *Lucina canterburiensis,* both of which occur in the lower part of the Amuri Group. A saurian was also obtained in the concretionary greensand of Amuri by McKay. It seems most probable that both the Saurian beds and the concretionary greensands are of Upper Senonian age.

(c.) Beds above the Concretionary Greensands.—At present the palæontological evidence is too meagre to justify the expression of an opinion as to the age of the beds above the concretionary greensands. The Amuri limestone itself, although a fine-grained chalky deposit of considerable thickness and wide distribution, has yielded few fossils. Some fishes found in it were described by J. W. Davis†, but Dr. Smith Woodward informs me that they may belong either to the Upper Cretaceous or the Eocene. One species, however (*Lamna marginalis* Davis), is identified by Dr. Woodward‡ with *L. macrota* (Ag.), found in the Eocene and Miocene of Europe, and is recorded by Davis from both the *Teredo* limestone and the Amuri limestone ; this suggests that both deposits are of post-Cretaceous age. *Pecten (Amusium) Zitteli* Hutton,§ known elsewhere from the Oamaru Formation, has been recorded from the Amuri limestone, and favours the view that that deposit is of Tertiary age. The only other fossils at present known in the Amuri limestone are Foraminifera, which have not yet been studied.

II. The Waipara and Weka Pass District.

This district is about fifty miles south-west of Amuri Bluff, forty miles north of Christchurch, and some twelve miles inland. The beds are generally similar to those of Amuri Bluff, particularly in the middle part (the Saurian beds). The lower fossiliferous sandstones are not so thick, and in general only one bed, the *Ostrea* bed, is distinguished. Below it is a series of loose sands with coal and conglomerates. The Amuri limestone is present, and forms an escarpment. All the fossils come from the *Ostrea* bed and the Saurian beds, and in most cases are poorly preserved.

* Hector, Trans. & Proc. N.Z. Inst., vol. vi (1874), p. 333 : Lydekker, Cat. Foss. Reptilia and Amphibia Brit. Mus., pt. i (1888), pp. 267, 270 ; pt. ii (1889), pp. 188, 215, 220, 245.

† Sci. Trans. R. Dublin Soc., ser. 2, vol. iv (1888), p. 1.

‡ Cat. Foss. Fishes Brit. Mus., pt. i (1889), p. 402.

§ Cat. Tert. Mollusca and Echinod. N.Z. (1873), p. 32 ; Zittel, Foss. Mollusk. u. Echinod. aus Neu Seeland (Novara Exped., Geol. Teil., Band I, 2, 1864), p. 53, pl. ix, figs. 1*b*, 3.

The *Ostrea* bed contains *Trigonia Hanetiana* d'Orb., *Ostrea* sp. *cf. dichotoma* Bayle, *Cucullœa*, "*Arca*" *Hectori* sp. nov., and *Pecten (Camptonectes) Hectori* sp. nov. The *Trigonia* and *Pecten* indicate that this bed belongs to the horizon of the Amuri Group, and is equivalent to the *Ostrea* bed of the Selwyn River (Malvern Hills). The *Ostrea* is similar to a species found in the Senonian of other regions.

The Saurian beds have yielded *Cimoliosaurus australis* (Owen), *C. caudalis* Hutton,* *C. Haasti* (Hect.), *C. Hoodi* (Owen), *C. Holmesi* (Hect.), *Leiodon haumuriensis* Hect., *Malletia (Neilo) cymbula* sp. nov., *Mactra* sp., *Thracia* sp., *Trigonia waiparensis* sp. nov., *Cardium* sp., and *Belemnites*. The reptiles indicate that these beds are of the age of the Saurian beds of Amuri Bluff. The Lamellibranchs, however, have not been recognized either at Amuri or in the Malvern Hills, but *Malletia (Neilo) cymbula* and *Trigonia waiparensis* suggest that the age is Upper Senonian; the former is allied to *M. pencana* (Phil.) from the Quiriquina beds, and the latter is of the same type as *T. parva* Brüggen and *T. crenifera* Stol., both from the Upper Senonian.

III. The Malvern Hills.

Cretaceous deposits are found in the Malvern Hills about one hundred miles south-west of Amuri Bluff and nearly forty miles west of Christchurch, where they rest on an extensive series of volcanic rocks. No clear account of the district is available. The lowest beds are quartz sands and conglomerates of great thickness, containing coal at different horizons. Below the coal of Deans' Coal-mine there is an *Ostrea* bed similar to that of the Waipara district. An *Ostrea* bed, which is probably the same, is found above the coal on the south side of the Selwyn River, and contains *Trigonia pseudocundata* Hect., *T. Hanetiana* d'Orb., *Panopea malvernensis* sp. nov., *Pecten (Camptonectes) Hectori* sp. nov., and probably *Lucina canterburiensis* sp. nov. The species of *Trigonia* indicate that this bed belongs to the horizon of the lower part of the Amuri Group (the calcareous conglomerate).

A higher series of fossiliferous beds (the Selwyn Rapids beds) is found in the Selwyn River Rapids, and is followed by beds lithologically similar to the Saurian beds, above which come loose sands and volcanic rocks; the Amuri limestone is not present. The Selwyn Rapids beds contain *Pectunculus selwynensis* sp. nov., *Ostrea* sp., *Pecten (Camptonectes) Hectori* sp. nov., *Pinna* sp., *Astarte (Eriphyla) lenticularis* (Goldf.), *Lucina canterburiensis* sp. nov., *Tellina* sp. *cf. Largillierti* (d'Orb.), *Callista (Callistina) Thomsoni* sp. nov., *Callista* sp., *Dosinia* sp., *Cardium* sp., and *Panopea malvernensis*.

Of these species, only *Lucina canterburiensis* and *Pecten (Camptonectes) Hectori* have been recognized at Amuri, where they occur in the calcareous conglomerate of the Amuri Group.

Although very little palæontological evidence is at present available for correlation, it is probable that the Selwyn Rapids beds represent the upper part of the Amuri Group. They rest on the *Ostrea* bed, which contains species characteristic of the calcareous conglomerate, and are followed by the Saurian beds. An Upper Senonian age for the Selwyn Rapids beds is suggested by the presence of *Astarte (Eriphyla) lenticularis*, *Panopea malvernensis*, (which resembles *P. simplex* Hupé from the Quiriquina beds), *Tellina* sp. *cf. Largillierti* (d'Orb.) also from the Quiriquina beds, and *Callista* sp. (which may be compared with *C. sculpturata* Stol. from the Ariyalúr Group).

From the foregoing account it will be seen that in this region (Amuri to Malvern Hills) the only Cretaceous horizon which can be recognized at present is the Upper Senonian. There is no evidence for the existence of Cenomanian (Lower Chalk), Turonian, or Lower Senonian; so that we have here an instance of the Senonian transgression similar to that which occurs in Pondichéry, Madagascar, South Africa, and Quiriquina (Chile).

* Trans. and Proc. N.Z. Inst., vol. xxvi (1894), p. 354.

TABLE OF DISTRIBUTION OF SPECIES AT AMURI BLUFF, WAIPARA AND THE WEKA PASS, AND THE MALVERN HILLS.

	Amuri.				Waipara and Weka Pass.		Malvern Hills.		
	Amuri Group.		Greensand Group.						
—	Calcareous Conglomerate.	Black Grit.	Saurian Bed.	Concretionary Greensand.	Ostrea Bed.	Saurian Bed.	Ostrea Bed.	Selwyn Rapids Bed.	Page.
Nuculana amuriensis sp. nov.	x	..	..	..	..	..	..	..	18
„ sp.	x	..	..	..	..	..	..	..	18
Malletia (Neilo) cymbula sp. nov.	..	..	..	..	..	x	..	..	18
Barbatia Mackayi sp. nov.	x	..	..	..	..	..	..	..	19
Nemodon ? sp.	..	..	..	..	x	..	..	..	19
"*Arca*" *Hectori* sp. nov.	..	..	..	..	x	..	..	..	19
Cucullœa zealandica sp. nov.	x	..	..	..	..	..	..	..	20
„ sp.	x	..	..	..	..	..	..	..	20
Pectunculus selwynensis sp. nov.	..	..	..	..	..	..	..	x	20
„ sp.	x	..	..	..	..	..	..	..	20
Trigonia pseudocundata Hect.	x	..	..	..	..	..	x	..	21
„ *Hanetiana* d'Orb.	x	..	..	..	x	..	x	..	22
„ *waiparensis* sp. nov.	x	..	..	..	..	x	..	..	23
Modiola sp. *cf. typica* Forbes	x	..	..	..	..	..	..	..	23
„ *flagellifera* Forbes	x	..	..	..	..	..	..	..	24
Dreissensia lanceolata (Sow.)	x	..	..	..	..	..	..	..	24
Ostrea sp. *cf. dichotoma* Bayle	..	..	..	..	x	..	x	..	24
„ sp.	x	..	..	..	..	..	..	..	25
Pecten (Syncyclonema) membranaceus Nilss.	x	x	..	x	..	..	..	..	25
„ *(Camptonectes) Hectori* sp. nov.	x	x	..	..	x	..	x	x	26
„ *(Æquipecten) amuriensis* sp. nov.	x	?	..	..	..	..	..	..	26
Lima (Limatula) Huttoni sp. nov.	x	..	..	..	..	..	..	..	27
Inoceramus australis sp. nov.	x	x	..	..	..	..	..	..	27
„ *pacificus* sp. nov.	x	..	..	..	..	..	..	..	28
„ sp.	x	..	..	..	..	..	..	..	28
Pinna sp.	x	..	..	..	..	..	..	x	28
Astarte (Eriphyla) meridiana sp. nov.	x	..	..	..	..	..	..	..	28
„ „ *lenticularis* (Goldf.)	..	..	..	..	..	..	..	x	29
Anthonya elongata sp. nov.	x	..	..	..	..	..	..	..	29
Lucina canterburiensis sp. nov.	x	..	..	x	..	..	?	x	30
Tellina sp. *cf. Largillierti* (d'Orb.)	..	..	..	..	..	..	..	x	30
„ sp.	..	..	..	..	..	..	..	x	30
Mactra ? sp.	..	..	..	..	..	x	..	..	30
Cultellus cretaceus sp. nov.	x	..	..	..	..	..	..	..	31
Callista (Callistina) Wilckensi sp. nov.	x	..	..	..	..	..	..	..	31
„ „ *Thomsoni* sp. nov.	..	..	..	..	..	..	..	x	32
„ sp.	..	..	..	..	..	..	..	x	32
Dosinia sp.	..	..	..	..	..	..	..	x	32
„ sp.	..	..	..	..	..	..	?	x	32
Cardium sp.	x	..	..	..	..	..	..	..	33
„ sp.	..	..	..	..	..	..	..	x	33
Panopea clausa Wilck.	x	..	..	..	..	..	..	..	33
„ *malvernensis* sp. nov.	..	..	..	..	..	..	x	x	33
Thracia Haasti sp. nov.	x	...	..	..	..	..	..	..	34
„ sp.	..	..	..	..	..	x	..	..	34
Nautilus sp.	x	..	..	..	..	..	..	..	..
Kossmaticeras (Madrasites) haumuriensis (Hect.)	x	..	..	..	..	..	..	..	34
Gaudryceras sp. (aff. *Jukesi* Whit.)	x	..	..	..	..	..	..	..	35
Hamites (Anisoceras ?) sp.	x	..	..	..	..	..	..	..	35
Baculites sp. *cf. vagina* Forb.	x	..	..	..	..	..	..	..	36
Belemnites Lindsayi Hect.	x	..	..	..	..	..	..	..	36

Description of Species.

LAMELLIBRANCHIA.

Genus Nuculana Link.

Nuculana amuriensis sp. nov. Plate VI, fig. 1.

Description.—Shell more or less oval, moderately inequilateral; convex between the umbo and the opposite ventral margin, becoming gradually compressed posteriorly. Antero-dorsal margin slightly concave; anterior margin rounded; ventral margin slightly or moderately convex, curving upwards to the posterior margin, which is more or less rounded, and forms a rounded angle with the straight or slightly concave postero-dorsal margin. Ornamentation consists of concentric ribs, which disappear or become indistinct towards the ends of the valves, and are best developed near the ventral margin or near a well-marked growth-ring; these ribs cut the ventral margin of the shell at an acute angle.

Affinities.—In form this species resembles some examples of *N. leia* (Wanner),* from the Danian and Mæstrichtian of Egypt and Tunis, but the concentric ornamentation is coarser, and recalls that of *N. lineata* (Sowerby)† from the Upper Greensand of England; in that species, however, the posterior part of the shell is more pointed, and the postero-dorsal region more compressed than in *N. amuriensis*. The posterior part is also less pointed than in *N. perdita* (Conrad).‡

Distribution.—Amuri Group (calcareous conglomerate); west wing of Amuri Bluff (13), and *Aporrhais* beds, east wing of Amuri Bluff (6).

Nuculana sp. Plate VI, fig. 2.

Another species is represented by an internal cast of a right valve only. On account of the upward slope of the posterior part of the ventral margin the height of the posterior part of the shell is less than in *N. amuriensis*.

Distribution.—Amuri Group (calcareous conglomerate), west wing of Amuri Bluff (13).

Genus Malletia des Moulins.

Subgenus Neilo Adams.

Malletia (Neilo) cymbula sp. nov. Plate VI, figs. 3*a*, *b*.

Description.—Shell convex, but with the postero-dorsal part much compressed; length about twice the height; the posterior part not quite so high as the anterior part; slightly inequilateral. Anterior margin rounded, curving gradually to join the slightly convex ventral margin. Posterior margin slightly convex, somewhat oblique, forming an angle with the slightly concave postero-dorsal margin, rounded ventrally. Umbo incurved. Ornamentation consists of strong concentric ribs.

Affinities.—This species resembles *Malletia pencana* (Philippi)§ from the Quiriquina beds, but is less inequilateral, more convex, less pointed posteriorly, and the ribs are more numerous and not so strong. The postero-dorsal part of the shell is more compressed than in the example figured by Wilckens. The hinge has not been seen,

* Palæontographica, vol. xxx, 2 (1902), p. 120, pl. xvii, figs. 16, 17; Quaas, *ibid.* (1902), p. 197, pl. xxxi, figs. 41–44; Pervinquière, Études Paléont. Tunisienne, vol. ii (1912), p. 96, pl. vii, figs. 15–19.

† Woods, Mon. Cret. Lamell. England, vol. i (1899), p. 7, pl. i, figs. 28–32.

‡ Lartet, Ann. Sci. géol., vol. iii (1873), p. 50, pl. xii, figs. 1, 2.

§ Tertiär. u. Quartär. Verstein. Chiles (1887), p. 192, pl. xli, fig. 5; Wilckens, Neues Jahrb. für Min., &c., Beil.-bd. xviii (1904), p. 230, pl. xix, fig. 6.

but from the external character of the shell it seems probable that it belongs to the subgenus *Neilo*.

Distribution.—Saurian beds, Middle Waipara (761).

Genus Barbatia Gray.

Barbatia Mackayi sp. nov. Plate VI, figs. 4 *a*, *b*.

Description.—Shell elongate-oval, moderately inequilateral, height equal to about three-fifths of the length; flanks compressed. Antero-dorsal margin sloping rapidly forwards. Anterior margin rounded. Ventral margin nearly straight or slightly concave, almost parallel to the hinge-line. Posterior margin subtruncate or rounded. Umbones broad, not prominent, incurved.

Ornamentation consists of numerous small rounded radial ribs, which become more widely separated on the postero-dorsal part of the valve.

Affinities.—This species, known at present by only a single right valve, resembles *B. micronema* (Meek),* from the Colorado Formation, but the shell is less inequilateral and the radial ornamentation more distinct.

Distribution.—Amuri Group (calcareous conglomerate), west wing of Amuri Bluff (13).

Genus Nemodon Conrad.

Nemodon ? sp. Plate VI, figs. 5 *a*, *b*.

An imperfect right valve possesses a hinge which resembles that of *Arca japetica* Forbes,† but the downward curvature of the anterior teeth is more marked. *A. japetica* is found in the Ariyalúr Group of Southern India, and was referred doubtfully by Stoliczka to the genus *Grammatodon*, but the hinge seems to agree more nearly with that of *Nemodon*. In the New Zealand specimen the surface of the shell is abraded, so that the nature of the ornamentation cannot be determined, and the umbo is missing.

Distribution.—*Ostrea* bed, McKay's Creek, Middle Waipara (149).

Genus Arca Linnæus.

"Arca" Hectori sp. nov. Plate VI, figs. 6 *a*, *b*.

Description.—Shell subquadrate, rather short, moderately convex, with a distinct but rounded carina, which limits a flattened posterior area. Anterior margin convex, passing gradually into the slightly curved ventral margin, which is nearly parallel with the hinge-line. Posterior margin nearly straight, oblique, forming a rounded angle with the ventral margin and an obtuse angle with the dorsal margin. Umbones inconspicuous, situated at about one-third of the length of the shell from the anterior margin. Hinge-area low.

Ornamentation consists of numerous regular radial ribs which, except near the carina, are of two sizes, the stronger ribs being widely separated by from three to six small ribs.

Remarks.—This is a well-marked species, but is represented by one right valve only, and the hinge is not shown, so that the generic position cannot be determined. The ornamentation shows some resemblance to that of *Arca disparilis* d'Orbigny,‡ from Pondichéry, but the valve is less convex.

Distribution.—*Ostrea* bed, Boby's Creek, Waipara (277).

* Stanton, Colorado Formation (Bull. U.S. Geol. Surv., 106, 1893), p. 89, pl. xxi, figs. 1–4.
† Stoliczka, Cret. Fauna S. India, vol. iii (1871), p. 350, pl. xviii, figs. 9, 10.
‡ Voy. Pole Sud., Atlas géol. (1847), pl. viii, figs. 37, 38.

Genus Cucullæa Lamarck.

Cucullæa zealandica sp. nov. Plate VI, figs. 7 *a*, *b*; Plate VII, fig. 1.

Description.—Shell subquadrate, somewhat inequilateral, posterior part higher than the anterior part. Anterior margin slightly convex; ventral margin oblique, nearly straight. Umbones high, prominent, incurved. The carina present on the early part of the shell posterior to the umbo soon becomes indistinct.

The middle and anterior parts of the shell are ornamented with rounded radial ribs. At first the ribs are of uniform size, but on the later parts of the shell they become separated by broad interspaces, in which a small secondary rib appears. On the posterior part of the shell the radial ribs are smaller, less distinct, or perhaps absent in some cases. Numerous concentric growth-lines occur, some of which at intervals are more prominent than the others.

Distribution.—Amuri Group (calcareous conglomerate), east and west wings of Amuri Bluff (5, 13).

Cucullæa sp. Plate VII, figs. 2 *a–c*, 3.

Some specimens of *Cucullæa* from the Amuri Group (calcareous conglomerate), east and west wings of Amuri Bluff (5, 13), appear to differ from *C. zealandica* in having the ribs closer together, of uniform size, and with numerous transverse scale-like ridges. Owing to the small number of specimens and the imperfect preservation of the shell-surface, it is difficult to determine how far these differences may be due to preservation and variation. These specimens resemble *C. antarctica* Wilckens,* from the Senonian of South Patagonia, but have rather more numerous ribs, and apparently a more oblique and less curved ventral margin. Internal casts show the characteristic hinge of *Cucullæa*.

Genus Pectunculus Lamarck.†

Pectunculus selwynensis sp. nov. Plate VII, figs. 4–7.

Description.—Shell somewhat inequilateral, globose, slightly concave between the umbo and the posterior margin. Height and length nearly equal. Anterior margin slightly convex, forming a rounded angle with the antero-dorsal margin, and curving rapidly to join the moderately convex ventral margin. Posterior margin relatively short, truncated, slightly concave, forming an angle with the postero-dorsal margin. Umbones rather broad, incurved. Inner margins of valves coarsely toothed. Anterior adductor impression larger than the posterior.

Ornamentation consists of strong radial ribs, with rounded summits (sometimes subangular on the posterior part of the shell), separated by concave interspaces. Both are crossed by numerous small growth-ridges.

Affinities.—The radial ribs in this species are similar to those of *P. Veatchi* (Gabb),‡ but are more numerous and rather narrower. Some specimens show fine radial lines, which may be comparable with the finer ornamentation of the ribs of *P. Veatchi*. The shell in *P. selwynensis* is, however, of smaller size and somewhat different shape. *P. Veatchi* is found in the Chico Group and also in the Vancouver Island region.

Distribution.—Selwyn Rapids beds of Selwyn River (23), and Selwyn River Rapids (589).

Pectunculus sp. Plate VII, fig. 8.

An internal cast from the Amuri Group (calcareous conglomerate) of Amuri Bluff (13) indicates the existence of a species distinct from *P. selwynensis*.

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* Ber. naturf. Gesellsch. i Br., vol. xv (1905), p. 36 [132], pl. vi, figs. 5, 6.

† The name *Glycymeris*, Da Costa, is used by some authors in place of *Pectunculus*.

‡ Whiteaves, Mesoz. Foss. (Geol. Surv. Canada), vol. i (1903), p. 391, pl. xlvii, figs. 3, 4.

Genus Trigonia Bruguière.

Trigonia pseudocundata Hector. Plate VII, fig. 9; Plate VIII, figs. 1–5.

1880. *Trigonia amuriensis* J. Hector, Append. Catal. Internat. Exhib. Sydney, N.Z. Court, p. 12 (*nom. nud.*)
1886. *Trigonia pseudocundata* Hector, Catal. Ind. & Colon. Exhibit., Geol. Exhibits, p. 64, fig. 28, 7.
1886. *Trigonia amuriensis* Hector, *ibid.*, p. 16.

Description.—Anterior part of shell inflated, high; posterior part gradually compressed, flattened, and rapidly diminishing in height. Anterior margin convex, passing gradually into the strongly convex ventral margin, the posterior part of which bends rapidly upwards, and is nearly straight or only slightly curved. Posterior margin very short. Postero-dorsal margin concave. Umbones broad, strongly incurved, and with a small backward curvature. The umbones are situated at a distance equal to about a quarter of the length of the shell from the anterior margin. Escutcheon concave, with costellæ. Area narrow, with a linear longitudinal furrow. A ridge on the inside of the posterior part of the valves divides the siphonal region into a dorsal and a ventral portion.

Ornamentation consists of strong radial ribs. On the anterior inflated part of the valves the ribs are broad and rounded, and are separated by relatively narrow concave interspaces. The ribs, which start immediately behind the umbo, pass in nearly a straight line to the opposite ventral margin; the more anterior ribs pass to the anterior margin, and have usually a slight anterior curvature before they reach the margin. The ribs are crossed at intervals by strong concentric furrows, which are widely spaced except towards the ventral margin, where they gradually become more numerous and closer together. These furrows, according to their distance from one another, divide the ribs into elongate, or nearly square, or short and broad portions. On the posterior compressed part of the valves the ribs are usually smaller and more numerous than on the anterior part; they extend from the margin of the area to the posterior part of the ventral margin, and become more oblique posteriorly. These ribs are also crossed by concentric furrows, which are usually less distinct than on the anterior part of the valves. The decrease in size of the ribs in passing from the anterior to the posterior part of the valves is sometimes gradual, but usually rapid. The ribs of the two valves alternate in position. The inner margins of the valves are crenulated.

Affinities.—*T. pseudocundata* resembles, in form and in the general character of its ornamentation, *T. tuberculifera* Stoliczka* from the Trichinopoli Group of Southern India; but is distinguished from that species by its less elevated umbones, and the broader, closer, and usually more numerous ribs, and their less distinctly tuberculate character. The ribs also appear to be less curved. *T. tuberculifera* is allied to *T. ventricosa* (Krauss) and other southern species.

Remarks.—In all the specimens examined the umbonal part is abraded, so that the character of the ornamentation in the early stages cannot be determined. The figure of *T. pseudocundata* given by Hector represents imperfectly the character of the species, and was not accompanied by any description. The type has not been identified. *T. amuriensis* Hector (*nom. nud.*) is founded on internal casts of *T. pseudocundata.*

Distribution.—Common in the Amuri Group, calcareous conglomerate (*Trigonia* beds and *Aporrhais* beds), west wing of Amuri Bluff (13). Two specimens were found in the *Ostrea* bed, swamp south of Selwyn River, Malvern Hills (469).

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* Cret. Fauna S. India, vol. iii (1871), p. 315, pl. xv, figs. 10–12.

Trigonia Hanetiana d'Orbigny. Plate VIII, fig. 6; Plate IX, figs. 1–6.

1842. *Trigonia Hanetiana* A. d'Orbigny, Voy. Amerique Mérid., vol. iii, pt. 4, p. 127; Atlas, viii (1847), pl. xii, figs. 14–16.
1847. *Trigonia Hanetiana* d'Orbigny, Voy. Pole Sud., Atlas géol., pl. v, figs. 23, 24.
1850. „ „ d'Orbigny, Prodr. de Pal., vol. ii, p. 240.
1854. „ „ Hupé, in C. Gay, Hist. fis. e pol. Chile, Zool., vol. viii, p. 327.
1854. „ *obtusa* Hupé, *ibid.*, p. 327, pl. v, fig. 9.
1874. „ *sulcata* J. Hector, Trans. & Proc. N.Z. Inst., vol. vi, p. 358.
1887. *Trigonia Hanetiana* R. A. Philippi, Tertiär. u. Quartär. Verstein. Chiles, p. 199, pl. xlii, figs. 1, 3.
1887. *Trigonia obtusa* Philippi, *ibid.*, p. 200, pl. xlii, fig. 2.
1887. „ *glabra* Philippi, p. 200, pl. xlii, fig. 4.
1886. *Trigonia sulcata* J. Hector, Catal. Ind. & Colon. Exhib., N.Z. Court, Geol. Exhibits, pp. 16, 64, fig. 28, 5.
1895. *Trigonia Hanetiana* W. Möricke, Neues Jahrb. für Min., &c., Beil.-band x, p. 101, pl. vii, figs. 8, 9.
1904. *Trigonia Hanetiana* O. Wilckens, *ibid.*, xviii, p. 231.
1905. *Trigonia Hanetiana* Wilckens, Ber. nat. Gesellsch. Freiburg i Br. vol. xv, p. 38 [134], pl. vii, fig. 4.

Description.—Shell subtriangular, sometimes subquadrate, of moderate convexity, or with the sides compressed; length greater than height, but the relative proportions varying considerably in different individuals; moderately inequilateral, except in elongate specimens, which are considerably inequilateral. Anterior margin moderately or considerably convex, usually curving rapidly to join the ventral margin, which is slightly convex in the elongate forms, more convex in the shorter forms, and bends inward in front of the postero-ventral angle. Posterior margin more or less oblique, slightly convex. Postero-dorsal margin long, slightly curved or nearly straight, sloping gradually to the posterior end. Umbones broad, not much elevated, with a moderate backward curvature.

Area moderately broad, bounded by a carina which becomes more rounded and less distinct on the later part of the shell; the area is divided by a shallow furrow, and is ornamented by a few radial ribs, which may become indistinct on the posterior part. Escutcheon concave, with concentric growth-ridges. In front of the carina a broad sulcus extends from the umbo to the posterior part of the ventral margin, where it makes a rounded sinus in the margin.

In front of the sulcus the shell is ornamented with strong ribs, which increase gradually in breadth; they extend obliquely backwards from the dorsal and anterior part to the sulcus or to the ventral margin; the later parts are curved, and may become concentric near the sulcus. These ribs are broken up into rounded, oval, or elongate portions. On the anterior marginal part of the valves ribs may extend upwards from the edge for a short distance, and join the oblique ribs at an angle.

Affinities.—*T. ecplecta* Wilckens,* from the Upper Chalk of Southern Patagonia, is believed by Wilckens to be allied to *T. Hanetiana*, but no other closely related form appears to be known at present. An examination of specimens shows clearly that *T. sulcata* Hector is identical with *T. Hanetiana*; the probability of this was suggested by Steinmann and Möricke, but the brief description (1874) and the unsatisfactory character of Hector's figure (1886) did not permit of a definite statement. A short form of *T. Hanetiana* was named *T. obtusa* by Hupé. *T. glabra* Philippi is believed by Wilckens to be a decorticated example of *T. Hanetiana*.

Remarks.—This species varies considerably in the relative proportions of its length and height, and consequently in outline and in the obliquity of the ribs. The state of preservation makes considerable differences in the appearance of the shell; this is seen particularly on the area, which in the less perfectly preserved specimens

* Ber. nat. Gessellsch. Freiburg i Br., vol. xv (1905), p. 37 [133], pl. vii, figs. 2, 3.

appears to be without ribs. The examples figured by Philippi are somewhat abraded. *T. Hanetiana* is a characteristic fossil of the Quiriquina beds; the type came from Quiriquina, and other examples have been found at Tomé, San Vicente, Hualpen, Cerro Amarilla (near Concepcion), and Algarrobo.

Specimens found in the *Ostrea* bed of the Waipara and Malvern Hills districts differ somewhat in appearance from those collected at Amuri Bluff; the sulcus is usually shallower, and the ribs are smaller and appear to become nearly concentric near the anterior margin in larger specimens. The shells are to some extent decorticated, and I am inclined to regard the apparent differences as being due mainly to differences in the state of preservation.

Distribution.—Amuri Group, calcareous conglomerate (*Trigonia* beds), west wing (13) and east wing (5) of Amuri Bluff. *Ostrea* bed of Middle Waipara (762); Boby's Creek, Waipara (277); and Selwyn River (23).

Trigonia waiparensis sp. nov. Plate X, figs. 1–3.

Description.—Shell small, more or less trigonal, inequilateral, moderately convex in the dorsal and median part; length greater than height. Umbones situated at one-third or rather less than one-third of the length of the shell from the front of the anterior margin. Anterior margin rounded, passing gradually into the ventral margin, which at first is moderately convex, but becomes less convex posteriorly, and slopes upward to form an angle with the short oblique posterior margin. Postero-dorsal margin long, sloping gradually from the umbo backwards. Carina indistinct.

Ornamentation consists of strong radial ribs, which appear to bear tubercles. On the flanks the ribs extend in nearly straight lines from the umbo and the carinal line to the opposite ventral margin, the posterior ribs sloping backwards. From the carinal line another set of ribs starts, forming an acute angle with those of the flanks; these ribs curve downwards from the carinal region to the postero-dorsal margin of the valve.

Affinities.—Two species which have a similar type of ornamentation, but are clearly distinguished by the shape of the shell, the direction of the ribs, and other characters, are *T. parva* Brüggen* from the Senonian of North Peru and *T. crenifera* Stoliczka† from the Ariyalúr Group of Southern India.

Remarks.—Only a few specimens of this species have been seen. The surface is rather imperfectly preserved, but external casts indicate the presence of tubercles on the ribs. So far as can be made out, the escutcheon does not appear to be delimited from the area.

Distribution.—Saurian beds of Middle Waipara (761). Amuri Group, calcareous conglomerate (*Trigonia* beds), west wing of Amuri Bluff (13).

Genus Modiola Lamarck.

Modiola sp. *cf.* typica Forbes. Plate IX, fig. 7; Plate X, figs. 4*a*, *b*.

1846. *Mytilus (Modiolus) typicus* E. Forbes, Trans. Geol. Soc., ser. 2, vol. vii, p. 152, pl. xiv, fig. 4.
1866. *Modiola typica* K. A. Zittel, Bivalv. d. Gosaugeb., pt. 2, p. 2 [78], pl. xi, fig. 5.
1871. ,, ,, F. Stoliczka, Cret. Fauna S. India, vol. iii, p. 377, pl. xxiii, figs. 13–15.
1883. ,, ,, A. Fritsch, Die Iserschichten, p. 106, fig. 73.
1897. ,, ,, Fritsch, Die Chlomeker Schichten, p. 59, fig. 70.
1906. ,, ,, J. Pethö, Palæontographica, vol. lii, p. 235, pl. xvi, fig. 16.

The collection contains four specimens of *Modiola*, which closely resemble *M. typica* Forbes from the Trichinopoli Group of Southern India and the Senonian of Gosau and

* Neues Jahrb. für Min., &c., Beil.-bd. xxx (1910), p. 754, pl. xxv, fig. 7; non *T. parva* Kitchin, 1893.
† Cret. Fauna S. India, vol. iii (1871), p. 318, pl. xv. fig. 13.

other places; but without more material for comparison it is difficult to feel quite sure of the identification, especially as the Indian and Gosau examples show considerable variation.

None of the specimens have the radiating striæ on the anterior slope preserved. The type of *M. typica* is in the Geological Society collection (British Museum).

M. Vishnu Nötling,* from the Mæstrichtian of the Mari Hills, is allied to *M. typica*.

Distribution.—Amuri Group (calcareous conglomerate), west wing of Amuri Bluff (13).

Modiola flagellifera Forbes. Plate X, fig. 5.

The only specimen seen is the posterior part of a right valve; it agrees closely with the type of *M. flagellifera*† which is now in the British Museum (Geological Society collection). The type came from the Valudayúr beds (Upper Senonian), of Pondichéry; other examples have been described from the Senonian of Gosau and Fruska Gora, the Upper Greensand of England, &c.

Distribution.—Amuri Group (calcareous conglomerate), west wing of Amuri Bluff (13).

Genus Dreissensia van Beneden.

Dreissensia lanceolata (Sowerby). Plate X, figs. 6 *a*, *b*.

The Amuri specimens agree perfectly with English examples of *D. lanceolata* (Sowerby).‡ In England this species has not been found above the zone of *Schlœnbachia rostrata*, but specimens from the Senonian of Aachen are believed by Holzapfel§ to be referable to *D. lanceolata*. An internal cast from Skidegate (Queen Charlotte Islands) has been identified with this species by Whiteaves.||

Distribution.—Amuri Group (calcareous conglomerate): *Trigonia* and *Aporrhais* beds, east wing of Amuri Bluff (5, 6); *Trigonia* beds, west wing of Amuri Bluff (13).

Genus Ostrea Linnæus.

Ostrea sp. *cf.* **dichotoma** Bayle. Plate X, figs. 7 *a*, *b*; Plate XI, fig. 1.

There are several examples of a species of *Ostrea* of the same type as *O. dichotoma* Bayle¶ (including *O. Sollieri* Coquand), which is found in the Coniacian, Santonian, and Campanian of Algeria, and has also been recorded from Egypt, Persia, and Mexico.

In most of the New Zealand specimens the shell is much higher than long; the left valve is convex, very thick in large specimens, and often with a high ligament-pit; the right valve is flattened, but often convex between the umbo and the opposite margin. The ribs are numerous, either rounded or angular, and sometimes bifurcate.

In the New Zealand specimens the ribs are more numerous and smaller than in the figured examples of *O. dichotoma* and *O. Sollieri*; but Peron has shown that this feature, and also the form of the shell, vary considerably. Pervinquière regards *O. semiarmata* Bosé,** from the Senonian of Mexico, as a synonym of *O. dichotoma*. Although the New Zealand specimens are fairly numerous, their state of preservation is not sufficiently good to allow a definite determination of the species to be made.

* Palæont. Indica, ser. xvi, vol. i, pt. 3 (1897), p. 44, pl. xi, fig. 3.

† For references to figures, see Woods, Mon. Cret. Lamellibr. England, vol. i (1900), p. 99; Pethö, Palæontographica, vol. lii (1906), p. 236, pl. xvi, figs. 17, 18; Scupin, *ibid.* (Suppl.-band vi, 1912–13), p. 198.

‡ For references, see Woods, Mon. Cret. Lamellibr. England, vol. i (1900), p. 110.

§ Palæontographica, vol. xxxv (1889), p. 218.

|| Mesoz. Foss. (Geol. Surv. Canada), vol. i (1884), p. 236, pl. xxxi, fig. 7.

¶ Coquand, Mon. *Ostrea*. Terr. Crét. (1869), pp. 56, 99, pl. xxvi, figs. 1, 2; pl. xxvii, figs. 1–7. For synonymy of *O. dichotoma*, see Peron, Descript. Brach., &c., Terr. Crét. Tunisie (1890), p. 156; and Pervinquière, Études Paléont. Tunisienne, ii, Gastrop. et Lamellibr. Terr. Crét. (1912), p. 206, pl. xiv, figs. 20, 21.

** Senon. de Cárdenas (Bol. Instit. geol. México, No. 24 (1906), p. 44, pl. ii, fig. 1; pl. iii, figs. 1, 2; pl. iv, fig. 4; pl. v, figs. 1, 5.

Distribution.—*Ostrea* bed of Weka Creek (782), Middle Waipara (762), Upper Waipara Gorge, and Boby's Creek, Waipara (277); *Ostrea* bed, swamp south of Selwyn River (469); and Selwyn River (23).

Ostrea sp. Plate XI, fig. 2.

Portions of *Ostrea* are very abundant in the lower part of the Amuri Group (chiefly in the *Trigonia* bed) of the west wing of Amuri Bluff (13). Owing to the hardness of the rock and the foliaceous character of the shell, the specimens cannot be extracted so as to show the external character of the shell satisfactorily. The inner margin of the valves is crenulate.

Genus Pecten Müller.

Subgenus Syncyclonema Meek.

Pecten (Syncyclonema) membranaceus Nilsson. Plate XI, figs. 3–5.

1827. *Pecten membranaceus* S. Nilsson, Petrific. Suecana, p. 23, pl. ix, fig. 16 (lower figure).
1836. „ „ A. Goldfuss, Petref. Germ., vol. ii, p. 75, pl. xcix, fig. 7.
1837. „ „ W. Hisinger, Lethæa Suecica, p. 53, pl. xvii, fig. 6.
1841. „ *spathulatus* F. A. Römer, Verstein. nord-deutsch. Kreidegeb., p. 50, pl. viii, fig. 5.
1842. „ *membranaceus* F. v. Hagenow, Neues Jahrb. für Min., &c., p. 553.
1847. „ „ J. Müller, Mon. Petref. Aachen. Kreidef., i, p. 31.
1866. „ „ K. A. Zittel, Bivalv. d. Gosaugeb., ii, p. 31, pl. xvii, fig. 3.
1870. „ „ C. Schlüter, Neues Jahrb. für Min., &c., p. 951.
1872. *Pecten Nilssoni* H. B. Geinitz, Das Elbthalgeb. in Sachsen (Palæontographica, xx, 2), p. 33, pl. ix, figs. 15–18.
1889. *Pecten spathulatus* E. Holzapfel, Die Mollusk. Aachen. Kreide (Palæontographica, xxxv), p. 233, pl. xxvi, figs. 3, 5.
1891. *Syncyclonema spatulata* J. Böhm, Palæontographica, vol. xxxviii, p. 85, pl. iii, fig. 37.
1894. *Pecten membranaceus* A. Hennig, Geol. Fören. i Stockholm Förhandl., vol. xvi, p. 518.
1896. *Pecten membranaceus* Hennig, Revis. Lammellibr. i Nilsson's "Petrific. Suecana," p. 37, pl. iii, figs. 6–8.

Examples of this species are abundant in the Amuri Group, and agree well with the European forms, especially those figured by Böhm and Holzapfel. The proportions of height and length, and consequently the size of the apical angle, vary just as in European specimens, but the form of the ears appears to be more constant.

P. membranaceus is found in the Senonian of Kopinge (Sweden), Rügen, Aachen, Gosau, and other European localities. The specimens from the Ariyalúr Group of Southern India, described and figured by Stoliczka,* are either closely allied to or identical with this species. An imperfect specimen from Cockburn Island is doubtfully referred to *P. membranaceus* by Wilckens.†

In Europe specimens from horizons below the Senonian have been identified with *P. membranaceus* by some writers.‡ Thus Geinitz figures the species from the Turonian and Cenomanian; and Römer (1870), Windmöller, Michael, and Söhle record it from the Cenomanian. Of these occurrences the one from the Turonian of Saxony (Geinitz) is accepted by Hennig as an example of *P. membranaceus*.

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* Cret. Fauna S. India, vol. iii (1871), p. 436, pl. xxxii, fig. 5; pl. xli, figs. 7, 8.

† Die Annelid., Bivalv. u. Gastrop. d. Antarkt. Kreideformat. (Schwedisch. Südpol.-Expedit., 1901–3, iii, 12, 1910), p. 17, pl. i, fig. 9.

‡ References to these and some Senonian forms not mentioned in the synonymy are: Reuss, Verstein. d. böhm. Kreideformat., pt. 2 (1846), p. 26, pl. xxxix, fig. 4; Kner, Haidinger's Naturwiss. Abhandl., vol. iii, pt. 2 (1850), p. 28; Alth, *ibid.* (1850), p. 245, pl. xii, fig. 28; Strombeck, Zeitschr. d. deutsch. geol. Gesellsch., vol. xv (1863), p. 154; Favre, Mollusques foss. Craie de Lemberg (1869), p. 140; Römer, Geol. v. Oberschles. (1870), pp. 333, 356, pl. xxvi, fig. 5, pl. xxxix, figs. 11, 12; Windmöller, Jahr. d. k. preussisch. geol. Landesanst. für 1881 (1882), p. 21; Schröder, Zeitschr. d. deutsch. geol. Gessellsch., vol. xxxiv (1882), p. 270; Söhle, Geogn. Jahresh., 1896 (1897), p. 40; Greipenkerl, Palæont. Abhandl., vol. iv (1889), p. 47; Michael, Zeitschr. d. deutsch. geol. Gesellsch., vol. xlv (1893), p. 236; Leonhard, Palæontographica, vol. xliv (1897), p. 26; Gagel and Kaunhowen, Jahrb. d. k. preussisch. geol. Landesanst., 1899 (1900), p. 231.

Distribution.—Amuri Group: Calcareous conglomerate (2, 5), greensand (7), and black grit (8), east wing of Amuri Bluff; Amuri Group (calcareous conglomerate), west wing of Amuri Bluff (13). Concretionary greensands, east wing of Amuri Bluff (10, 11).

Subgenus CAMPTONECTES Meek.

Pecten (Camptonectes) Hectori sp. nov. Plate XI, figs. 6–9; Plate XII, fig. 1.

Description.—Shell ovate, pointed dorsally, inequilateral, higher than long. Valves moderately and nearly equally convex. Antero-dorsal margin long, concave; postero-dorsal margin shorter, slightly convex. Anterior ear of right valve large, with its front margin nearly perpendicular to the hinge-line; posterior ear small, obtusely triangular. Anterior ear of left valve large, triangular, with its outer angle rather larger than a right angle; posterior ear small. Ornamentation of the left valve consists of numerous radial furrows curving outwards, with flat interspaces.*

Affinities.—The right valve resembles that of *Pecten occulte-striatus* Zittel,† from the Senonian of Gosau, but the antero-dorsal margin is relatively longer and slopes less steeply, and the byssal sinus is deeper. It is also similar to a species‡ from the Senonian of Pondoland, but the antero-dorsal margin is concave, and the shell more inequilateral.

Distribution.—*Ostrea* bed of Selwyn River (23); Weka Creek (782); Middle Waipara (762); above Deans' Coal-mine, Malvern Hills; and McKay's Creek, Middle Waipara (149). Selwyn Rapids beds of Selwyn Rapids (589). Amuri Group (calcareous conglomerate), west wing of Amuri Bluff (13); and black grit, east wing of Amuri Bluff (8).

Section ÆQUIPECTEN Fischer.

Pecten (Æquipecten) amuriensis sp. nov. Plate XII, figs. 2–9.

Description.—Right valve ovate, slightly convex, somewhat inequilateral; height and length equal or nearly equal; outline rounded, with the umbonal region pointed. Antero-dorsal margin slightly concave or nearly straight; postero-dorsal margin slightly convex. Ears large; the anterior elongate triangular, with a few radial ribs; byssal sinus deep. Posterior ear obtusely triangular, with radial ribs crossed by regularly spaced concentric linear ribs. Shell apparently nearly smooth, but with faint radial ribs which are stronger near the posterior ear than elsewhere.

Left valve ovate, nearly equilateral, moderately convex. Ears large, triangular, with radiating ribs. Ornamentation consists of numerous narrow strong radial ribs, separated by broad flat or slightly concave interspaces, which are crossed at intervals by fine linear concentric ribs.

Remarks.—Although the two valves described above have not been found united in any case, it seems probable that they belong to the same species, since they occur abundantly in the same beds, and in some cases are found close together on the same block of rock. The surface of the right is not perfectly preserved, so that the exact character of the ornamentation cannot be determined; but on one specimen linear and concentric ribs, like those on the left valve, are seen.

Associated with the specimens just described are several left valves (Plate XII, figs. 10, 11) having the same form, but usually with more numerous radial ribs, which are sometimes alternately large and small; and the fine concentric ribs are not generally visible, but in one specimen they are seen near the umbo. It seems probable that

* Owing to imperfect preservation, the ornamentation is not seen on any of the right valves.
† Die Bivalv. d. Gosaugeb., pt. 2 (1866), p. 33 [109], pl. xvii, fig. 6.
‡ Woods, Ann. S. African Mus., vol. iv (1906), p. 297, pl. xxxv, figs. 12, 13.

this is not more than a variety of *P. amuriensis;* some of the apparent differences may be due to imperfect preservation.

Affinities.—The form of the right valve is similar to that of *P. subaratus* Nilsson,* from the Senonian of Sweden, but the radial ornamentation appears to be much less well developed, and on the left valve of that species the radial ribs are more numerous, and concentric ribs appear to be absent. The ornamentation of the left valve is somewhat similar to that of *P. tesselatus* Hennig,† from the Senonian of Sweden.

Distribution.—Amuri Group (calcareous conglomerate), east and west wings of Amuri Bluff (5, 6, 13); perhaps also black grit, east wing of Amuri Bluff (8).

Genus Lima Bruguière.

Subgenus Limatula Wood.

Lima (Limatula) Huttoni sp. nov. Plate XII, figs. 12–16.

Description.—Shell small, oval, convex, inequilateral, rather oblique. Ventral margin rounded; anterior margin less convex than the posterior. Anterior ear larger then the posterior.

Ornamentation consists of numerous strong radial ribs, which cover all except the anterior part of the valves. The ribs have more or less angular summits, and become smaller on the posterior region. The interspaces are narrow, and often include a small radial rib. Numerous fine concentric ridges cross both ribs and interspaces, and sometimes give the former a serrate or tuberculate character. The anterior part of the valves is ornamented with fine concentric ridges only.

Affinities.—This is more oblique than most of the species of *Limatula;* in this respect it shows some resemblance to *Lima (Limatula) perisimilis* (Stoliczka)‡ and *L. (Limatula) antarctica* Wilckens,§ but is clearly distinguished from both by the character of its ornamentation.

Distribution.—Amuri Group, calcareous conglomerate (*Aporrhais* beds), east and west wings of Amuri Bluff (6, 13).

Genus Inoceramus Sowerby.

Inoceramus australis sp. nov. Plate XII, figs. 17–19; Plate XIII, figs. 1–3.

Description.—Shell more or less ovate in outline, very inequilateral, oblique; height greater than length. Valves moderately convex, sometimes becoming considerably convex during the later stages of growth. Hinge-line forming less than a right angle with the anterior margin, which is nearly straight. Umbones acute, only slightly curved. Anterior marginal part of valves flattened, often nearly perpendicular to the plane of the valves.

Ornamentation consists of concentric ribs with an unsymmetrical curvature; on the anterior part the ribs curve gradually, on the posterior part more rapidly and upwards. In some small specimens all the ribs are small and of equal size, but usually at intervals some of the ribs are stronger than the others; and in large specimens only the stronger ribs are found, and are separated by broad concave interspaces.

Affinities.—This species appears to be allied to some forms of *I. inconstans* Woods, but the angle between the hinge-line and the anterior margin of the valve is smaller, and the posterior ear is not developed. The smaller size of the angle mentioned also distinguishes this species from *I. labiatus* var. *latus* Sow. The obliquity of the

* Hennig, Revis. Lamellibr. Nilsson's "Petrific. Suecana" (1897), p. 46, pl. iii, figs. 16, 17.
† Bihang. Svenska Vet. Akad. Handl., vol. xxiv (1899), p. 10, pl. i, figs. 5, 6.
‡ Cret. Fauna S. India, vol. iii (1871), p. 420, pl. xxix, figs. 4, 5.
§ Annelid., Bivalv. u. Gastrop. d. Antarkt. Kreidiformat. (1910), p. 16, pl. i, fig. 8.

shell is similar to that seen in some Upper Senonian species of *Inoceramus*, such as *I. lobatus* Goldf. and *I. lingua* Goldf.

Distribution.—Amuri Group (calcareous conglomerate), east and west wings of Amuri Bluff (5, 3, 14); black grit, east wing of Amuri Bluff (8).

Inoceramus pacificus sp. nov. Plate XIV, figs. 1, 2.

1877. *Inoceramus multiplicatus* J. Hector, Reports Geol. Explor. 1873–74 (Geol. Surv. N.Z.), p. xii; non *I. multiplicatus* Stol.

1886. *Inoceramus multiplicatus* Hector, Catal. Ind. & Colon. Exhibit. Geol. Exhibits, p. 17.

Remarks.—The shell is convex, and ornamented with numerous regular concentric ribs, which are of nearly uniform size, and have rounded summits. The ribs are separated by broad concave interspaces. Only four imperfect specimens of this species are present in the collection, so that the shape of the shell cannot yet be made out satisfactorily. The species appears to be allied to *I. cycloides* Wegner,* from the Senonian (*granulatus* chalk) of North Germany.

Some of the specimens in the collection bear Hector's label, but he gave no figure or description of the species, and there is nothing to show whether he regarded this as a new species or identified it with *I. multiplicatus* of Stoliczka.

Distribution.—Amuri Group (calcareous conglomerate), east and west wings of Amuri Bluff (13, 14).

Inoceramus sp. Plate XIV, figs. 3, 4.

Another species of *Inoceramus* is represented by a few internal casts, and resembles some forms of the *I. Lamarcki* group. The hinge-line forms approximately a right angle with the anterior margin of the valve. Strong concentric ribs occur at intervals, with small ribs in the interspaces.

Distribution.—Amuri Group (calcareous conglomerate), west wing of Amuri Bluff (14).

Genus Pinna Linnæus.

Pinna sp. Plate XV, fig. 1.

A few specimens of *Pinna*, too imperfect for specific determination, have been found in the *Trigonia* beds (5), east wing of Amuri Bluff; in the Amuri Group of Oäro Creek, Amuri Bluff (14); and in the Selwyn Rapids beds of Selwyn Rapids (589).

Genus Astarte Sowerby.

Subgenus Eriphyla Gabb.

Astarte (Eriphyla) meridiana sp. nov. Plate XV, figs. 2–7.

Description.—Shell with rounded outline, slightly or moderately inequilateral; height usually rather greater than length, but in some cases equal to or somewhat less than the length. Valves usually regularly convex, sometimes with the postero-dorsal part sloping to the margin more rapidly than the anterior part. Antero-dorsal margin concave; postero-dorsal margin moderately convex; the anterior, ventral, and posterior margins more convex, and often forming a regular curve. Umbones relatively high, curved anteriorly. Lunule broad, deep, concave, limited by a sharp edge. Escutcheon very narrow.

Ornamentation consists of numerous, fairly regular, concentric ridges separated by narrow furrows. In many cases some of the ridges and furrows, at intervals, are stronger than the intervening ones.

* Zeitschr. d. deutsch. geol. Gesellsch., vol. lvii (1905), p. 162, pl. vii, fig. 3, text-figs. 5, 6. Compare also Scupin, Palæontographica, Suppl.-band vi (1912–13), p. 212, pl. ix, fig. 14.

Hinge: One strong cardinal tooth in each valve; one lateral tooth next the lunule, and in the right valve another lateral tooth below and extending in front of the lunular tooth. Pallial sinus relatively deep, rounded.

Measurements.—	(1.) Mm.	(2.) Mm.	(3.) Mm.	(4.) Mm.	(5.) Mm.	(6.) Mm.	(7.) Mm.
Length	24	31	32	33	35	35	36
Height	25·5	31	34	35	35	36·5	37

Affinities.—This species differs from *A. (Eriphyla) Forbesiana* Stoliczka* by its less orbicular outline, which is due to the greater slopes of the antero-dorsal and postero-dorsal margins, the more elevated umbonal region, the somewhat greater height of the valves, and the more concave antero-dorsal margin. Also the lunule is larger, the valves more convex, and there are some differences in the ornamentation.

In similar respects this species is distinguished from *A. (Eriphyla) lenticularis* (Goldfuss).

A. (Eriphyla) Forbesiana is found in the Ariyalúr Group of Southern India. For distribution of *A. (Eriphyla) lenticularis* see below.

This is probably the species referred to *Lucina americana* Forbes by Hector.†

Distribution.—Amuri Group (calcareous conglomerate), west wing of Amuri Bluff (13); Belemnite beds (3), *Trigonia* beds (5), and *Aporrhais* beds (6), east wing of Amuri Bluff.

Astarte (Eriphyla) lenticularis (Goldfuss). Plate XV, figs. 9, 10.

The collection contains five examples of this species, which agree closely with specimens found in the Senonian of Aachen (the locality of the type), and with the figures given by various authors.‡

A. (Eriphyla) lenticularis is a widely distributed species; it has been found in the Senonian and Turonian of Europe, in the Trichinopoli Group of Southern India, and in the Senonian of Pondoland and Zululand.

Distribution.—Selwyn Rapids beds of Selwyn Rapids, Malvern Hills (589).

Genus Anthonya Gabb.

Anthonya elongata sp. nov. Plate XV, figs. 11–13; Plate XVI, figs. 1–3.

Description.—Shell extremely inequilateral, greatly elongated, compressed, blade-like, tapering slightly. Anterior margin rounded; dorsal margin nearly straight, and almost parallel to the slightly curved ventral margin. Umbones small, at a short distance from the anterior end of the shell. Postero-dorsal part of the shell flattened, making a faint ridge where it joins the slightly convex ventral part. The latter is ornamented with small growth-ridges, which cut the anterior margin.

Hinge: Three long, more or less oblique, cardinal teeth in the right valve, and two similar teeth in the left valve. Anterior adductor impression below the umbones, deep, with its dorsal margin steeply inclined.

Affinities.—This species is remarkable for the great elongation of the shell. The external characters, the deep anterior adductor impression, and the hinge (so far as it can be made out) are similar to those of the few specimens known of *Anthonya*. In England this genus has not been found above the zone of *Pecten asper*, but the type (*A. cultriformis* Gabb) comes from later beds—the Chico Group of Martinez.

Distribution.—Amuri Group, calcareous conglomerate (*Trigonia* and *Aporrhais* beds), east and west wings of Amuri Bluff (5, 13).

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* Cret. Fauna S. India, vol. iii (1870), p. 181, pl. vi, figs. 14–16.

† Catal. Ind. & Colon. Exhibit., Geol. Exhibits (1886), pp. 16, 64, fig. 28, 8.

‡ For references to figures and descriptions of this species, see Woods, Cret. Fauna of Pondoland (Ann. S. African Mus., vol. iv, 1906), p. 301; Scupin, Die Löwenberger Kreide (Palæontographica, Suppl.-band vi, 1912–13), p. 179.

Genus Lucina Bruguière.

Lucina canterburiensis sp. nov. Plate XVI, figs. 4, 5 *a–c*.

Description.—Shell more or less oval, somewhat pointed dorsally, slightly convex; length rather greater than height, the anterior part rather longer than the posterior part. Antero-dorsal margin long, nearly straight or slightly concave, sloping anteriorly, forming a rounded angle with the slightly convex anterior margin; the latter curves rapidly to join the slightly convex ventral margin. Posterior margin relatively short, slightly curved, forming an obtuse angle with the slightly convex postero-dorsal margin. Postero-dorsal part of valves compressed, limited by a shallow sulcus passing from the umbo to the postero-ventral extremity. Umbones moderately prominent, curved slightly forward. Lunule elongate, narrow.

Ornamentation consists of regular lamellar concentric ribs, separated by broad flat interspaces bearing fine linear ribs. The ribs become sinuous where they cross the sulcus.

Affinities.—This species resembles *Lucina subnummismalis* d'Orbigny,* from the Senonian of Aachen, Faxö, &c., but is distinguished by the greater ventral slope of the antero-dorsal margin, the presence of a sulcus, and the relatively shorter shell. A similar type of ornamentation is seen in *L. Cornueliana* d'Orbigny, *L. plicato-costata* d'Orbigny, *L. Downesi* Woods, and *L. cretacea* (Conrad).

Distribution.—Selwyn Rapids beds of Selwyn River (23) and Selwyn River Rapids (589). *Ostrea* bed (?) of Malvern Hills (754) and MacIlwraith's Coal-mine, Malvern Hills (763). Amuri Group (calcareous conglomerate), west wing of Amuri Bluff (13), and concretionary greensand, east and west wings of Amuri Bluff (10, 13).

Genus Tellina Linnæus.

Tellina sp. *cf.* Largillierti (d'Orbigny). Plate XVI, fig. 6.

Some internal casts, with a portion of the shell imperfectly preserved in one case, closely resemble in form *T. Largillierti* (d'Orbigny)† from the Quiriquina beds, but it is not clear if they show the flattening of the postero-dorsal marginal region seen in that species. An exact determination cannot be made until better specimens have been obtained.

Distribution.—Selwyn Rapids beds of Selwyn Rapids (589).

Tellina sp. Plate XVI, fig. 7.

Some internal casts differ from the above in the smaller ventral slopes of the antero- and postero-dorsal margins, consequently the apical angle is larger. They resemble *T. æqualis* Gabb‡ from the Martinez Group, but are rather more elongate.

Distribution.—Selwyn Rapids beds of Selwyn Rapids (589).

Genus Mactra Linnæus.

Mactra (?) sp. Plate XVI, figs. 8 *a, b*.

A specimen from the Saurian beds, Middle Waipara (761), resembles *Mactra Mœvusi* Coquand§ from the Cenomanian and Senonian of Tunis, but the shell is imperfectly preserved, and the hinge is not exposed, so that definite determination cannot be made.

* Müller, Petrefact. Aachen Kreidef., i (1847), p. 25, pl. ii, fig. 5; Böhm, Grünsand v. Aachen (1885), p. 114; Holzapfel, Palæontographica, xxxv (1889), p. 187, pl. xix, figs. 1–3; Ravn. Mollusk. Danmarks Kridtafl. i, Lamellibr. (1902), p. 61, pl. iv, fig. 21. If Böhm's measurements represent the usual size of the shell, then Holzapfel's figures must be enlarged about twice.

† Voy. Amérique mérid., vol. iii, pt. 4 (1842), p. 128, pl. xv, figs. 9, 10; D'Orbigny, Voy. Pole Sud., Atlas géol. (1847), pl. v, figs. 5, 6; Philippi, Tertiär. u. Quartär. Verstein. Chiles (1887), p. 194, pl. xxxi, fig. 7; Wilckens, Neues Jahrb. für Min., &c., Beil.-bd. xviii (1904), p. 248.

‡ Geol. Surv. California, Palæont., vol. ii (1869), p. 182, pl. xxix, fig. 73.

§ Geol. Pal. S. Constantine (1862), p. 191, pl. vii, figs. 3, 4; pl. viii, figs. 9, 10; Pervinquière, Études Paléont. Tunisienne, vol. ii (1912), p. 281, pl. xx, figs. 18, 19.

Genus Cultellus Schumacher.

Cultellus cretaceus sp. nov. Plate XVI, fig. 9.

Description.—Shell elongate, very inequilateral, convex dorsally, gradually compressed ventrally and posteriorly. Anterior margin rounded; ventral margin nearly parallel to the dorsal margin, curving upwards at the posterior end, which is rounded. Postero-dorsal margin long, nearly straight. Ornamentation consists of concentric growth-ridges.

Remarks.—This species is represented by a single left valve. The specimens from Brazil, referred to this genus by White* (*C. paraensis*), are much more elongated.

Distribution.—Amuri Group (calcareous conglomerate), west wing of Amuri Bluff (13).

Genus Callista Mörch.

Section Callistina Jukes-Browne.

Callista (Callistina) Wilckensi sp. nov. Plate XV, fig. 8; Plate XVI, figs. 10 *a, b*, 11; Plate XVII, figs. 1 *a, b*, 2 *a–d*, 3.

Description.—Shell oval, considerably inequilateral, moderately convex, with the postero-dorsal part sloping rapidly to the margin. Antero-dorsal margin concave. Anterior margin rounded, passing gradually into the uniformly convex ventral margin. Posterior margin rounded or subtruncate, often forming a very obtuse rounded angle with the convex postero-dorsal margin. Umbones broad, close together, with a considerable anterior curvature. Lunule ovate, slightly concave, but raised in the middle, limited by a distinct groove. Escutcheon narrow.

Ornamentation consists of numerous concentric ribs, separated by narrow furrows; on the later part of the shell the ribs often become less distinct, and at intervals more prominent concentric grooves occur.

Hinge: In the left valve one strong, elongate, antero-lateral tooth parallel to the lunular margin; three diverging cardinal teeth, of which the anterior is straight and grooved at the summit, the median is somewhat stouter and curved, the posterior is much elongated, curved, and separate. Pallial sinus rather large, angular, horizontal or slightly ascending.

Affinities.—This species resembles *Callista sculpturata* Stoliczka,† from the Ariyalúr Group of Southern India, but it appears to differ in having a relatively shorter shell and less prominent and less widely separated ribs. Wilckens states that *C. auca* (d'Orbigny),‡ from the Quiriquina beds, is closely allied to *C. sculpturata*. *C. Wilckensi* also resembles *C. auca*, but possesses a rather shorter shell; and the pallial sinus, instead of being rounded as in Wilckens's§ figure of *C. auca*, is angular. Another similar form is that identified by Whiteaves|| as *Cytherea (Callista) laciniata* Stoliczka, and found in Hornby Island and Sucia Islands.

Remarks.—This species is abundant in the Amuri Group, and shows some variation in the relative length and height of the shell, and in the position of the umbo. Some of the specimens were examined by the late Mr. Jukes-Browne, who agreed with me in placing the species in the section or subgenus *Callistina*.

Distribution.—Amuri Group (calcareous conglomerate): *Trigonia* beds, east wing of Amuri Bluff (5); *Trigonia* and *Aporrhais* beds, west wing of Amuri Bluff (13).

* Archiv. Mus. Nac. Rio de Janeiro, vol. vii (1887), p. 112, pl. viii, figs. 1, 2.
† Cret. Fauna S. India, vol. iii (1870), p. 173, pl. vii, figs. 7–9.
‡ For references see Wilckens, Neues Jahrb. für Min., &c., Beil.-band xviii (1904), p. 243.
§ *Ibid.*, pl. xix, fig. 14.
|| Mesoz. Foss. (Geol. Surv. Canada), vol. i (1879), p. 148, pl. xvii, fig. 13; pl. xix, fig. 4.

Callista (Callistina) Thomsoni sp. nov. Plate XVII, figs. 4, 5 *a, b*, 6.

Description.—Shell large, more or less oval, subangular posteriorly, moderately inequilateral, convex; postero-dorsal part sloping rapidly to the margin. Antero-dorsal margin concave. Anterior margin rounded, passing gradually into the moderately convex ventral margin, which forms a rounded angle with the short oblique slightly convex posterior margin. Postero-dorsal margin long, convex, with a large ventral slope. Umbones rather large, curved forward. Lunule ovate, depressed, limited by a linear furrow. Escutcheon narrow, deep, limited by a ridge.

Ornamentation consists of strong concentric ribs.

Affinities.—This species resembles in form *C. (Callistina) Wilckensi* described above, but is much larger, the slope of the antero-dorsal margin is less rapid, and the concentric ribs are stronger. It is also similar to some forms of *C. sculpturata* Stoliczka, but is larger, and the postero-dorsal margin is more strongly curved. The concentric ribs appear to be stronger, but the surface of the shell is not well preserved. The hinge is not shown in any specimen, but the form of the shell closely resembles that of *Callistina*.

Distribution.—Selwyn Rapids beds of Selwyn Rapids (589).

Callista sp. Plate XVII, fig. 7.

This species is represented by an imperfect left valve and the posterior portion of a right valve. It is ornamented with strong sharp angular ribs, separated by relatively broad furrows in which smaller ribs are sometimes seen. The anterior curvature of the umbones is smaller than in *C. (Callistina) Thomsoni* described above. The hinge is not shown.

Distribution.—Selwyn Rapids beds of Selwyn River (589).

Genus Dosinia Scopoli.

Dosinia sp. Plate XVIII, fig. 1.

The collection contains four imperfect valves of *Dosinia*, which in form resembles Peron's figure of *D. cataleptica* (Coquand)* from the Turonian of Tunis. The ornamentation consists of numerous concentric ribs separated by narrow furrows, and appears to be similar to that of *D. cataleptica;* at intervals some of the ribs are slightly stronger than the others. Pervinquière† considers that *D. cataleptica* is a synonym of *D. inelegans* (Sharpe)‡ from the Turonian of Portugal, and that *D. brasiliensis* White,§ from the Turonian of Brazil, also belongs to this species.

Without more material I am unable to identify definitely the New Zealand species.

Distribution.—Selwyn Rapids beds of Selwyn River Rapids (589).

Dosinia sp. Plate XVIII, fig. 2.

A specimen from the same locality (589) and another from MacIlwraith's Coal-mine, Malvern Hills (763, probably *Ostrea* bed), differ from the last species in having a relatively higher shell and more convex valves: they appear to belong to a distinct species.

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* Peron, Descipt. Moll. Foss. Terr. Crét. Tunisie (1890), p. 311, pl. xxix, figs. 15, 16.

† Etudes Paléont. Tunisienne, vol. ii (1912), p. 271.

‡ Quart. Journ. Geol. Soc., vol. vi (1850), p. 177, pl. xx, fig. 3.

§ Archiv. Mus. Nac. R. de Janeiro, vol. vii (1887), p. 97, pl. viii, figs. 13, 14.

Genus Cardium Linnæus.

Cardium sp. Plate XVIII, figs. 3 *a, b*.

An internal cast of a left valve from the *Trigonia* beds of the west wing of Amuri Bluff shows radial ribs, which are prolonged at the posterior margin; it seems probable that it belongs to the same group of species as *C. acuticostatum* d'Orbigny,* from the Quiriquina beds.

Cardium sp. Plate XVIII, figs. 4, 5.

There are several specimens of a small form of *Cardium*, but all are either internal casts or have only a thin layer of shell preserved, so that specific determination cannot yet be made. The internal casts show radial rows of what appear to be tubercles (fig. 4), but in specimens in which some of the inner layers of the shell are preserved (fig. 5) the rows of "tubercles" seem to alternate with ribs, and are separated by transverse bars. At present it is not possible to make out the real character of the ornamentation, but there seems no doubt that radial ribs were present. The inner margins of the valves are coarsely toothed.

Distribution.—Selwyn Rapids beds of Selwyn River (23) and Selwyn Rapids (589).†

Genus Panopea Ménard de la Groye.

Panopea clausa Wilckens. Plate XVIII, figs. 6 *a–c*, 7.

1910. *Panopea? (Pleuromya?) clausa* O. Wilckens, Die Annelid. Bivalv. u. Gastrop. d. Antarkt. Kreideformat., p. 68, pl. iii, fig. 10.

Internal casts of *Panopea*, sometimes with small portions of the shell preserved, are common in the Amuri Group, and agree closely with *P. clausa*, which, as pointed out by Wilckens, resembles greatly the European *P. gurgitis* var. *plicata* Sow.

Distribution.—Amuri Group, calcareous conglomerate (Belemnite, *Trigonia*, and *Aporrhais* beds), east and west wings of Amuri Bluff (3, 5, 6, 13).

Panopea malvernensis sp. nov. Plate XVIII, figs. 8 *a, b*, 9; Plate XIX, figs. 1 *a, b*, 2.

Description.—Shell elongate-oval, slightly or moderately inequilateral, convex, with compressed flanks; depressed in front of and behind the umbones. Anterior margin very convex, rounded, passing gradually into the nearly straight ventral margin. Posterior margin subtruncate, rounded. Postero-dorsal margin with a small posterior slope. Umbones broad, incurved. Posterior gape small. Surface of shell with inconspicuous growth-ridges.

Affinities.—This species shows some resemblance to *P. simplex* Hupé,‡ from the Quiriquina beds, but the umbones are broader and the concentric ridges less distinct. It may also be compared with *P. nagorzanyensis* Favre,§ from the Senonian of Galicia.

Remarks.—The specimens are fairly numerous, and several have considerable portions of the shell preserved, but in most cases the form of the shell has been altered by pressure.

Distribution.—Selwyn Rapid beds of Selwyn River (23) and Selwyn Rapids (589). *Ostrea* beds, swamp south of Selwyn River, Malvern Hills (469).

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* Voy. Amérique mérid., vol. iii (1842), p. 120, pl. xii, figs. 19–21; Wilckens, Neues Jahrb. für Min., &c., Beil.-band xviii (1904), p. 231.

† A *Cardium* of larger size, but with somewhat similar ornamentation, occurs in the Saurian beds of Middle Waipara.

‡ Gay's Hist. Chile, vol. viii (1854), p. 374, pl. vi, fig. 7; Philippi, Tertiär. u. Quartär. Verstein. Chiles (1887), p. 166, pl. xxxiv, fig. 4; Wilckens, Neues Jahrb. für Min., &c., Beil.-band xviii (1904), p. 263, pl. xx, fig. 10.

§ Mollusques Foss. Craie de Lemberg (1869), p. 104, pl. xi, fig. 9.

Genus Thracia Leach.

Thracia Haasti sp. nov. Plate XIX, figs. 3*a–c*.

Description.—Shell sub-elliptical, moderately convex, nearly equilateral, slightly inequivalve. Height equal to about three-fifths of the length. Anterior margin very convex, rounded, passing gradually into the regularly convex ventral margin. Posterior margin truncated, nearly straight and perpendicular. Postero-dorsal margin concave. Umbones broad, curved slightly backwards. A carina passes in a curve from the umbo to the postero-ventral angle, and is at first sharp, but becomes rounded posteriorly. Surface of shell ornamented with growth-rings.

Affinities.—This species shows some resemblance to *Thracia subtruncata* Meek,* from Nanaimo (Vancouver Island) and the Sucia Islands, but the ventral margin is more convex and the umbones more anterior. It is also similar to *Periplomya truncata* Whitfield,† from the Raritan Formation of New Jersey, but the valves are less convex, the carina is not so sharp, and the posterior part of the shell is relatively longer.

Distribution.—Amuri Group (calcareous conglomerate), west wing of Amuri Bluff (13).

Thracia sp. Plate XIX, figs. 4 *a*, *b*.

A large species of *Thracia* is represented by three imperfect right valves. It shows some resemblance to *T. semiplanata* Whiteaves,‡ but without more material a satisfactory comparison cannot be made. The great convexity of the specimen figured is due partly to dorso-ventral crushing.

Distribution.—Saurian beds, Middle Waipara (761).

CEPHALOPODA.

Genus Kossmaticeras de Grossouvre, 1901.

Subgenus Madrasites Kilian and Reboul, 1909.

Kossmaticeras (Madrasites) haumuriensis (Hector). Plate XIX, figs. 5 *a–c*; Plate XX, fig. 1.

1886. *Ammonites haumuriensis* J. Hector, Catal. Indian and Colon. Exhibit., N.Z. Court, Geol. Exhibits, p. 58, fig. 20, 7.

Remarks.—Two incomplete specimens, which were named by Hector, are in the collection, but the type has not been found. These specimens resemble *K. (Madrasites) Bhavani* (Stoliczka),§ but the umbilicus is relatively smaller and the whorls rather less compressed. So far as can be made out from these specimens, umbilical tubercles were either absent or indistinct. The suture resembles that of *K. (Madrasites) Bhavani* as figured by Kossmat.

K. (Madrasites) Bhavani occurs in the Trichinopoli and Ariyalúr Groups of Southern India. Varieties of this species from the Senonian of Seymour Island have been described by Kilian and Reboul,‖ and an allied form is figured by Whiteaves¶ from the Senonian of the Queen Charlotte Islands.

Distribution.—Amuri Group (calcareous conglomerate), east wing of Amuri Bluff (2).

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* Bull. Geol. and Geogr. Surv. Territ., vol. ii (1876), p. 363, pl. ii, fig. 4; Whiteaves, Mesoz. Foss. (Geol. Surv. Canada), vol. i (1879), p. 140, pl. xvii, fig. 7.

† Brach. and Lamellibr. Raritan Clays and Greensand Marls, New Jersey (Mon. U.S. Geol. Surv., ix, 1885), p. 220, pl. xxviii, figs. 20, 21.

‡ Mesoz. Foss. (Geol. Surv. Canada, vol. i, 1884), p. 221, pl. xxix, fig. 5.

§ Cephalop. Cret. Rocks, S. India, vol. i (1865), p. 138, pl. lxix, figs. 4–7; Kossmat. Südindische Kreideformat. (Beitr. z. Paläont. u. Geol. Österr.-Ungarns u.d. Orients, xi, 1897), p. 38, pl. viii, figs. 5, 6.

‖ Les Céphalop. Néocrét. des Îles Seymour et Snow Hill (Schwedisch. Südpol.-Expedit. 1901–3, band iii, lief. 6, 1909), pp. 29, 30.

¶ Mesoz. Foss. vol. i (Geol. Surv. Canada, 1884), p. 208, pl. xxiv, fig. 1.

Genus Gaudryceras Grossouvre.

Gaudryceras sp. aff. Jukesi (Whiteaves). Plate XX, fig. 2.

Remarks.—A specimen, consisting of portions of three whorls only, resembles closely a form from the Senonian of the Vancouver Island region figured by Whiteaves,* and identified by him with *Ammonites Jukesi* Sharpe,† from the hard chalk (zone of *Belemnitella mucronata*) of County Londonderry, Ireland. The type of that species is in the Museum of Practical Geology, London; it consists of parts of three imperfectly preserved whorls, and possesses more numerous ribs than the form figured by Whiteaves.

The form found in the Vancouver Island region has been identified by Kossmat,‡ by Kilian and Reboul,§ and by Pervinquière|| with *G. Kayei* (Forbes), which is found in the Valudayúr beds of Pondichéry, and has also been recorded from Tunis, Pondoland, Snow Hill Island (Graham Land), Quiriquina, &c.

Ammonites Jukesi Sharpe is doubtfully identified by Kilian and Reboul with *Gaudryceras varagurense* Kossmat,¶ from the Upper Trichinopoli Group of Southern India; this species, however, seems to be distinguished from *Am. Jukesi* by its more numerous ribs, which are more distinctly curved and sickle-shaped. A specimen from the Senonian of Seymour Island is identified by Kilian and Reboul as *G. varagurense.*

Distribution.—Amuri Group (calcareous conglomerate), *Trigonia* beds, east wing of Amuri Bluff (5).

Genus Hamites Parkinson.

Hamites (Anisoceras ?) sp. Plate XX, figs. 3 *a–c*, 4.

This species is represented by two fragments, which perhaps belong to the same individual. The shell is slightly oval in section. It is ornamented with many small ribs, which become weaker on the internal margin. On the straight part of the shell the ribs are transverse, but on the hooked part they become somewhat oblique. Each rib bears two tubercles, which are placed symmetrically on either side of the external margin. Between the tubercles the shell is somewhat flattened. The suture is not seen.

In the character of the tubercles this species resembles *Hamites interruptus* Schlüter,** *H. Wernickei* Wollemann,†† and *H. Carolinus* d'Orbigny,‡‡ from the Senonian, but does not closely agree with them in other respects. The ribbing, except for the presence of tubercles, is similar to that of some forms of *H. (Anisoceras) indicum* Forbes,§§ from the Valudayúr Group of Southern India.

Distribution.—Amuri Group (calcareous conglomerate), east wing of Amuri Bluff (2).

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* Trans. Roy. Soc. Canada, ser. 2, vol. i (1895), p. 129, pl. ii, figs. 1, 2; Mesoz. Foss., vol. i (Geol. Surv. Canada, 1879), p. 111, pl. xiii, fig. 3.

† Mollusca Chalk of England, Cephalop. (1855), p. 53, pl. xxiii, fig. 11.

‡ Südindische Kreideformat. (Beitr. z. Paläont. u. Geol. Österr.-Ungarns u.d. Orients, ix, 1895), p. 124.

§ Les Céphalop. néocrét. des Îles Seymour et Snow Hill (Schwedisch. Südpol.-Expedit., 1901–3), band iii, lief. 6 (1909), p. 12.

|| Études Paléont. Tunisienne, i, Cephalop. (1907), p. 69.

¶ Kossmat. *op. cit.*, p. 122, pl. xvii, fig. 9; pl. xviii, fig. 2.

** Palæontographica, vol. xxi (1872), p. 105, pl. xxxii, figs. 8, 9.

†† Fauna d. Lüneburger Kreide (1902), p. 95, pl. iv, figs. 4, 5; Pervinquière, Études Paléont. Tunisienne, i, Céph. (1907), p. 86, pl. iii, fig. 33.

‡‡ Hébert, Mém. Soc. géol. de France, ser. 2, vol. v (1855), p. 371, pl. xxix, fig. 5.

§§ For references to figures see Kossmat, Südindische Kreideformat. (Beitr. z. Paläont. u. Geol. Österr.-Ungarns u.d. Orients, bd. ix, 1895), p. 145, pl. xix, fig. 4.

Genus Baculites Lamarck.

Baculites sp. *cf.* **vagina** Forbes. Plate XX, figs. 5 *a–d*.

1886. *Baculites anceps* Hector, Indian and Colon. Exhibit., N.Z. Court Cat. Geol. Exhibits, p. 64. fig. 28, 6.

An imperfectly preserved specimen, which was referred to *B. anceps* Lam. by Hector, is probably an example of *B. vagina* Forbes. At the smaller end of the specimen the section is oval; at the larger end it is ovate, with the siphonal margin sharp but apparently not carinate.* *B. vagina* is found in the Ariyalúr Group of Southern India and in the Quiriquina beds of Chile,† and a closely allied species occurs in California and the Vancouver Island region.

Distribution.—Amuri Group, calcareous conglomerate (*Aporrhais* beds), of Amuri Bluff.

Belemnites.

Belemnites Lindsayi Hector. Plate XX, figs. 6–11.

1874. *Belemnitella Lindsayi* J. Hector, Trans. & Proc. N.Z. Inst. (1873), p. 356.
1877. *Belemnites Lindsayi* Hector, Rep. Geol. Explor. 1873–74 (Geol. Surv. N.Z.), p. xii.
1878. ,, *australis* Hector, Trans. & Proc. N.Z. Inst., vol. x. (1877), p. 487, pl. xxiii.
1886. *Belemnites australis* Hector, Catal. Indian and Colon. Exhibit., N.Z. Court, Geol. Exhibits, p. 64, fig. 28, 1–3.

This species belongs to a group of *Belemnites* found in Southern India, Australia, and New Zealand, the principal species being *B. seclusus* Blanford,‡ from the Lower Utatúr Group of Southern India; *B. superstes* Hector, from Coverham (p. 12); *B. australis* Phillips,§ *B. Canhami* Tate||, *B. oxys* Tenison-Woods,¶ and *B. Kleini* Gürich,** from the Cretaceous of Queensland and New South Wales. It is difficult to compare *B. Lindsayi* satisfactorily with the Indian and Australian species without seeing specimens. *B. Lindsayi* is larger than *B. seclusus*, the lateral furrows are relatively longer and not so near the ventral margin, and the dorsal furrow appears to be absent. *B. Lindsayi* differs from *B. superstes* (p. 12) in the less elongate guard, in the form of the alveolar part which is somewhat compressed laterally, and in the lateral furrows, which are farther from the dorsal surface, usually curved, and not so long.

The name *B. Lindsayi* was given to this species by Hector in 1874 and 1877, but in his description of 1878 it was identified with *B. australis* Phillips: this identification, however, is not accepted by Etheridge, with whom I am inclined to agree. The name *B. Lindsayi* was first given to specimens from the concretionary greensand of Amuri Bluff (1874) and from the black grit (1877). The specimens from these horizons were not described or figured, and consequently the examples found in the

* The specimen may be compared with some of the examples figured by Stoliczka, Foss. Ceph. S. India (1866), pl. xci, figs. 1, 2; also Kossmat, Südindisch. Kreideformat. (1895), p. 155, pl. xix, figs. 13, 14.

† Steinmann, Neues Jahrb. für Min., &c., Beil.-bd. x (1895), p. 89, pl. vi, fig. 4, text-figs. 8–10; Wilckens, *ibid.*, xviii (1904), p. 188.

‡ Blanford and Stoliczka, Ceph. Cret. S. India (Palæont. India, 1861, 1866), pp. 4, 202, pl. i, figs. 43–51; pl. ii, fig. 8. E. Spengler, Beitr. z. Paläont. u. Geol. Österr.-Ungarns u.d. Orients, vol. xxiii (1910), p. 153, pl. xiv, fig. 7.

§ Quart. Journ. Geol. Soc., vol. xxvi (1870), p. 258, pl. xvi, figs. 1, 2; Jack and Etheridge, Geol. and Palæont. Queensland and New Guinea (1892), p. 487, pl. xxxv, figs. 1, 2.

|| Phillips, *ibid.*, pl. xvi, figs. 3, 4; Tate, Proc. R. Soc. S. Australia, 1879–80 (1880), p. 104, pl. iv, fig. 2; Jack and Etheridge, *op. cit.* (1892), p. 490, pl. xxxv, figs. 3, 4, 7–9, 12–14; Etheridge, Cret. Invert. Fauna N.S.W. (1902), p. 45, pl. viii, figs. 8, 9, pl. ix, fig. 2.

¶ Proc. Linn. Soc. N.S.W., vol. viii (1883), p. 237, pl. xiii, figs. 1–3; Etheridge, Cret. Invert. Fauna N.S.W. (1902), p. 48.

** Neues Jahrb. für Min., &c., Beil.-bd. xiv (1901), p. 489, pl. xix, figs. 2, 3; Etheridge, Cret. Invert. Fauna N.S.W. (1902), p. 47.

calcareous conglomerate which were figured and described in 1878 must be taken as the types.

It is probable that the group of species to which *B. Lindsayi* belongs should be regarded as a special section of *Belemnites;* for although, as pointed out by Spengler in the case of *B. seclusus,* it shows some resemblance to *Duvalia,* yet it is clearly distinguished from that section. It may also be pointed out that the alveolar end of the guard is somewhat foliaceous, as in *Actinocamax,* and that similar lateral grooves, but much less distinct, can be traced in some species of *Actinocamax.* On the other hand, the alveolus is deeper than in *Actinocamax,* and the slit in the alveolar end of the guard appears to be absent. In *B. Lindsayi* and *B. superstes,* and probably in other species of this group, the alveolar end of the guard is thicker on the ventral than on the dorsal side.

Distribution.—Amuri Group (calcareous conglomerate) of Amuri Bluff. Perhaps also black grit and concretionary greensand.

INDEXES.

INDEX TO GENERA AND SPECIES.

(The synonyms are in italics.)

K.

L.

M.

N.

O.

P.

S.

T.

GENERAL INDEX.

(Includes all New Zealand localities, and the more important foreign localities mentioned in the text.)

L.

M.

N.

O.

P.

Q.

R.

S.

T.

U.

V.

W.

Z.

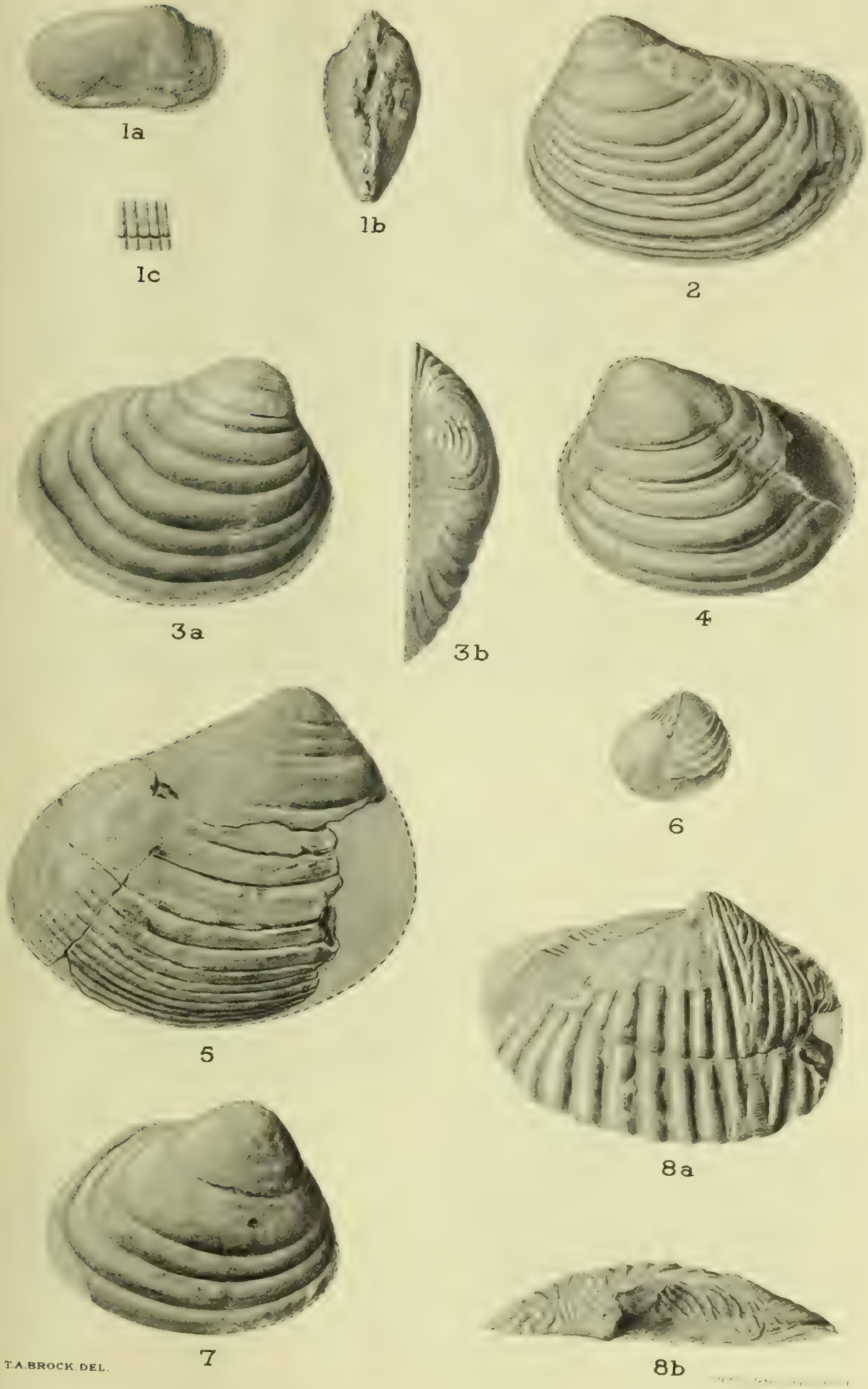
PLATE I.

(The figures are of natural size, unless the amount of enlargement is stated.)

Fig. 1. *Arca (Barbatia)* sp. Dark volcanic sandstone, Gladstone and Middlehurst Runs. *b*, dorsal view of *a*; *c*, ornamentation near middle of left valve, × 4. (Page 5.)

Figs. 2–7. *Trigonia meridiana* sp. nov. 2–6, Gladstone and Middlehurst Runs; 7, conglomerate, Seymour River; 3*b*, dorsal view of 3*a*; 6, part near the umbo, × 2. (Page 6.)

Fig. 8. *Trigonia glyptica* sp. nov. *b*, dorsal view of *a*. Conglomerate, Seymour River. (Page 6.)



Cretaceous Fossils.

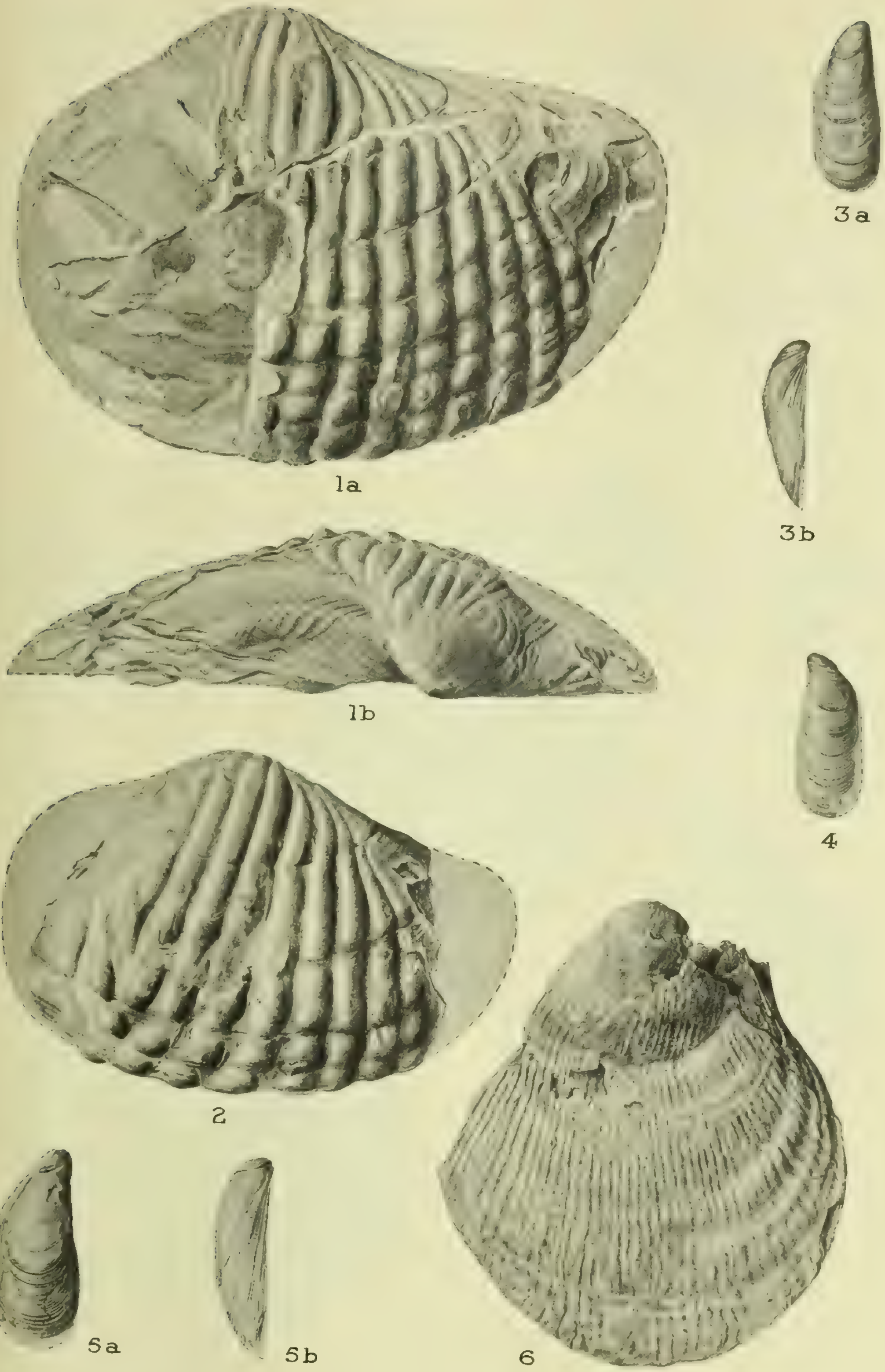
PLATE II.

(The figures are of natural size, unless the amount of enlargement is stated.)

Figs. 1, 2. *Trigonia glyptica* sp. nov. Conglomerate, Seymour River. 1*b*, dorsal view of 1*a*. (Page 6.)

Figs. 3–5. "*Modiola*" *kaikourensis* sp. nov. 3, 4, sandstone, Bluff River; 5, sandstone above lake, near Cherwell Downs; 3*b*, 5*b*, antero-ventral views of 3*a*, 5*a*. (Page 8.)

Fig. 6. *Spondylus* sp. Dark volcanic sandstone, Gladstone and Middlehurst Runs. (Page 8.)



T. A. BROCK, DEL.

Cretaceous Fossils.

PLATE III.

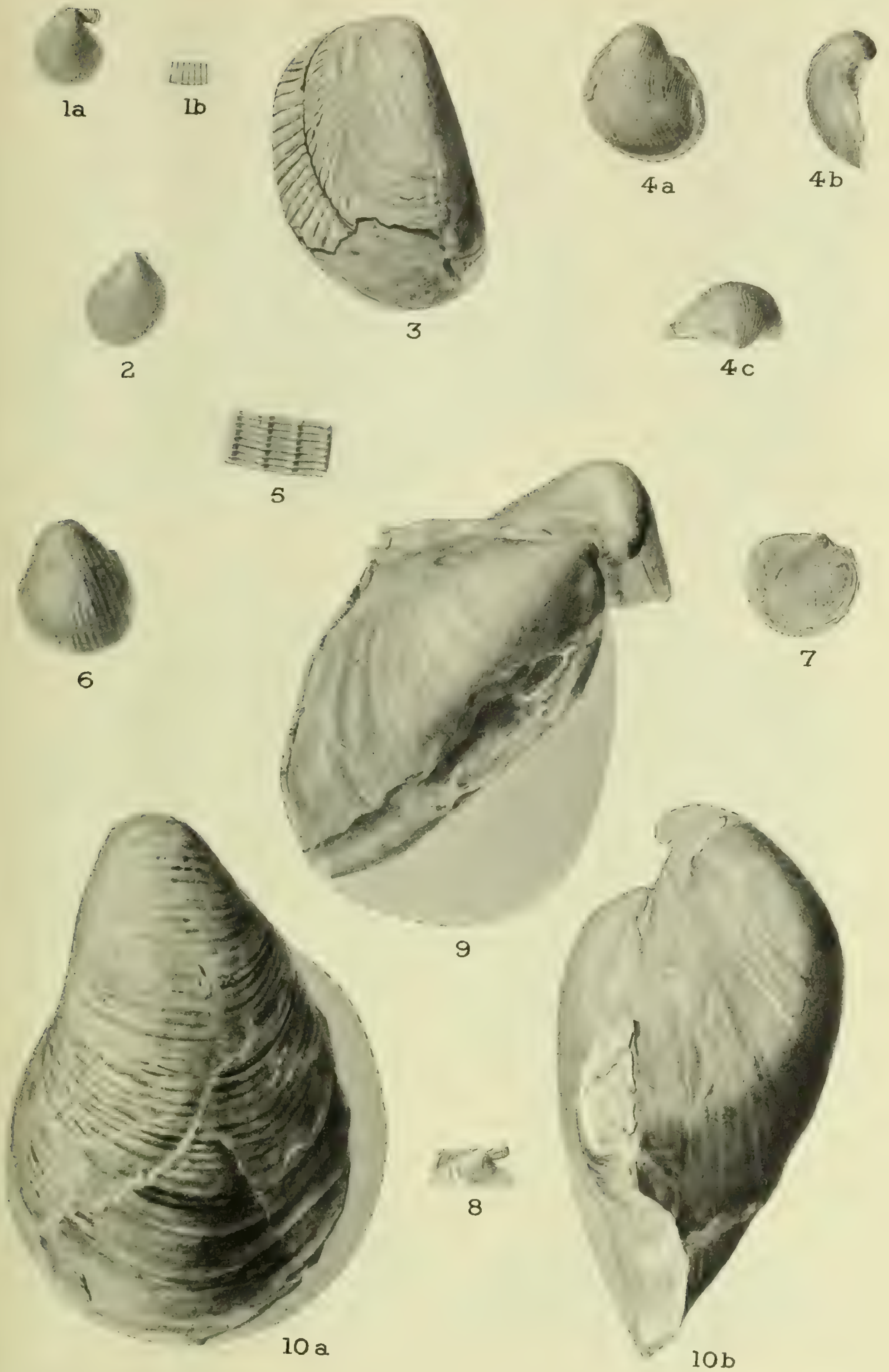
(The figures are of natural size, unless the amount of enlargement is stated.)

Figs. 1, 2. *Pecten (Camptonectes)* sp. Dark volcanic sandstone, Gladstone and Middlehurst Runs. 1*b*, portion near ventral margin of 1*a*, × 6. (Page 8.)

Fig. 3. *Lima marlburiensis* sp. nov. Dark volcanic sandstone, Gladstone and Middlehurst Runs. (Page 8.)

Figs. 4–8. *Aucellina euglypha* sp. nov. 4–7, Sawpit Gully mudstones, Swale River; 8, Wharf mudstones, Wharf River; 4*b*, *c*, posterior and dorsal views of 4*a*; 5, ornamentation of left valve, × 9; 6, left valve, × 1½; 7, right valve, × 1½; 8, dorsal part of right valve, × 2. (Page 9.)

Figs. 9, 10. *Inoceramus concentricus* Park. Cover Creek mudstones, Cover Creek. 10*b*, anterior view of 10*a*. (Page 9.)



T.A.BROCK DEL

Cretaceous Fossils.

PLATE IV.

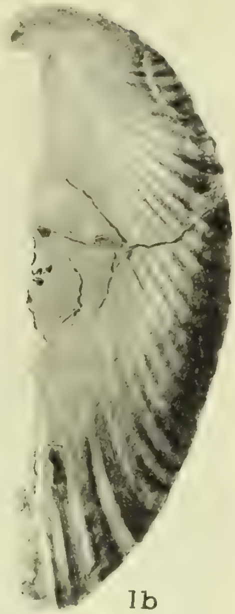
(The figures are of natural size, unless the amount of enlargement is stated.)

Figs. 1, 2. *Inoceramus concentricus* var. *porrectus* var. nov. Sawpit Gully mudstones, Sawpit Gully. 1, from 150 ft. below flint-beds; 2, from 30 ft. below flint-beds; 1*b*, anterior view of 1*a*. (Page 10.)

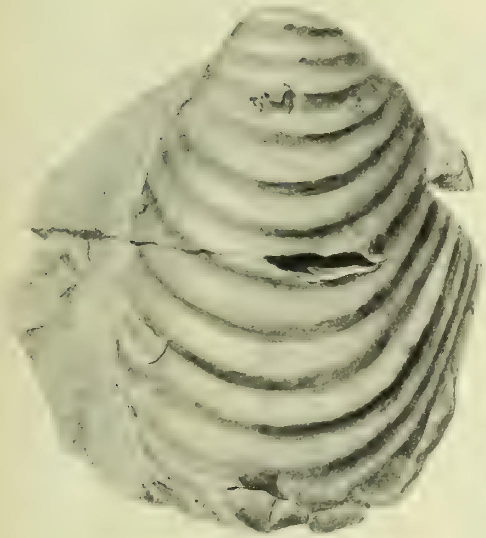
Fig. 3. *I. concentricus* var. *porrectus?* Dark volcanic sandstone, Gladstone and Middlehurst Runs. (Page 10.)

Fig. 4. *Panopea awaterensis* sp. nov. Dark volcanic sandstone, Gladstone and Middlehurst Runs; 4*b*, dorsal view of 4*a*. (Page 10.)

1a



1b



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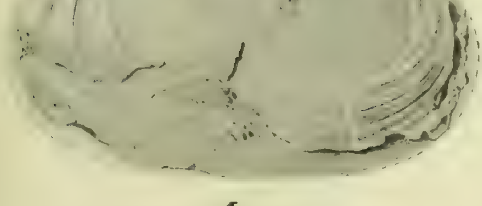

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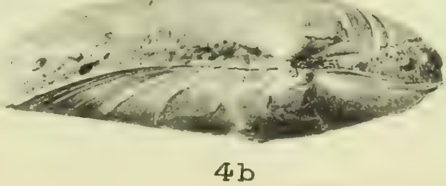

4b

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Cretaceous Fossils.

PLATE V.

(The figures are of natural size, unless the amount of enlargement is stated.)

Fig. 1. *Thracia* sp. Light sandstone, Bluff River. (Page 11.)

Figs. 2, 3. *Turrilites circumtaeniatus* Kossmat. Cover Creek mudstones, a quarter of a mile above Coverham station. 2*b*, base of 2*a*. (Page 11.)

Fig. 4. *Gaudryceras Sacya* (Forb.). Sawpit Gully mudstones, Sawpit Gully. 4*b*, the central part of 4*a*, × 2. (Page 11.)

Figs. 5–7. *Belemnites superstes* Hector. Wharf mudstones, left bank of Wharf, half a mile below pack-track. 5 *a*, *b*, ventral and lateral views; 5*c*, alveolar end (margin incomplete); 6 *a*, *b*, *c*, ventral, dorsal, and lateral views; 7*a*, *b*, ventral and lateral views. (Page 12.)

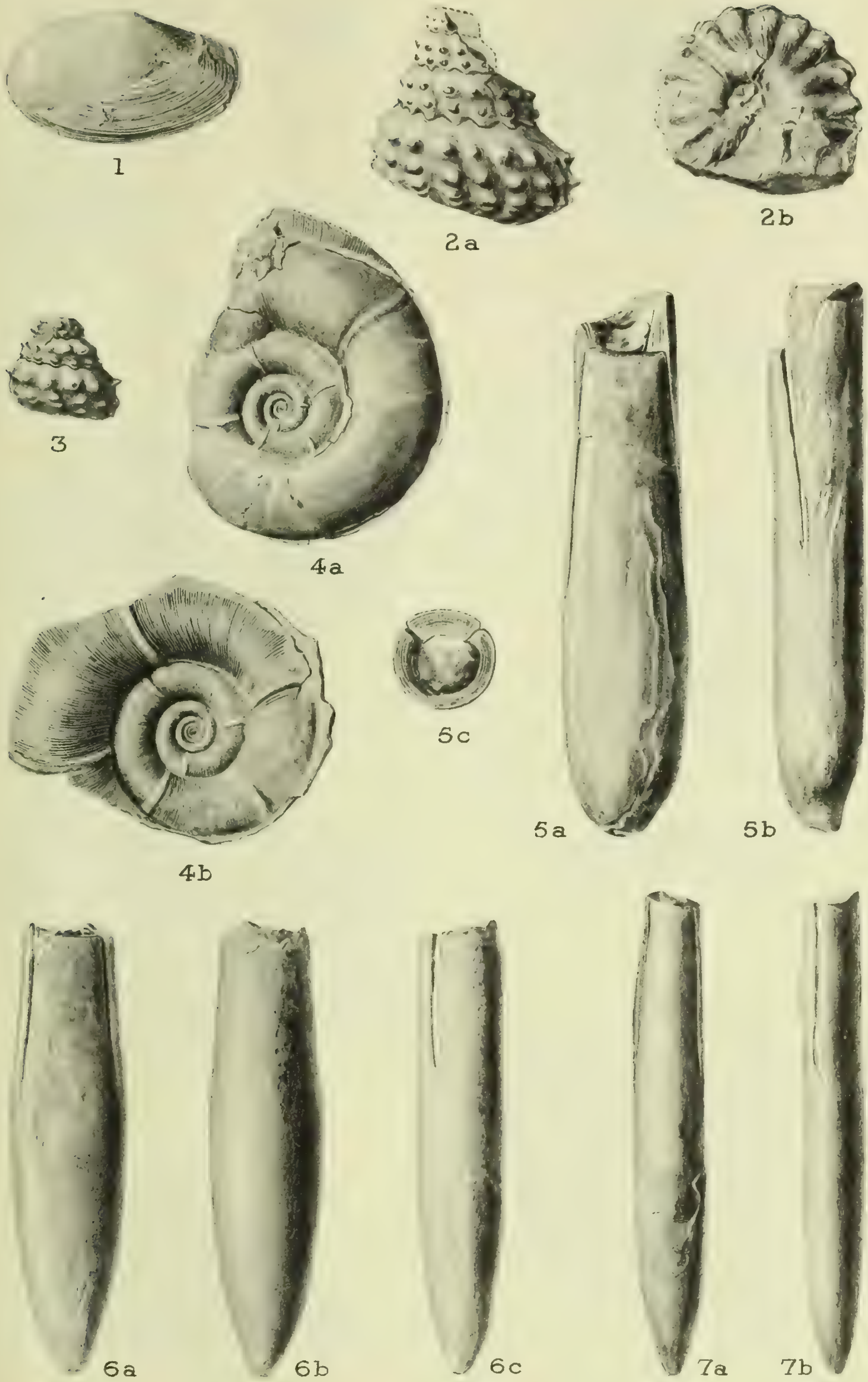

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PLATE VI.

(The figures are of natural size, unless the amount of enlargement is stated.)

Fig. 1. *Nuculana amuriensis* sp. nov. Calcareous conglomerate (*Aporrhais* beds), Amuri Bluff; × 1½. (Page 18.)

Fig. 2. *Nuculana* sp. Calcareous conglomerate, Amuri Bluff. (Page 18.)

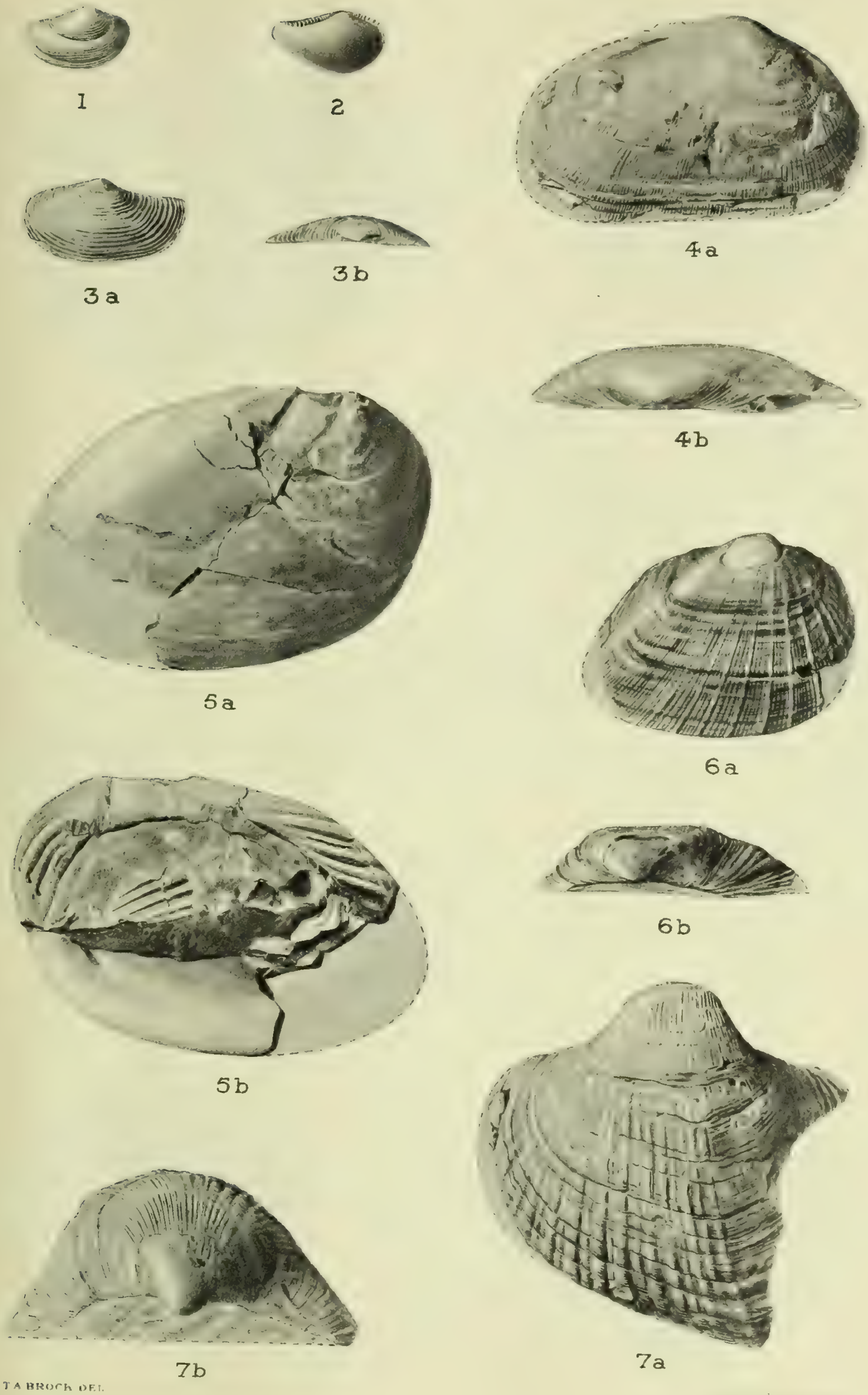
Fig. 3. *Malletia (Neilo) cymbula* sp. nov. Saurian beds, Middle Waipara. **3*b***, dorsal view of 3*a*. (Page 18.)

Fig. 4. *Barbatia Mackayi* sp. nov. Calcareous conglomerate, Amuri Bluff. **4*b***, dorsal view of 4*a*. (Page 19.)

Fig. 5. *Nemodon?* sp. *Ostrea* bed, McKay's Creek, Middle Waipara. Umbonal part missing. 5*b*, hinge and interior of 5*a*. (Page 19.)

Fig. 6. "*Arca*" *Hectori* sp. nov. *Ostrea* bed, Boby's Creek, Waipara. 6*b*, dorsal view of 6*a*. (Page 19.)

Fig. 7. *Cucullæa zealandica* sp. nov. Calcareous conglomerate, Amuri Bluff; **7*b***, dorsal view of 7*a*. (Page 20.)



Cretaceous Fossils.

PLATE VII.

(The figures are of natural size, unless the amount of enlargement is stated.)

Fig. 1. *Cucullæa zealandica* sp. nov. Calcareous conglomerate, Amuri Bluff. Internal cast of right valve. (Page 20.)

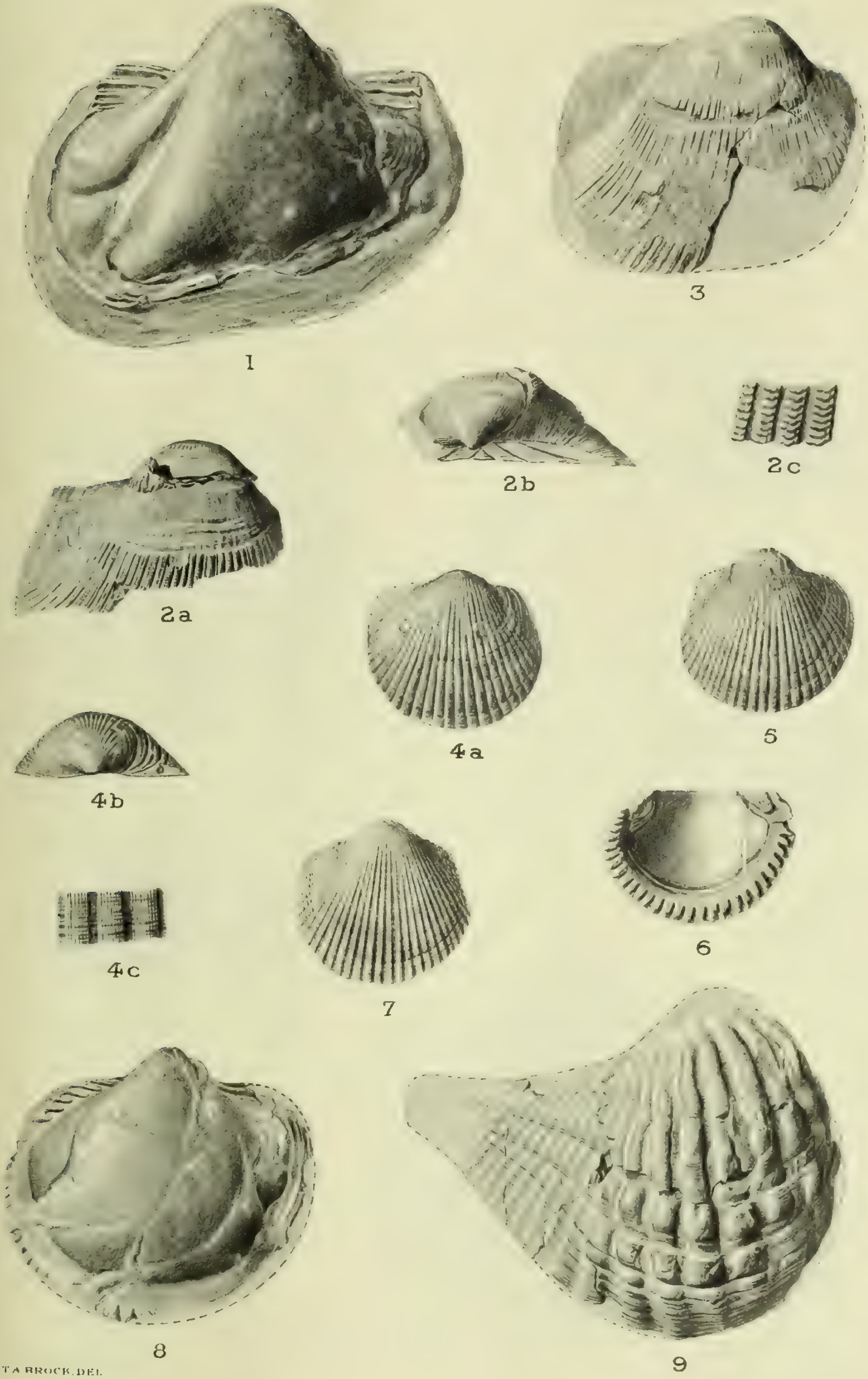
Figs. 2, 3. *Cucullæa* sp. Calcareous conglomerate, Amuri Bluff. 2*b*, dorsal view of 2*a*; 2*c*, ornamentation of 2*a*, × 3. (Page 20.)

Figs. 4–7. *Pectunculus selwynensis* sp. nov. Selwyn Rapids beds, Selwyn River Rapids. 4*b*, dorsal view of 4*a*; 4*c*, ornamentation of 4*a*, × 5; 6, interior of part of a left valve. (Page 20.)

Fig. 8. *Pectunculus* sp. Calcareous conglomerate, Amuri Bluff. Internal cast. (Page 20.)

Fig. 9. *Trigonia pseudocaudata* Hector. Calcareous conglomerate, Amuri Bluff. (Page 21.)

PL. VII



Cretaceous Fossils.

PLATE VIII.

(The figures are of natural size, unless the amount of enlargement is stated).

Figs. 1–5. *Trigonia pseudocundata* Hector. Calcareous conglomerate, Amuri Bluff. 2 *b*, *c*, dorsal and anterior views of 2*a*; 3*b*, anterior view of 3*a*; 5, anterior view of part of two united valves. (Page 21.)

Fig. 6. *Trigonia Hanetiana* d'Orb. Calcareous conglomerate, Amuri Bluff. (Page 22.)

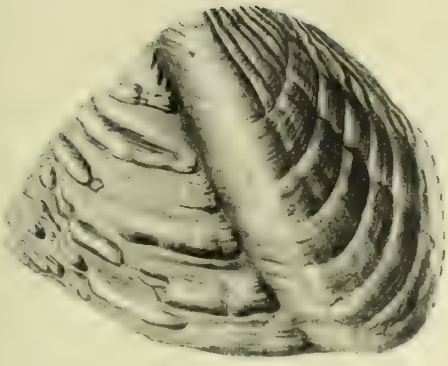
Cretaceous Fossils.

PLATE IX.

(The figures are of natural size, unless the amount of enlargement is stated.)

Figs. 1–6. *Trigonia Hanetiana* d'Orb. 1–5, calcareous conglomerate, Amuri Bluff; 1, 2, drawn from wax moulds of external casts; 6, *Ostrea* bed, Middle Waipara. (Page 22.)

Fig. 7. *Modiola* sp. *cf. typica* Forb. Calcareous conglomerate, Amuri Bluff. (Page 23.)



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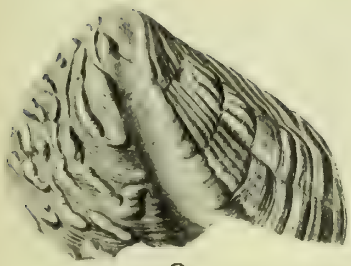
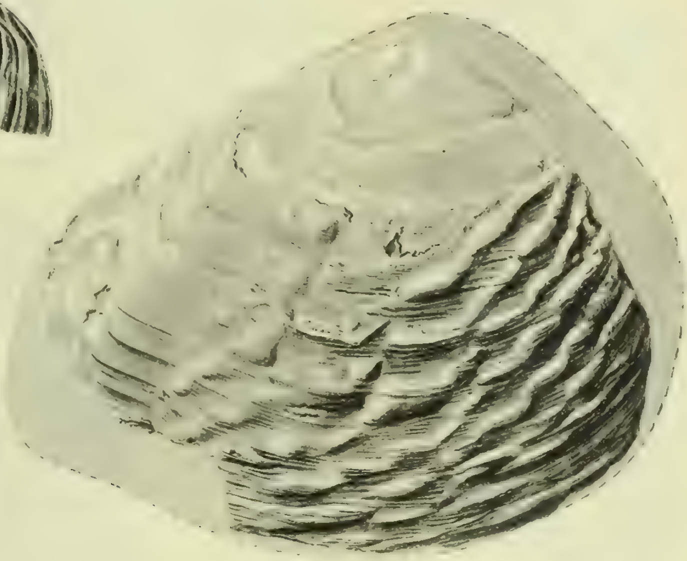


2



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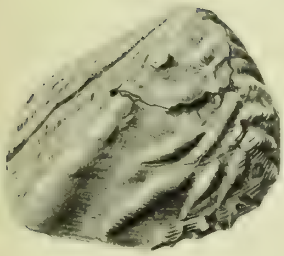

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4

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Cretaceous Fossils.

PLATE X.

(The figures are of natural size, unless the amount of enlargement is stated.)

Figs. 1–3. *Trigonia waiparensis* sp. nov. Saurian beds, Middle Waipara. (Page 23.)

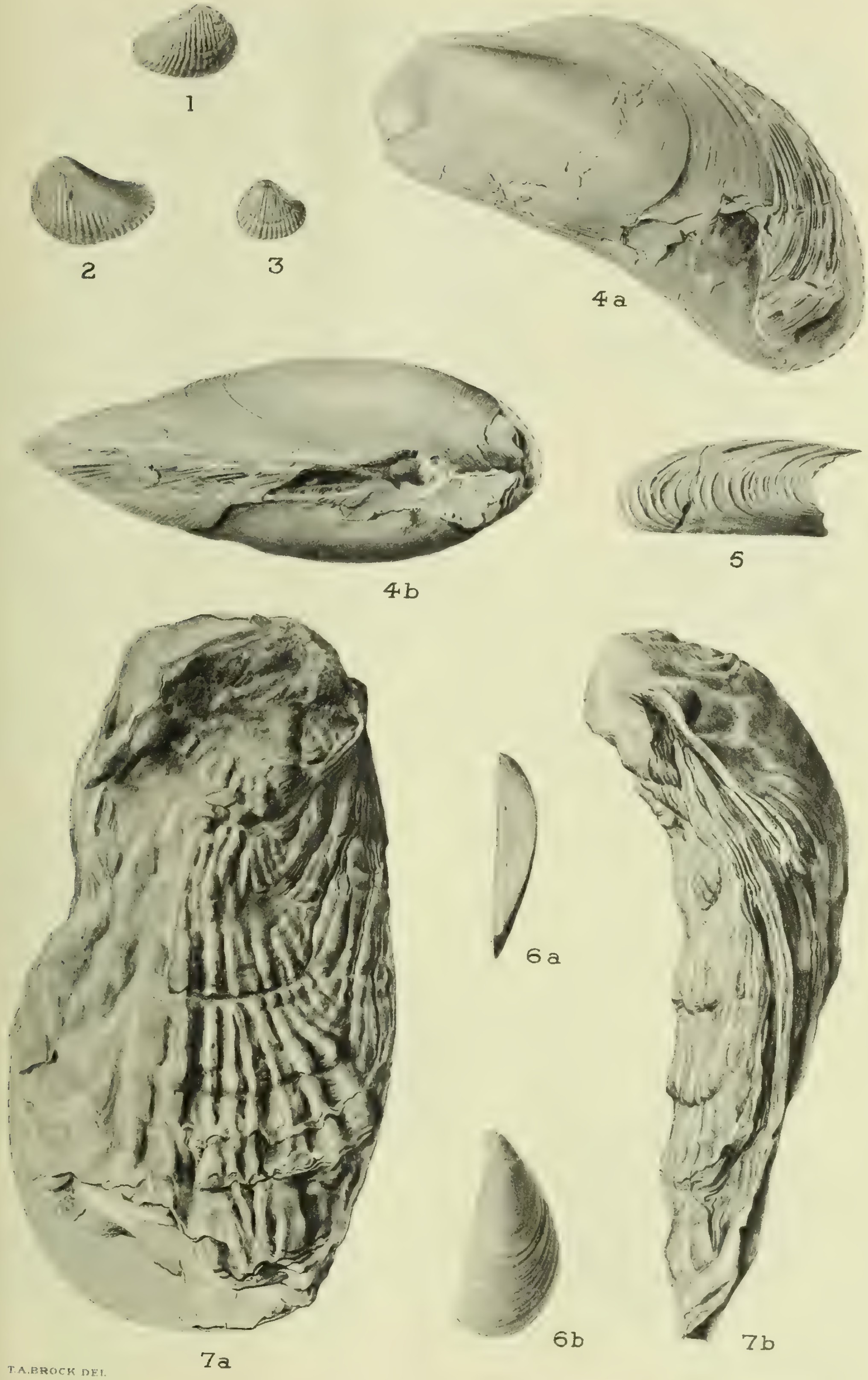
Fig. 4. *Modiola* sp. *cf. typica* Forb. Calcareous conglomerate, Amuri Bluff. 4*b*, dorsal view of 4*a*. (Page 23.)

Fig. 5. *Modiola flagellifera* Forb. Calcareous conglomerate, Amuri Bluff. (Page 24.)

Fig. 6. *Dreissensia lanceolata* (Sow.). Calcareous conglomerate, Amuri Bluff. 6*a*, antero-ventral view of 6*b*. (Page 24.)

Fig. 7. *Ostrea* sp. *cf. dichotoma* Bayle. *Ostrea* bed, Weka Creek. 7*b*, posterior view of 7*a*. (Page 24.)

PL. X



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Cretaceous Fossils.

PLATE XI.

(The figures are of natural size, unless the amount of enlargement is stated.)

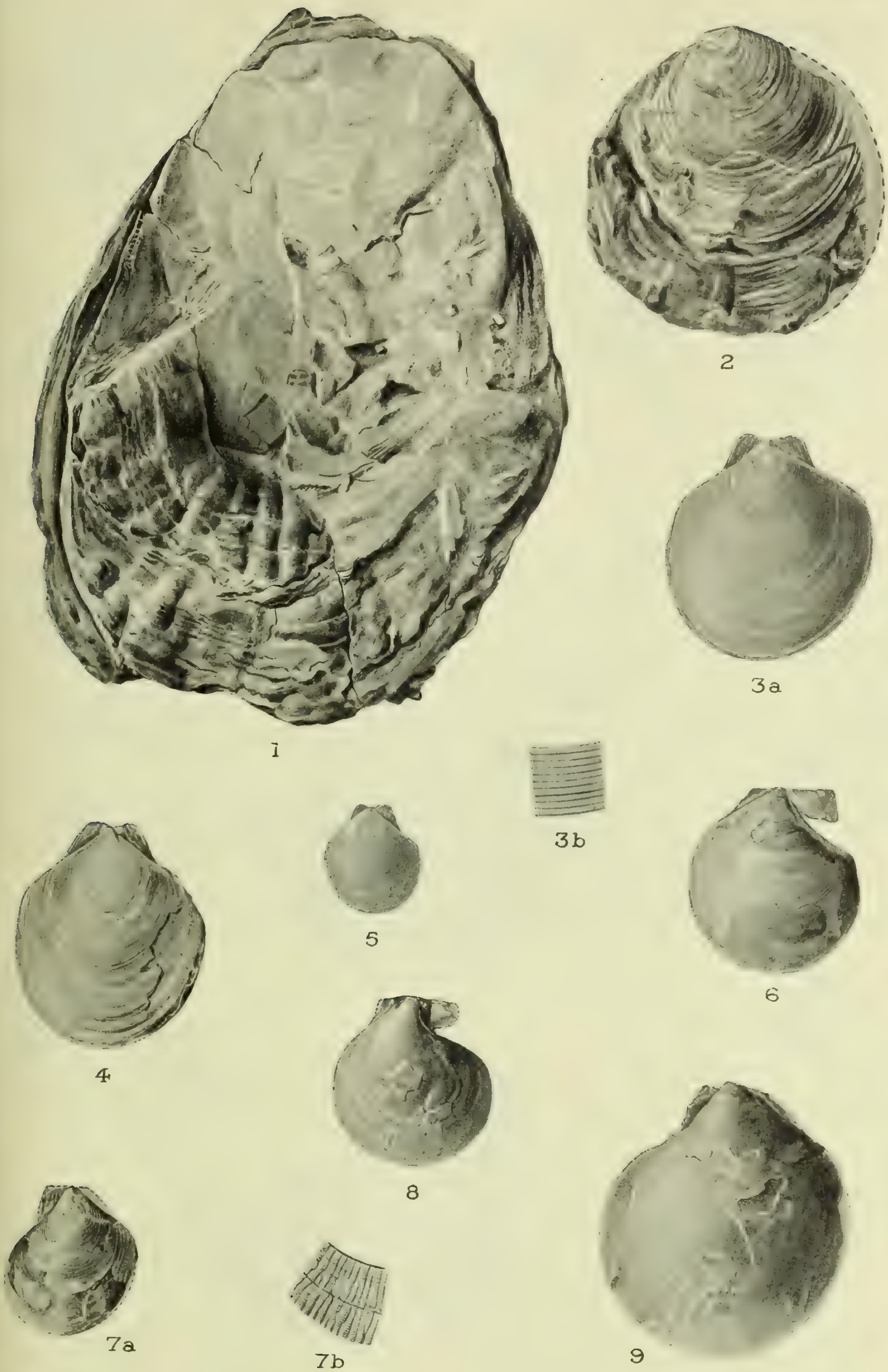
Fig. 1. *Ostrea* sp. *cf. dichotoma* Bayle. *Ostrea* bed, Weka Creek. (Page 24.)

Fig. 2. *Ostrea* sp. Calcareous conglomerate, Amuri Bluff. (Page 25.)

Figs. 3–5. *Pecten (Syncyclonema) membranaceus* Nilss. Amuri Group (black grit), Amuri Bluff. 3*b*, ornamentation of 3*a*, × 5. (Page 25.)

Figs. 6–9. *Pecten (Camptonectes) Hectori* sp. nov. 6, 7, *Ostrea* bed, Selwyn River. 8, 9, Calcareous conglomerate, Amuri Bluff; internal casts. 7*b*, ornamentation of 7*a*, × 6. (Page 26.)

PL. XI



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Cretaceous Fossils.

PLATE XII.

(The figures are of natural size, unless the amount of enlargement is stated.)

Fig. 1. *Pecten (Camptonectes) Hectori* sp. nov. Calcareous conglomerate, Amuri Bluff. Internal cast. (Page 26.)

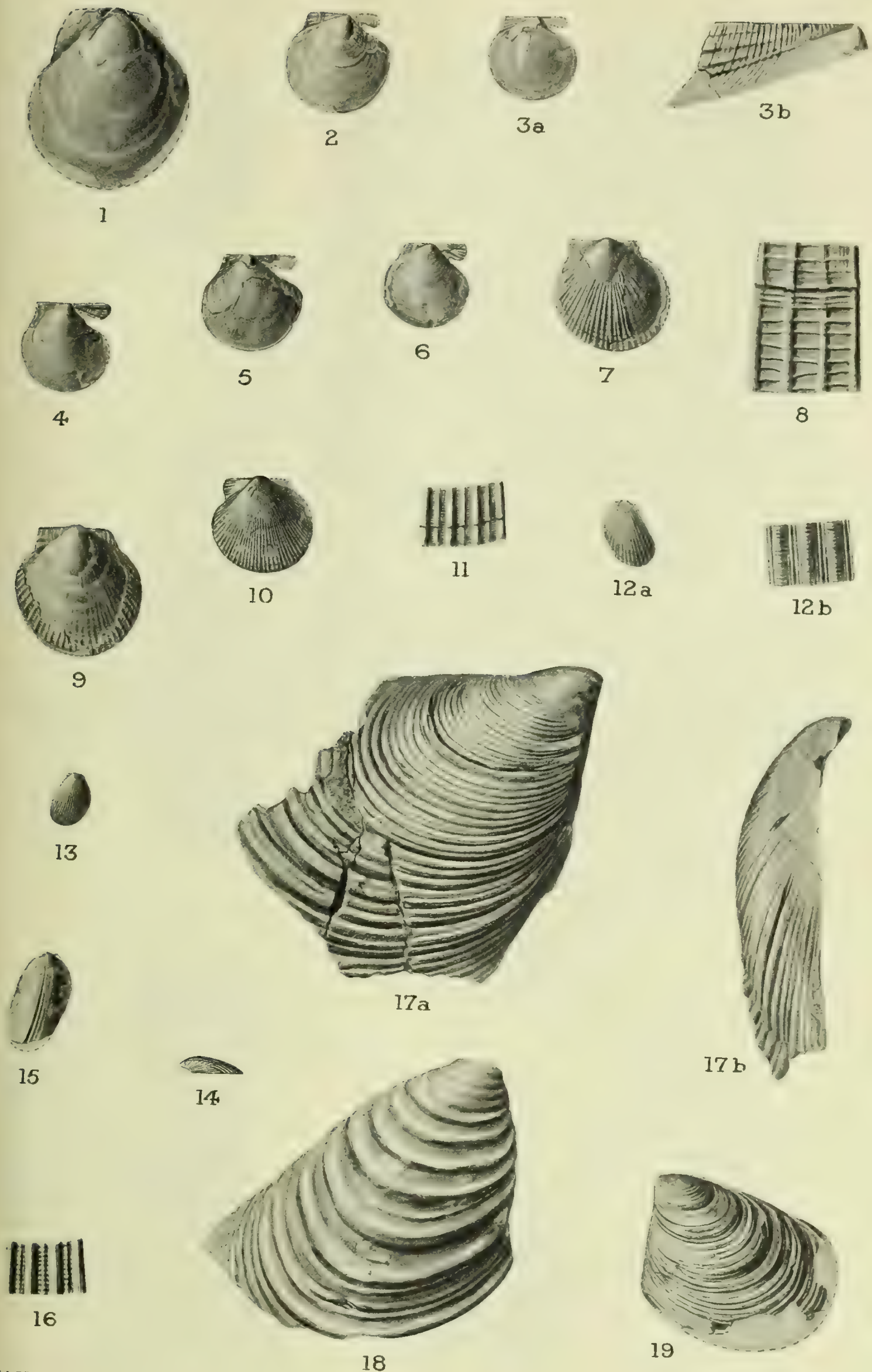
Figs. 2–9. *Pecten (Æquipecten) amuriensis* sp. nov. Calcareous conglomerate, Amuri Bluff. 3*b*, posterior ear of 3*a*, × 4; 4–7, × 1½; 8, ornamentation of left valve, × 8. (Page 26.)

Figs. 10, 11. Probably a form of *P. (Æquipecten) amuriensis* with more numerous ribs than usual. Calcareous conglomerate, Amuri Bluff. 10, × 1½; 11, ornamentation of left valve, × 8. (Page 26.)

Figs. 12–16. *Lima (Limatula) Huttoni* sp. nov. Calcareous conglomerate, Amuri Bluff. 12*a*, × 1½; 12*b*, ornamentation of 12*a*, × 8; 13, × 1½; 14, anterior view of left valve, × 1½; 15, internal cast, × 1½; 16, ornamentation, × 8. (Page 27.)

Figs. 17–19. *Inoceramus australis* sp. nov. Calcareous conglomerate, Amuri Bluff. 17*b*, anterior view of 17*a*. (Page 27.)

PL. XII



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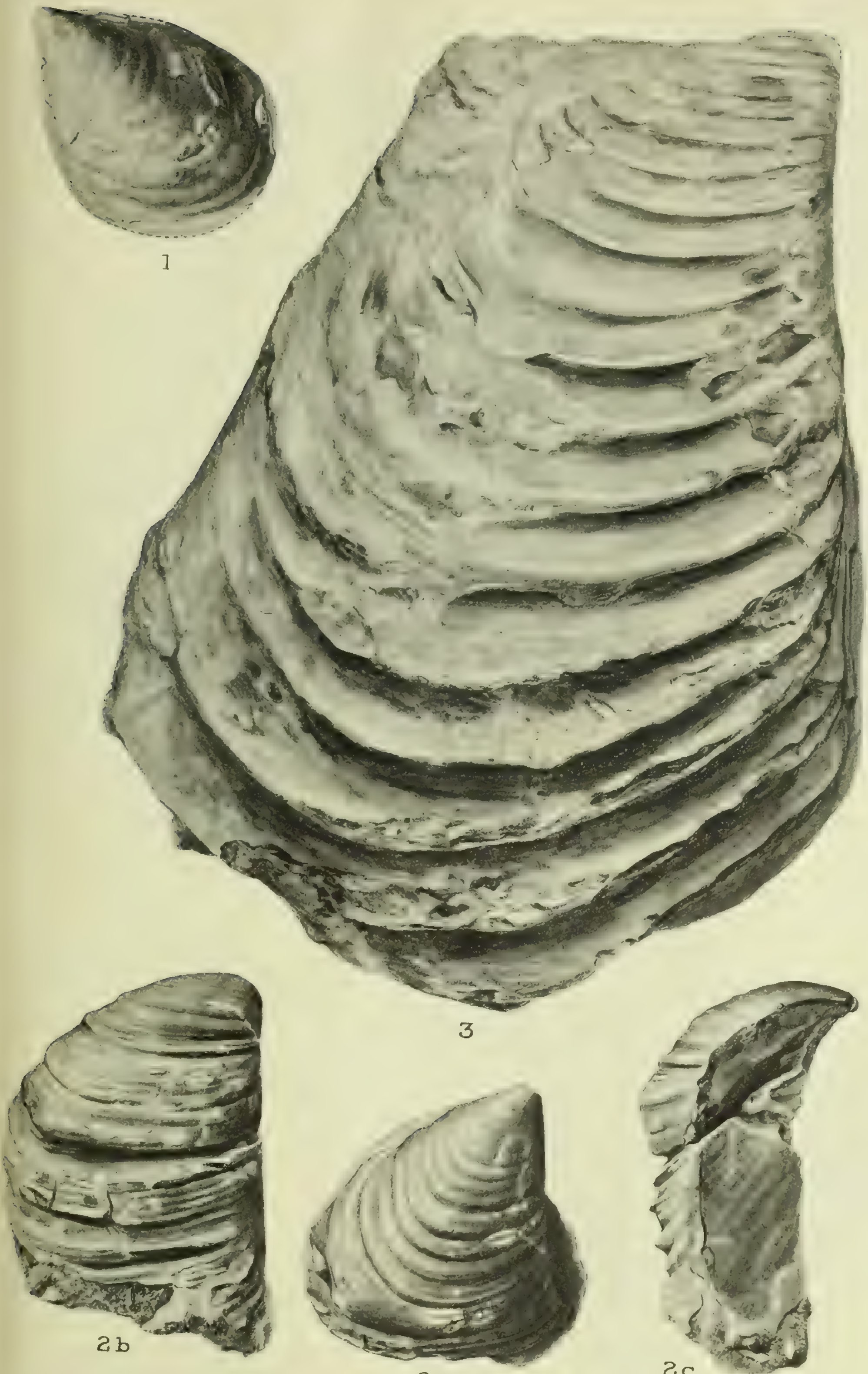
Cretaceous Fossils.

PLATE XIII.

(The figures are of natural size, unless the amount of enlargement is stated.)

Figs. 1–3. *Inoceramus australis* sp. nov. Calcareous conglomerate, Amuri Bluff. 2*a*, dorsal part of the right valve shown in 2*b*; 2*c*, anterior view of 2*b*. (Page 27.)

PL. XIII



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Cretaceous Fossils.

PLATE XIV.

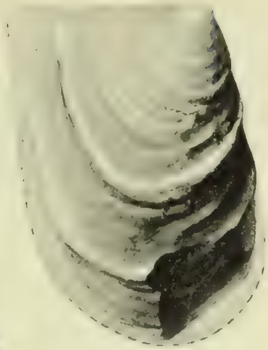
(The figures are of natural size, unless the amount of enlargement is stated.)

Figs. 1, 2. *Inoceramus pacificus* sp. nov. Calcareous conglomerate, Amuri Bluff. (Page 28.)

Figs. 3, 4. *Inoceramus* sp. Calcareous conglomerate, Amuri Bluff. 3*b*, anterior view of 3*a*. (Page 28.)

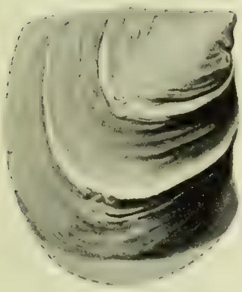
PL. XIV

2



3a

3b



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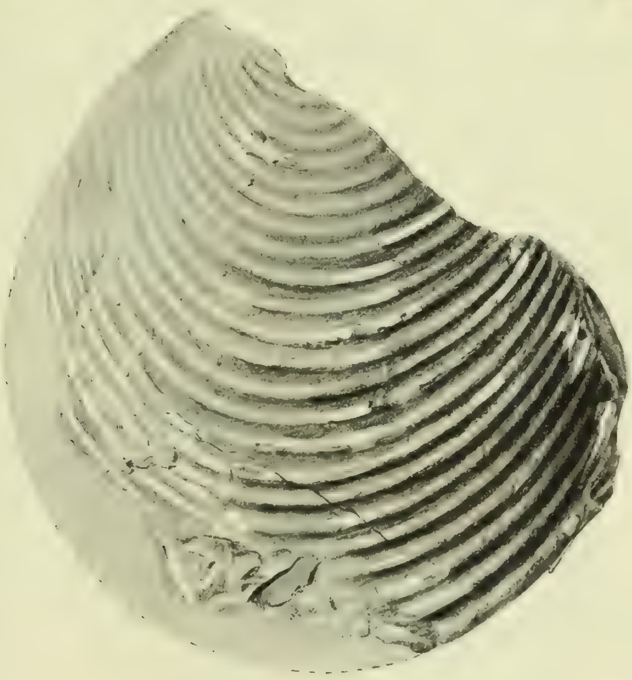

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Cretaceous Fossils.

PLATE XV.

(The figures are of natural size, unless the amount of enlargement is stated.)

Fig. 1. *Pinna* sp. Calcareous conglomerate, Amuri Bluff. (Page 28.)

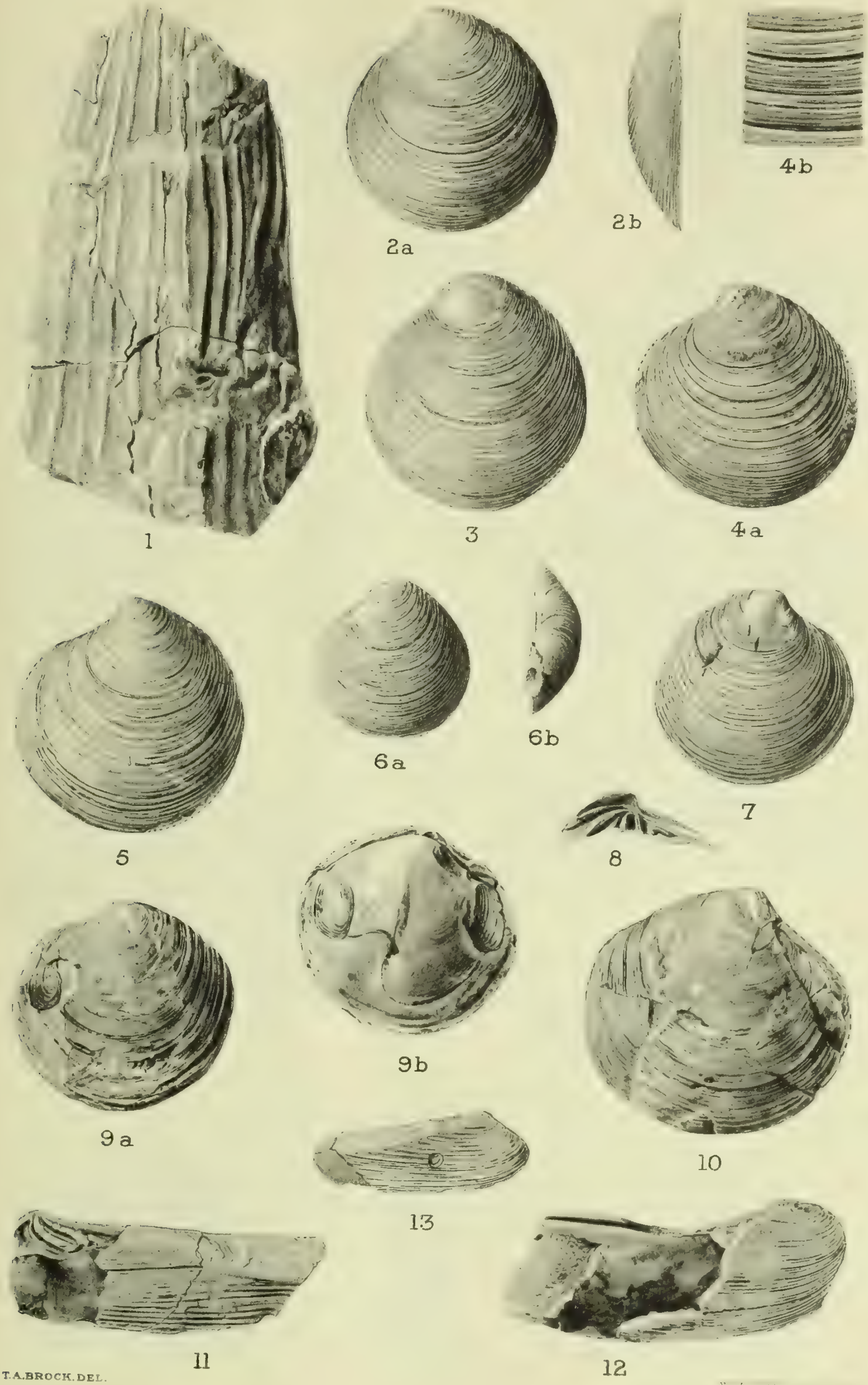
Figs. 2–7. *Astarte (Eriphyla) meridiana* sp. nov. Calcareous conglomerate, Amuri Bluff, 2*b*, posterior view of 2*a*; 4*b*, ornamentation of 4*a*, × 3; 6*b*, dorsal view of 6*a*. (Page 28.)

Fig. 8. *Callista (Callistina) Wilckensi* sp. nov. Calcareous conglomerate, Amuri Bluff. Hinge of left valve. (Page 31.)

Figs. 9, 10. *Astarte (Eriphyla) lenticularis* (Goldf.). Selwyn Rapids beds, Selwyn Rapids. 9*b*, cast of right valve of 9*a*. (Page 29.)

Figs. 11–13. *Anthonya elongata* sp. nov. Calcareous conglomerate, Amuri Bluff. (Page 29.)

PL. XV



Cretaceous Fossils.

PLATE XVI.

(The figures are of natural size, unless the amount of enlargement is stated.)

Figs. 1–3. *Anthonya elongata* sp. nov. Calcareous conglomerate, Amuri Bluff. 1, internal cast of right valve; 2, 3, hinge and interior of parts of right valves. (Page 29.)

Figs. 4, 5. *Lucina canterburiensis* sp. nov. Selwyn Rapids beds, Selwyn River (4), and Selwyn Rapids (5). 5*b*, dorsal view of 5*a*; 5*c*, ornamentation of 5*a*, × 4. (Page 30.)

Fig. 6. *Tellina* sp. *cf. Largillierti* (d'Orb.). Selwyn Rapids beds, Selwyn River. (Page 30.)

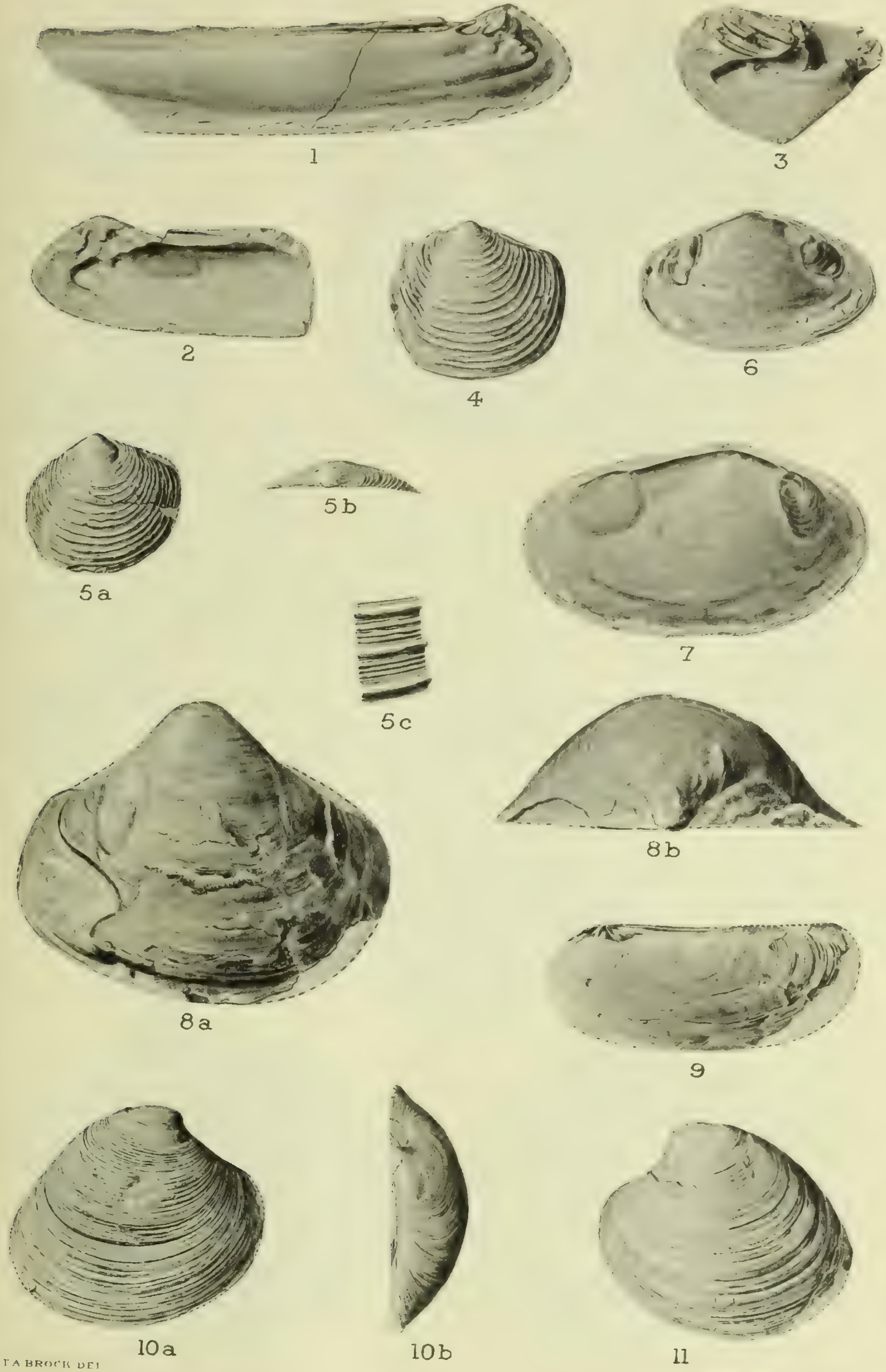
Fig. 7. *Tellina* sp. Selwyn Rapids beds, Selwyn River. (Page 30.)

Fig. 8. *Mactra ?* sp. Saurian beds, Middle Waipara. 8*b*, dorsal view of 8*a*. (Page 30.)

Fig. 9. *Cultellus cretaceus* sp. nov. Calcareous conglomerate, Amuri Bluff. (Page 31.)

Figs. 10, 11. *Callista (Callistina) Wilckensi* sp. nov. Calcareous conglomerate, Amuri Bluff. 10*b*, dorsal view of 10*a*. (Page 31.)

PL. XVI



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Cretaceous Fossils.

PLATE XVII.

(The figures are of natural size, unless the amount of enlargement is stated.)

Figs. 1–3. *Callista (Callistina) Wilckensi* sp. nov. Calcareous conglomerate, Amuri Bluff. 1*b*, dorsal view of 1*a*; 2b, anterior view of 2*a*; 2*c*, ornamentation near the middle of 2*a*, ×3; 2*d*, ornamentation near the ventral margin of 2*a*, ×3; 3, internal cast of right valve. (Page 31.)

Figs. 4–6. *Callista (Callistina) Thomsoni* sp. nov. Selwyn Rapids beds, Selwyn Rapids. 5*b*, dorsal view of 5*a*. (Page 32.)

Fig. 7. *Callista* sp. Selwyn Rapids beds, Selwyn Rapids. (Page 32.)

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Cretaceous Fossils.

PLATE XVIII.

(The figures are of natural size, unless the amount of enlargement is stated.)

Fig. 1. *Dosinia* sp. Selwyn Rapids beds, Selwyn River. (Page 32.)

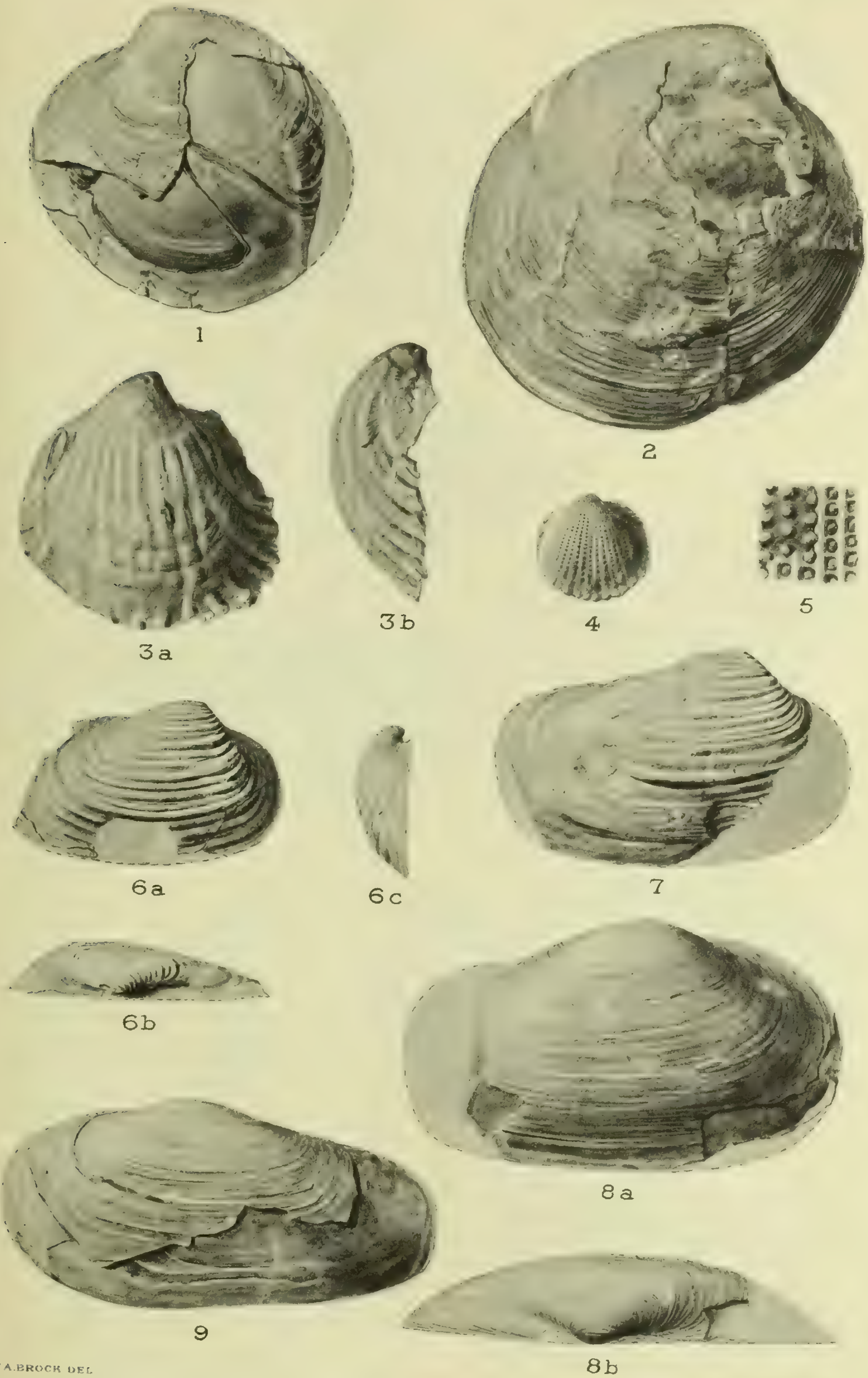
Fig. 2. *Dosinia* sp. Same locality and horizon. (Page 32.)

Fig. 3. *Cardium* sp. Calcareous conglomerate, Amuri Bluff. Internal cast. 3*b*, posterior view of 3*a*. (Page 33.)

Figs. 4, 5. *Cardium* sp. Selwyn Rapids beds, Selwyn Rapids. 4, $\times 1\frac{1}{2}$; 5, imperfectly preserved ornamentation, $\times 6$. (Page 33.)

Figs. 6, 7. *Panopea clausa* Wilck. Calcareous conglomerate, Amuri Bluff. 6*b*, *c*, dorsal and anterior views of 6*a*. (Page 33.)

Figs. 8, 9. *Panopea malvernensis* sp. nov. Selwyn Rapids beds, Selwyn Rapids. 8*b*, dorsal view of 8*a*. (Page 33.)



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Cretaceous Fossils.

PLATE XIX.

(The figures are of natural size, unless the amount of enlargement is stated.)

Figs. 1, 2. *Panopea malvernensis* sp. nov. Selwyn Rapids beds, Selwyn Rapids. 1*b*, dorsal view of 1*a*, the left valve displaced ; 2, internal cast of right valve. (Page 33.)

Fig. 3. *Thracia Haasti* sp. nov. Calcareous conglomerate, Amuri Bluff. 3*a*, right valve with part of the shell preserved ; 3*b*, cast of left valve of the same specimen ; 3*c*, dorsal view of 3*a*, *b*. (Page 34.)

Fig. 4. *Thracia* sp. Saurian beds, Middle Waipara. 4*b*, dorsal view of 4*a*. (Page 34.)

Fig. 5. *Kossmaticeras (Madrasites) haumuriensis* (Hector). Calcareous conglomerate, Amuri Bluff. 5*c*, part of suture of 5*a*, ×4. (Page 34.)

PL. XIX

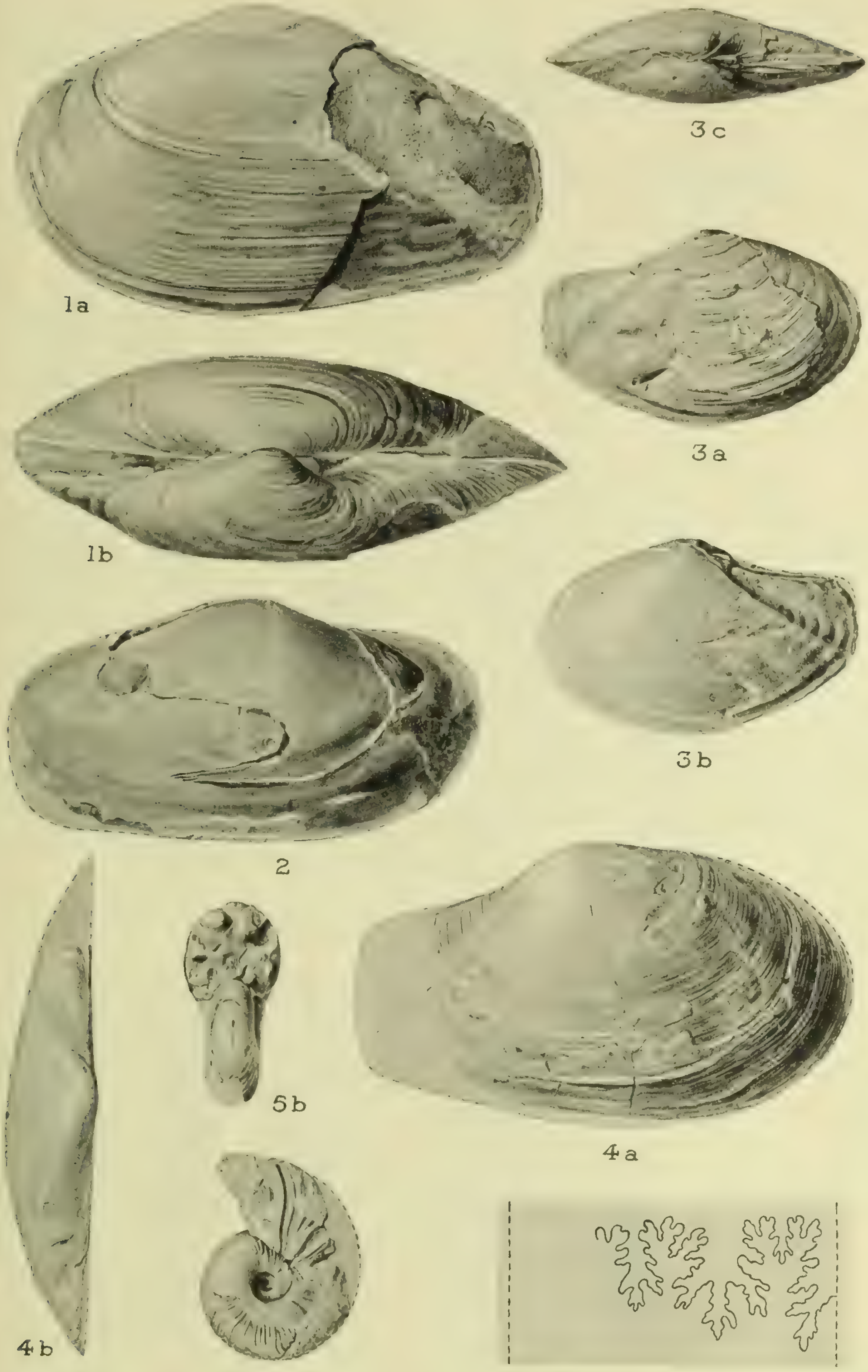

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PLATE XX.

(The figures are of natural size, unless the amount of enlargement is stated.)

Fig. 1. *Kossmaticeras (Madrasites) haumuriensis* (Hector). Calcareous conglomerate, Amuri Bluff. (Page 34.)

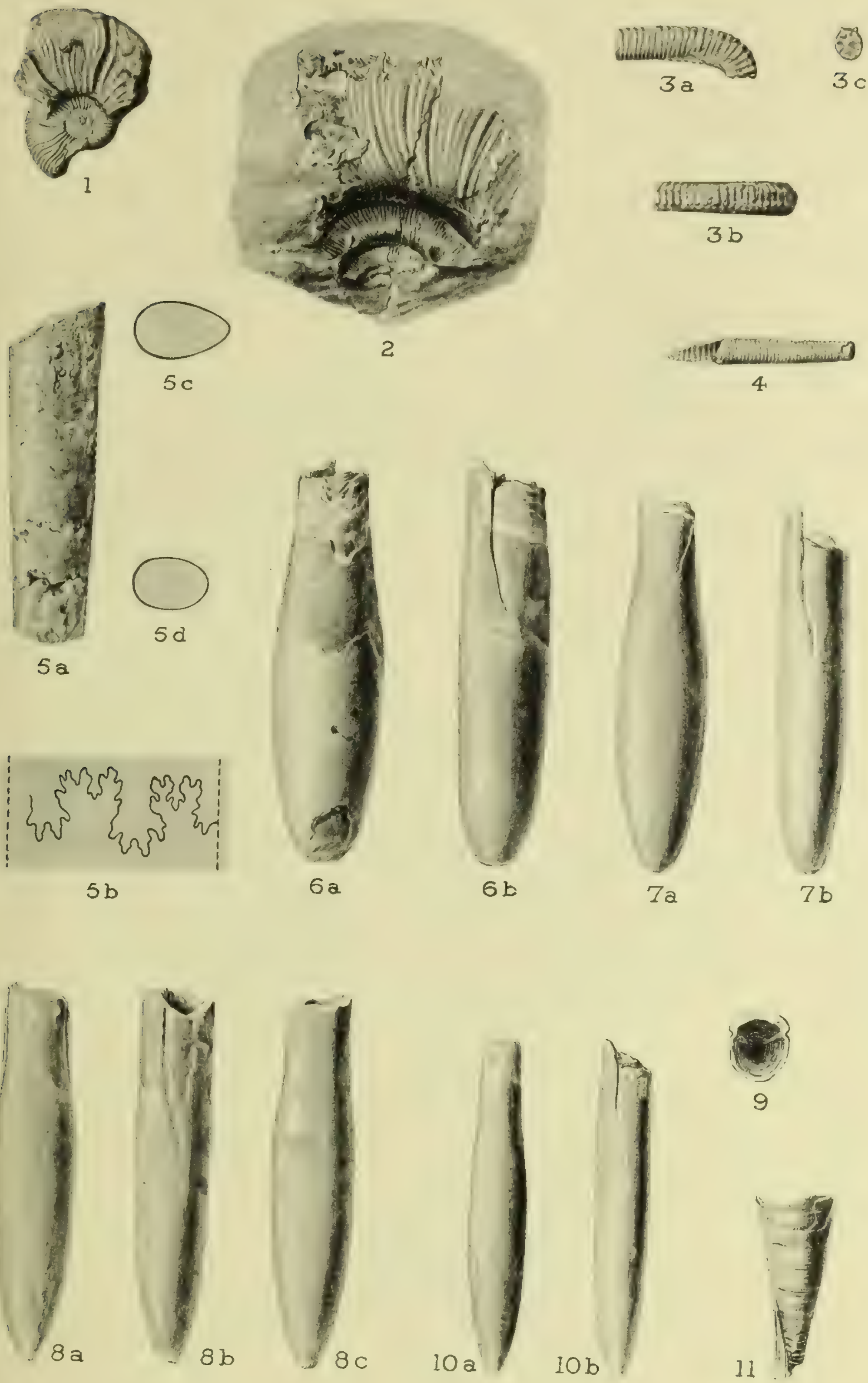
Fig. 2. *Gaudryceras* sp. (aff. *Jukesi* Whiteaves). Calcareous conglomerate, Amuri Bluff. (Page 35.)

Figs. 3, 4. *Hamites (Anisoceras ?)* sp. Calcareous conglomerate, Amuri Bluff. 3*b*, external margin of 3*a*; 3*c*, section of 3*a*; 4, internal margin of straight part. (Page 35.)

Fig. 5. *Baculites* sp. *cf. vagina* Forb. Calcareous conglomerate, Amuri Bluff. 5*b*, suture, ×2; 5*c*, *d*, sections of the ends of 5*a*. (Page 36.)

Figs. 6–11. *Belemnites Lindsayi* Hector. Calcareous conglomerate, Amuri Bluff. 6*a*, *b*, dorsal and lateral surfaces; 7 *a*, *b*, ventral and lateral; 8 *a–c*, ventral, lateral, and dorsal; 9, alveolar end; 10 *a*, *b*, ventral and lateral; 11, phragmocone. (Page 36.)

PL. XX



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Cretaceous Fossils.

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NEW ZEALAND.

Department of Mines.

NEW ZEALAND GEOLOGICAL SURVEY.

(P. G. MORGAN, Director.)

PALÆONTOLOGICAL BULLETIN No. 5.

ERRATA.

(Previous Bulletins.)

PALÆONTOLOGICAL BULLETIN No. 2.

Page 37, line 1: *For* "Plate V, fig. 4*a, b*," *read* "Plate III, figs. 5*a*, 5*b*."
Plate II, middle figure from bottom: *For* "8" *read* "12" *(Turris altus)*.

PALÆONTOLOGICAL BULLETIN No. 3.

Page 64, line 16 from bottom: *Read* "Fig. 14. *Mangilia (Clathurella) rudis*."
Page 64, line 18 from bottom: *Read* "Fig. 13. *Mangilia (Clathurella) cincta*."

AND,

HENRY SUTER.

ISSUED UNDER THE AUTHORITY OF THE HON. W. D. S. MACDONALD, MINISTER OF MINES.

WELLINGTON.
BY AUTHORITY: MARCUS F. MARKS, GOVERNMENT PRINTER.
1917.

NEW ZEALAND.

Department of Mines.

NEW ZEALAND GEOLOGICAL SURVEY.

(P. G. MORGAN, Director.)

PALÆONTOLOGICAL BULLETIN No. 5.

DESCRIPTIONS OF NEW TERTIARY MOLLUSCA OCCURRING IN NEW ZEALAND,

ACCOMPANIED BY

A FEW NOTES ON NECESSARY CHANGES IN NOMENCLATURE.

PART I.

BY

HENRY SUTER.

ISSUED UNDER THE AUTHORITY OF THE HON. W. D. S. MacDONALD, MINISTER OF MINES.

WELLINGTON.
BY AUTHORITY: MARCUS F. MARKS, GOVERNMENT PRINTER.
1917.

LETTER OF TRANSMITTAL.

Geological Survey Office,
Wellington, 1st May, 1917.

Sir,—

I have the honour to transmit herewith Palæontological Bulletin No. 5, entitled "Descriptions of New Tertiary Mollusca occurring in New Zealand, accompanied by a Few Notes on Necessary Changes in Nomenclature, Part I," and written by Mr. Henry Suter, of Christchurch, Consulting Palæontologist to the Geological Survey.

The bulletin contains 93 pages of letterpress, and is illustrated by thirteen plates. The number of new species and subspecies described and figured is 167. In addition, one of Professor F. W. Hutton's species has been redescribed and figured. The work as a whole will commend itself to New Zealand geologists, and will also be useful to palæontologists in other countries who are working on Tertiary Mollusca. Further, it will be welcomed by biologists who are engaged in the important work of elucidating the descent and migrations of marine molluscan faunas.

I have the honour to be,
Sir,
Your obedient servant,

P. G. MORGAN,
Director, New Zealand Geological Survey.

The Hon. W. D. S. MacDonald,
Minister of Mines, Wellington.

PREFACE.

SINCE 1911 Mr. Suter has been almost continuously occupied with the determination of the large collections of Tertiary Mollusca accumulated by the Geological Survey under Sir James Hector, and of collections more recently made, the object being to find a basis on which the molluscan fossils can be used in correlation. From the very first it appeared that the range of many species—for example, the well-known *Pecten huttoni* (Park)—was greater than had hitherto been supposed. Each Tertiary fauna seems to merge gradually into the succeeding one, and correlation will become definite only after a statement of the range of each species can be given. To ascertain this for over 750 molluscan species involves the examination of very large and complete collections from all horizons; and in order to make the investigation more complete Mr. Suter has been encouraged to undertake the examination of various collections other than those of the Geological Survey. A necessary preliminary to accurate determinations was the revision of the known species based on the available type material. The results of this work have already appeared in Bulletins 2 and 3 of this series. In the course of Mr. Suter's examinations many new species were discovered; and the present bulletin contains descriptions and figures of no less than 160 new species, including *Melina zealandica,* one of Hutton's *nomina nuda,* and of seven new subspecies. Figures and a more complete diagnosis of *Lapparia hebes* (Hutton) are also given. Many of the new species have been collected in several localities by different persons. It has unavoidably happened in a number of cases that a fossil first collected by McKay or other early worker has been re-collected in recent years and given to Mr. Suter for determination. As a result the later specimen becomes the type, and the earlier loses the place of honour. In the present bulletin Mr. Alexander McKay is mentioned as a collector 73 times, Dr. P. Marshall 45 times, Dr. J. A. Thomson 33 times, Mr. G. H. Uttley 16 times, Mr. M. C. Gudex 11 times, and Mr. Thomas Esdaile 10 times. Other collectors named are Professor J. Park, Messrs. J. D. Enys, C. Traill, and F. P. Worley, Sir James Hector, Sir David Monro, Dr. C. A. Cotton, Professor A. P. W. Thomas, Messrs. Fulton, P. G. Morgan, J. C. M. Nutt, and A. Purchas. The most prominent of the numerous localities that have yielded new species are Waihao River, Target Gully (near Oamaru), Trelissick Basin, Komiti Bluff, and Kakahu River. Target Gully deserves special mention, because the twenty-five new species or thereabouts obtained here were all collected in one horizon, and from a single excavation.

It has been pointed out in reviews of the previous bulletins that the details furnished as to locality and horizon of the species were very meagre. This was inevitable from the nature of the case. In most of the localities from which Tertiary fossils have been described several different horizons occur, but the details as to locality marked on the earlier type specimens do not discriminate between the different horizons. Thus many type specimens are labelled simply " Broken River " or " Trelissick Basin," alternative names for a district covering several square miles and containing at least five successive horizons of Tertiary fossils. In the present bulletin, where new species are described, an effort has been made to give such details as to locality and horizon as will enable the actual bed from which the fossils were derived to be recognized. For McKay's collections, reference in some cases must be made to his published accounts of the localities.

The age-determinations " Miocene " and " Pliocene " given by Mr. Suter apply only to the horizon of the type specimen, and are not to be taken as indicating the range of the species. In applying these terms Mr. Suter adopts the commonly accepted correlation of the Wanganui System of Hutton as Pliocene, and the Oamaru System of Park (Oamaru and Pareora systems of Hutton) as Miocene. It would perhaps be better to use local names until correlation with the divisions of the European time-scale has been rendered more certain. In particular, the lower beds included in the Oamaru System (or Oamaruian) are likely to prove older than Miocene.

Dr. J. A. Thomson has supplied the following table, indicating some probable correlations that should be made between the different localities, using as a basis his proposed classification of the Tertiary rocks by stages :—

Waitotaran : Motunau beds, Waipara ; Greta beds, Waikari ; Starborough Creek, Awatere River.

Awamoan : Awamoa (loc. 170) ; blue clays of Allday Bay ; Target Gully shell-bed ; Pukeuri ; Pareora beds, Kyeburn ; Mount Harris ; White Rock River (loc. 165) ; Pareora beds, Trelissick Basin ; shell-bed at base of uppermost Mount Brown limestone, Weka Pass.

Hutchinsonian : (?) Clay above limestone, Blue Cliffs ; Rifle Butts greensand, Oamaru.

Ototaran : Tuffs below limestone, Kakanui ; *Phorus* beds, Maerewhenua ; limestone, Otiake River ; tuff below limestone, Rifle Butts.

Waiarekan : Teaneraki (Enfield) ; Cave Valley (loc. 631) ; beds above coal-beds, Ngapara ; greensands below limestone at Maerewhenua (right bank of Waitaki River) and Wharekuri (left bank of Waitaki River) ; Waihao greensands (including " marly greensand " and " island sandstone ") ; coal-beds, Kakahu River ; tuffs in Amuri limestone, Coleridge Creek, Trelissick Basin ; Weka Pass stone.

The last chapter of Mr. Suter's bulletin is devoted to an explanation of the somewhat extensive changes in nomenclature that he has found desirable. It is hoped in the near future to issue an authoritative list of valid names to be used in conjunction with the " Alphabetical Hand-list of New Zealand Tertiary Mollusca " published about two years ago.

J. A. T. P. G. M.

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TABLE OF CONTENTS.


P G MORGAN
DIRECTOR
NEW ZEALAND
ENGLISH MILES
KILOMETRES
Place Names include Principal Localities mentioned in Palaeontological Bulletin Nº 5.
North Cape
Whangarei
Coromandel
Auckland
Waikato R.
AUCKLAND
East Cape
HAWKE'S BAY
Ormond
Gisborne
New Plymouth
C.Egmont
TARANAKI
Napier
WELLINGTON
Wanganui
Wanganui R.
Ormondville
C.Farewell
Nelson
Castlepoint
Westport
Buller River
NELSON
Blenheim
Wellington
C.Palliser
MARLBOROUGH
Wairau R.
C.Campbell
C Foulwind
Brighton
Clarence R.
Greymouth
Hokitika
Grey R.
WESTLAND
CANTERBURY
Waiau R.
Hurunui R.
Waipara R.
Waimakariri R.
Christchurch
Rakaia River
Rangitata River
Timaru
Waihao River
Waitaki River
Ngapara
Teaneraki
Oamaru
OTAGO
SOUTHLAND
Dunedin
Invercargill
Molyneux R. (Clutha)
STEWART Iᴰ.
Reference to numbered Localities.
1. Komiti Bluff.
2. Awatere River.
3. Trelissick Basin.
4. Wharekuri.
5. Kakahu River.
6. St.Andrews.
7. Pareora River
G.E.H.

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PALÆONTOLOGICAL BULLETIN No. 5.

DESCRIPTIONS

OF

NEW TERTIARY MOLLUSCA OCCURRING IN NEW ZEALAND,

ACCOMPANIED BY A FEW

NOTES ON NECESSARY CHANGES IN NOMENCLATURE.

PART I.

CHAPTER I.

Class PTEROPODA.

Fam. CAVOLINIIDÆ.

Clio (Creseis) urenuiensis nov. sp. Plate I, fig. 1.

SHELL cylindrically subulate, smooth over the whole surface, straight, gradually tapering towards the embryonic portion, which is not marked off by any constriction, and is terminating in a sharp point.

Length, 14 mm.; greatest diameter, 2·5 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 52 = White Cliffs, north of Urenui, Taranaki: Hector, 1874.—Miocene.

CHAPTER II.

Class GASTROPODA.

Fam. Fissurellidæ.

Subemarginula (Tugalia) elata nov. sp. Plate II, fig. 1.

Shell oblong-ovate, conical, the anterior end a little narrower, the apex central, radiately and concentrically striated. *Sculpture:* The unique specimen shows fine concentric lineation, and in one place fine radial riblets are visible. The anterior and posterior *slopes* slightly convex, rather slowly descending (angle 55° and 65°), the side slopes steeper and nearly straight. *Margins:* The anterior narrowly rounded, without any notch; the posterior margin more broadly convex; lateral margins very broadly rounded, lightly converging towards the front. *Apex* at the centre, very little to the left of the median line, blunt, curved backwards.

Length, 28 mm.; breadth, 21 mm.; height, 11 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 178 = "*Phorus* beds," Maerewhenua River, Waitaki Valley, North Otago: McKay, 1876.—Miocene.

Fissuridea (?) annulata nov. sp. Plate II, fig. 2.

Shell small, oval, rounded at the ends, sides subparallel, depressed conoidal, with a central perforation. *Sculpture* consisting of concentric incremental lines, and in one place there are traces of fine radial striation. *Sides* straight down to the margin. *Foramen* elongate-oval, central.

Length, 16 mm.; breadth, 6 mm.; height, 4·5 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 241 = Tufaceous greensands, Whitewater Creek, Trelissick Basin, Canterbury: McKay, 1879.—Miocene.

Remarks.—It is uncertain whether the opening at the apex of the shell is natural or produced by accident. If the former be the case the shell may be a *Fissuridea* or a *Fissurella*, but if the perfect shell has no foramen it should be classed under *Subemarginula*. The true generic position must remain uncertain for the present.

Fam. Trochidæ.

Trochus (Anthora) avarus nov. sp. Plate XI, fig. 1.

Shell conical, keeled at the periphery, granulosely spirally lirate, with a shallow false umbilicus, into which 2 smooth ribs enter. *Sculpture:* The post-embryonic whorls have close, equal, granulose spiral liræ, 8 on the penultimate whorl; and upon the base the spirals are also granulose, but farther apart; 2 smooth spirals, starting from the anterior part of the columella, are descending into the umbilical excavation. *Spire* conic, about 1½ times the height of the aperture, angle 70°. *Protoconch* lost. *Whorls* 5 to 6, first slowly then more rapidly increasing; the spire-whorls very slightly convex; body-whorl keeled, a little excavated above the angle, base very flatly convex. *Suture* deep. *Aperture* quadrangular, very little oblique. *Outer lip* acute, convex, forming a sharp angle with the horizontal, slightly rounded, basal lip. *Umbilical area* excavated, with 2 ribs entering it, its width about one-fourth of the diameter.

Height, 15 mm.; diameter, 13 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 243 = "Fan-coral beds," Trelissick Basin, Canterbury: Enys, 1866–79. —Miocene.

Cantharidus fenestratus nov. sp. Plate XI, fig. 2.

Shell small, ovate-conic, imperforate, with a few fine cinguli, reticulated by fine distant axials, nodulous at the points of intersection. *Sculpture:* The first two post-embryonic whorls with 2 fine spiral liræ; the succeeding volutions with 3 spirals, the first a short distance below the suture, the other two equally spaced between it and the suture below; the cinguli are reticulated by exceedingly fine axial threads, producing little nodules at the crossing-points; body-whorl with a spiral thread emanating from the suture, followed by 4 or 5 distant spirals upon the base, closer together towards the centre. *Spire* conical, nearly twice the height of the aperture, angle 60°. *Protoconch* broken off. *Whorls* 5 without the protoconch, convex, but slightly angled by the cinguli, regularly increasing, base flatly rounded. *Suture* deep, simple. *Aperture* almost round, very little higher than broad, a little angled above. *Outer lip* convex, rather acute. *Columella* vertical, smooth, nearly straight.

Height, 7 mm.; diameter, 6 mm. (holotype).

Holotype in my collection.

Loc.—Calcareous tuffs, Trig. M., Oamaru, by G. H. Uttley. There is also one specimen, pressed out of shape, but with fairly distinct sculpture, from loc. No. 831 = Cave Valley and Upper Waiareka Valley, North Otago, from chalk ooze and tufaceous greensands: T. Esdaile.—Miocene.

Calliostoma acutangulum nov. sp. Plate XI, fig. 3.

Shell small, acutely conical, imperforate, body-whorl keeled, with few gemmate cinguli. *Sculpture:* The first four or five post-embryonic whorls with 4 equal and equidistant granular spiral cords, the interstices very little narrower than the cinguli, with fine receding growth-lines; on the succeeding whorls each interspace is adorned with a fine granular spiral thread; the spirals upon the base are indistinctly granular, except the four central spirals, which are crossed by low, narrow, radial riblets. *Spire* narrowly conic, its outlines straight, angle 55°. *Whorls* of the imperfect holotype 4, but adult perfect specimens may have 6 to 8, flat, the last whorl acutely angled at the periphery; base flat, just a trifle convex. *Suture* deep, rendered false-canaliculate by the proximity of the cinguli. *Aperture* subquadrate. No callosity spreading over the umbilical tract.

Height, 14 mm.; diameter, 13 mm. (imperfect holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Upper tuffs or "fan-coral beds," Trelissick Basin, Canterbury: J. A. Thomson, 1914.—Miocene.

Calliostoma filiferum nov. sp. Plate XI, fig. 4.

Shell conical, imperforate, with narrow flat cinguli, the last whorl carinated, base flat, aperture quadrangular. *Sculpture* consisting of smooth, flat, subequal spiral riblets, about 11 on the penultimate whorl, separated by linear interstices; the same kind of cinguli adorn the outer part of the base, but towards the centre they are much stouter and convex. *Spire* conical, its outlines nearly straight, considerably higher than the aperture. *Whorls* almost flat, but very slightly convex, the last sharply keeled below; base flat, a little rounded on approaching the aperture. *Suture* inconspicuous. *Aperture* transversely quadrangular. *Outer lip* very little convex, sharply angled towards the horizontal, slightly rounded basal lip. *Inner lip* extending as a small callosity over the umbilical tract.

Height, 15 mm.; diameter, 19 mm. (imperfect holotype of 2 whorls).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 243 = "Fan-coral beds," Trelissick Basin, Canterbury: Enys, 1866–79.—Miocene.

Calliostoma oryctum nov. sp. Plate XI, fig. 5.

Shell small, conical, turreted, imperforate, with moniliform cinguli, base without callosity. *Sculpture:* The first post-embryonic whorl convex, with 3 nodular spiral riblets, the following whorls distinctly shouldered, the keel at the middle of the whorls or a little above it, 2 or 3 moniliform cinguli upon the shoulder, the keel with somewhat larger nodules, 2 or 3 moniliform spirals below it, the lowest margining the suture; base with coarse nodose spiral cords at the central part; there are fine, very obliquely retractive growth-lines. *Spire* conical, turreted, higher than the aperture. *Protoconch* of a few whorls, flatly convex. *Whorls* about 5, regularly increasing, the shoulder lightly excavated or almost flat, as they are also below the keel; base very slightly convex. *Suture* well impressed, margined above.

Height, 14 mm.; diameter, 12 mm. (holotype, most likely not adult).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—"Fan-coral beds," or upper tuffs, Trelissick Basin, Canterbury: loc. No. 243, Enys, 1866-79, and J. A. Thomson, 1914.—Miocene.

Calliostoma waiparaense nov. sp. Plate II, figs, 3, 3*a*.

Shell large, conoidal, solid, imperforate, last whorl rounded at the periphery, with moniliform spiral ribs, distant on the body-whorl, base with a broad callus. *Sculpture* consisting of strong, beaded, narrowly rounded spiral ribs, 8 on the penultimate whorl, about 15 on the body-whorl, interstices deep, concave, the same width as the ribs on the spire-whorls, but nearly twice as broad on the body-whorl; sometimes 1 or 2 spiral threads are intercalated between the larger ribs; fine and dense oblique growth-lines cross the spiral sculpture. *Spire* conical, outlines slightly convex, its height most likely about equal to the height of the aperture. *Protoconch* small, obtuse, convex. *Whorls* about 6 to 7, convex, first slowly then more rapidly increasing, narrowly rounded at the periphery of the body-whorl; base flatly convex. *Suture* impressed. *Aperture* rhomboidal, oblique, slightly broader than high. *Outer lip* solid, narrowly convex at the middle. *Columella* subvertical, short, arcuate. *Inner lip* broadly spread as a rather thick callus over the umbilical tract.

Height estimated at 50 mm.; diameter, 55 mm.

Holotype and one *paratype* in the collection of the New Zealand Geological Survey.

Loc.—Motunau beds, Lower Waipara Gorge, North Canterbury: J. A. Thomson, 1913. —Probably Pliocene.

Solariella prætextilis nov. sp. Plate XI, fig. 6.

Shell small, conoidal, very moderately umbilicated, thin, with oblique axial riblets on the upper whorls, reduced to gemmules upon the spiral liræ on the lower whorls. *Sculpture:* Protoconch spirally striated, the succeeding two or three whorls with oblique, retractive, fine axial riblets, about 30 on a whorl, which are present on the lower whorls only below the suture, but farther down by round gemmules upon the spiral threads, which number 6 on the penultimate whorl; on the body-whorl there are 2 stronger and a little more distant spirals at the periphery, rendering it faintly bicarinate; on the base there are 1 or 2 fine spiral threads below the periphery, the space between them and the umbilicus bearing fine radial riblets; and the umbilicus is margined by a strongly gemmate ridge, followed by a much finer one inside the umbilicus. *Spire* conoidal, a little lower than the height of the aperture. *Protoconch* small, convex, with a few spirals. *Whorls* 4½, convex, the last faintly bicarinate, the base flatly convex. *Suture* canaliculate. *Aperture* hidden by the matrix. *Umbilicus* moderate, not quite one-third of the greatest diameter, deep.

Height, 6 mm.; diameter, 6 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 239 = 'Fan-coral beds," Porter and Thomas Rivers, Trelissick Basin, Canterbury: McKay, 1879.—Miocene.

Remark.—Of Recent species *Solariella textilis* (Murdoch and Suter) is the nearest ally, though quite distinct.

Solariella sulcatina nov. sp. Plate XI, fig. 7.

Shell moderately large, turbinated, rather broadly umbilicated, with spiral liræ. *Sculpture:* Protoconch smooth, the succeeding whorls with unequal and subequidistant spiral threads, very fine below the suture, but considerably stronger upon the base, the interstices of the same width as the cinguli; umbilicus margined by a stronger spiral riblet, followed by about 6 spirals in the umbilicus, the interstices with strong growth-lines. *Spire* scalar, high, about 1½ times the height of the aperture. *Protoconch* flatly convex. *Whorls* 4½, strongly convex, base flattish. *Suture* very deep. *Aperture* round, subangled above. *Peristome* continuous, the outer and basal lip crenated on the outside by the cinguli. *Columella* short, excavated. *Inner lip* somewhat thickly callous, spread a little way over the body, and expanded over part of the umbilicus. *Umbilicus* deep and wide, about one-third of the greatest diameter.

Height, 11 mm.; diameter, 10 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Tuffs below limestone, Kakanui, North Otago: J. A. Thomson, 1913.—Miocene.

Remark.—The free expansion of the inner lip over the umbilicus is broken off.

Fam. Vitrinellidæ.

Lissospira exigua nov. sp. Plate I, fig. 2.

Shell minute, elevated turbinate, smooth, narrowly umbilicated, with a continuous peristome. *Sculpture* none, except very fine growth-lines. *Spire* conical, somewhat higher than the aperture. *Protoconch* small, of 1 convex whorl. *Whorls* 3½, regularly increasing, convex. *Suture* deep. *Aperture* nearly circular, slightly angled above. *Peristome* continuous, reduced to a thin callus on the body, acute. *Columella* short, arcuate. *Umbilicus* narrow, deep, half-covered by the inner lip.

Height, 1·3 mm.; diameter, 1·1 mm. (holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Shell-bed, Target Gully, Oamaru, North Otago: Marshall.—Miocene.

Remark.—This species is allied to the Recent *L. micra* (T.-Woods), which, however, is microscopically finely spirally striated.

Circulus politus nov. sp. Plate I, fig. 3.

Shell minute, subdiscoidal, umbilicated, finely spirally lirate above, peristome discontinuous. *Sculpture* consisting of fine spiral liræ, with linear interstices on the upper part of the last whorl, and a faint sulcus margining the suture on the outside. *Spire* very low. *Protoconch* small, of 1½ flatly convex whorls. *Whorls* 4, the last large, flattish above, convex at the periphery, base slightly rounded. *Suture* not deep, broadly margined. *Aperture* circular. *Peristome* not quite continuous, modified into a thin glaze upon the parietal wall. *Umbilicus* moderately wide, deep, about one-fifth of the greatest diameter.

Height, 1·5 mm.; diameter, 2·5 mm. (holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Shell-bed, Target Gully, Oamaru: Marshall.—Miocene.

Remarks.—This species is distinguished from the Recent *C. sub-tatei* Sut. by the much finer and closer spiral liræ with linear interstices, and narrower umbilicus. The Miocene *C. helicoides* (Hutt.) is easily separated from *C. politus* by the two spiral keels and the wider umbilicus.

Fam. TURBINIDÆ.

Turbo (Marmorostoma) approximatus nov. sp. Plate II, fig. 5.

Shell medium size, depressed turbinate, umbilicated, with convex smooth whorls. *Sculpture:* All the whorls are smooth, except for distant retractive growth-lines. *Spire* low, conoidal, with blunt apex. *Protoconch* planorbiform, very slightly convex. *Whorls* 5, first very slowly increasing, the last large, convex, much depressed and concave below the suture, base convex. *Suture* distinct, uneven. *Aperture* large, rounded. *Umbilicus* fairly deep, about one-fifth of the greatest diameter.

Height, 30 mm.; diameter, 22 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 486 = Greensands, Wharekuri, Waitaki Valley, North Otago: McKay, 1880.—Miocene.

Remark.—The lower part of the only specimen is broken off. The species resembles the Recent Australian *Turbo undulatus* (Martyn).

Astræa (Cyclocantha) bicarinata nov. sp. Plate II, figs. 6, 6*a*.

Shell moderately large, imperforate, turbiniform, suture margined above with a ridge of flat triangular spines, spirally nodosely striate, the cinguli oblique, gradually running out to the spines; body-whorl bicarinate, the upper keel strongly nodulous, the lower with flat triangular spines; base with slowly obliquely descending nodose cords, and a few rope-like spiral ribs in the centre. *Sculpture:* The spire-whorls with nodose oblique spiral cords which slowly descend and extend over the flat spines; body-whorl with a rounded nodose keel outside the suture, separated from it by a strong spiral cord; below and outside the upper carina there is a second, which is produced into flat triangular spines similar to those of *A. heliotropium;* between the two keels there is a thin undulating nodular spiral cord intercalated; base with distant oblique nodular cords, extending from the keel to the margin of the umbilical depression, which is adorned with 4 rope-like spiral ribs; fine spiral liræ seem to be spread over the body-whorl between the coarser sculpture already mentioned. *Protoconch* small, flat. *Spire* conoidal. *Whorls* regularly increasing, the last rather large, convex, somewhat flattened below the suture; body-whorl bicarinate, flat or slightly concave between suture and first keel, excavated between the two keels; base convex to the rather deeply excavated and sharply angled umbilical tract. *Suture* covered by the spinous flange.

Height, 29 mm.; diameter, 59 mm. (body-whorl, minus aperture, of the larger holotype).

Holotype and one *paratype* in the collection of the New Zealand Geological Survey.

Loc.—No. 237 = Shell-bed at base of Pareora beds, Trelissick Basin, Canterbury: McKay, 1879.—Miocene.

Astræa (Cyclocantha) transenna nov. sp. Plate II, fig. 7.

Shell medium size, imperforate, periphery carinated, with fine spiral threads and a row of large tubercles above the keel, base finely spirally lirate, decussated by growth-lines. *Sculpture:* The whole surface ornamented by fine spiral threads of somewhat unequal strength; above the carina there is a row of large, blunt, triangular and vertically slightly compressed tubercles, about 12 on the last whorl; the keel sharply rounded; base with about 9 distant stronger fine spiral cords, having crowded, fine, slightly undulating spiral threads between them, decussated at the central part by very distinct fine growth-lines.

Height, 19 mm.; diameter, 42 mm. (body-whorl of holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 237 = Shell-bed at base of Pareora beds, Trelissick Basin, Canterbury: McKay, 1879.—Miocene.

Remark.—The single specimen consists of part of the body-whorl only, but sufficient is shown to characterize the species.

Astræa (Uvanilla) subfimbriata nov. sp. Plate XI, fig. 8.

Shell small, broadly conical, imperforate, periphery acutely carinated, with granulate spiral lines and hollow spines on the lower part of the keel on the body-whorl, but these spines are very small above the suture of the spire-whorls; base with a large flatly convex callus covering the umbilical region. *Sculpture:* The small protoconch smooth, keeled, the next two whorls axially ribbed and keeled above the suture, the succeeding volutions with granulate spiral lines, 5 on a whorl, somewhat unequally spaced; the lower third or half of the last two whorls with dense and fine spiral threads; the upper part of the suture with distant, sharp, and broadly rounded rudimentary spines, which are reaching their full development on the lower part of the basal carina, forming hollow triangular spines, 18 to 20 on the volution; base with a few spiral threads below the row of spines, and about 3 indistinct spiral riblets outside the smooth central callus; flexuous growth-lines are visible on the spire, developing into oblique folds on the base. *Spire* conoidal, its height about twice that of the aperture, outlines straight, angle 75°. *Protoconch* small, flat, of 1½ whorls. *Whorls* 6½, first slowly, the last two much more rapidly increasing, perfectly flat, the base with a flatly rounded centre, a little excavated towards the periphery. *Suture* not deep, margined above by an undulating flange. *Aperture* transverse, squarish, rounded above. *Outer lip* acute, straight, sharply angled towards the somewhat convex basal lip. *Columella* very short, concave. *Inner lip* smooth, extending as a thick callus upon the central half of the base.

Height, 20 mm.; diameter, 26 mm. (holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Komiti* Bluff, Kaipara Harbour, North Auckland: Marshall.—Miocene.

Remarks.—This species resembles somewhat the Recent Australian *A. fimbriata* Lamarck.

Fam. CERITHIOPSIDÆ.

Cerithiopsis æquicincta nov. sp. Plate I, fig. 4.

Shell very small, subulate, with numerous whorls bearing fine axial riblets, a row of gemmules below the suture, and 2 nodulous cinguli below it, aperture with a very short canal. *Sculpture:* Protoconch smooth, with a median carina, the post-embryonic whorls with a row of close-set round gemmules close to the suture below, followed by 2 fine cinguli, produced into round gemmules at the points of intersection with the fine axial riblets, of which there are about 16 on a whorl; base with a sharp carina below the last nodulous spiral. *Spire* high, subulate, much higher than the aperture. *Protoconch* with 2 carinate whorls, the pullus lost. *Whorls* 12 or more when perfect, flat, the base contracted towards the beak. *Suture* not deep, margined above by the

* Also spelt "Kumete" on some published maps.

lowest cingulum, below by a row of gemmules. *Aperture* quadrangular, with a very short open canal below. *Outer lip* straight, crenate on the outside, forming a right angle with the basal lip, which is notched towards the canal. *Columella* short, straight, deflected and twisted below. *Inner lip* narrow, thin.

Height, 4 mm.; diameter, 1·2 mm. (holotype; imperfect specimen).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Shell-bed, Target Gully, Oamaru: Marshall.—Miocene.

Remarks.—The specimen is very likely not quite full-grown.

Cerithiella fidicula nov. sp. Plate I, fig. 5.

Shell very small, subulate, many-whorled, with fine arcuate axial riblets and 3 gemmate cinguli, the aperture with a short canal, deflected to the left. *Sculpture:* The post-embryonic whorls have numerous, fine, thread-like, flexuous, axial riblets, about 25 on a whorl, crossed by 3 equidistant spiral cords; the uppermost, close below the suture, is somewhat lower than the others, the lowest of which is also close to the suture; at the points of intersection with the axials small roundish nodules arise; base with a carina close to the lowest of the three cinguli. *Spire* high, subulate, much higher than the aperture. *Protoconch* broken off. *Whorls* 7 in the very imperfect specimen, gradually increasing, excavated between the cinguli; base contracted towards the beak. *Suture* well impressed, bimargined. *Aperture* quadrangular, with a short open canal, abruptly turned to the left, its base truncated. *Outer lip* nearly straight, angled below towards the basal lip which descends towards the canal, forming its inner margin. *Columella* short, lightly excavated, twisted below with a slightly raised fold, which follows the inflection of the canal. *Inner lip* thin, smooth.

Height, 4·5 mm.; diameter, 1·5 mm. (holotype; very imperfect specimen).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Shell-bed, Target Gully, Oamaru: Marshall.—Miocene.

Fam. Turritellidæ.

Turritella (Zaria) abscisa nov. sp. Plate II, fig. 8.

Shell long, turreted, many-whorled, with fine subequal spiral liræ, deep suture and sinus. *Sculpture* consisting of fine cinguli, generally stouter and finer ones alternating, less conspicuous or vanishing upon the shoulder, and continued over the base; axial sculpture formed by oblique incremental lines, deeply sinuous at the median part of the whorls. *Spire* high, turreted, angle about 20°. *Protoconch* lost. *Whorls* 10 on the imperfect holotype, with a broad steep and flat shoulder occupying about one-third the height of the whorl; on the earlier whorls the shoulder is not present, but usually marked in its limit by a spiral groove; below the angle the whorls are flat, but contracted towards the suture below. *Suture* deep. *Aperture* vertical, subquadrate, higher than broad, somewhat effuse below. *Outer lip* with a deep broad sinus, which is narrowly rounded at the middle. *Columella* vertical, slightly concave. *Inner lip* forming a thin glaze over columella and body-wall.

Height, 77 mm.; diameter, 20 mm. (imperfect holotype of 10 whorls).

Holotype in my collection.

Loc.—Oamaru (exact locality unknown).—Miocene.

Turritella (s. str.) waikopiroensis nov. sp. Plate XI, fig. 9.

Shell of medium size, subulate, with slightly convex whorls, deep suture, and unequal cinguli. *Sculpture:* Protoconch smooth, the following three whorls with 3 low spiral threads, the next two volutions have 4 cinguli, after that fine spiral threads appear on the upper and lower part of the whorls, increasing in strength as growth proceeds until there are 6 to 8 more prominent cinguli of unequal width, having 1 or 2 fine threads intercalated between them, but two or three of the lower spirals are always stronger than the others; base spirally striated with alternating broader and finer threads; strongly sinuous growth-lines cross the cinguli. *Spire* high, subulate, angle varying from 17° to 20°. *Protoconch* minute, of 1½ convex whorls. *Whorls* about 12, regularly increasing, slightly convex, the body-whorl sharply angled below, base flattish. *Suture* deep, simple. *Aperture* subquadrate, very little broader than high, angularly effuse below. *Outer lip* somewhat rounded, thin and acute, with a rather deep rounded anal sinus. *Columella* vertical, almost straight. *Inner lip* forming a thin glaze over a small part of the base.

Height, 27 mm.; diameter, 9 mm. (holotype).

Holotype in my collection.

Loc.—Waikopiro, near Ormondville, Hawke's Bay.—Pliocene.

Remark.—The Recent *T. chordata* Suter is a nearly allied species, though distinct.

Fam. STRUTHIOLARIIDÆ.

Struthiolaria tuberculata Hutton nov. subsp. **concinna**. Plate II, fig. 9.

Distinguished from the species by the presence of a third nodular keel on the body-whorl. The interspace between the second and third keel is about half the width of that between the two upper keels. The tubercles are smaller and closer together than on the keel above. The subspecies is somewhat smaller than the species.

The cast of a specimen from the Waihao greensands above Waihao Downs shows a very distinct trace of a fourth nodular carina upon the base; but this variation may be included in this subspecies, which must be described as having 3, sometimes 4, nodular keels on the body-whorl.

Height, 31 mm.; diameter, 23 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Waihao greensands, Waihao River, below Waihao Downs, South Canterbury: J. A. Thomson, 1913.

Fam. CALYPTRÆIDÆ.

Calyptræa (Sigapatella) maccoyi nov. sp. Plate II, fig. 10.

Shell small, rounded oval, with lateral apex and a few strong radial ribs, interrupted by growth-lines. *Sculpture* consisting of sharply marked, distant, and curved radial ribs, sometimes interrupted by spiral incremental ridges. *Spire* small, not elevated above the last whorl, lateral and posterior. *Protoconch* small, sharply raised. *Whorls* about 2, convex, the last large, somewhat flattened anteriorly, the margin regularly convex. *Basal plate* occupying about half of the base, the edge slightly concave. *Umbilicus* distinct.

Diameter, major 19 mm., minor 16 mm.; height, 11 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 170 = Awamoa beach and creek, North Otago: McKay, 1876. Also from Trelissick Basin.—Miocene.

Remark.—The specimen was accompanied by a label bearing the name *Calyptræa maccoyii*. It is most likely that the late Sir James Hector bestowed the name upon the species, but it does not appear in the Catalogue of the Colonial Museum, 1870.

Crepidula densistria nov. sp. Plate II, fig. 11.

Shell moderately large, oval, much elevated and strongly angled somewhat to the left of the middle, finely radially striated. *Sculpture* consisting of very close, narrow, rounded radial riblets, about 3 per millimetre, with linear interstices, and crossed by concentric growth-lines. *Protoconch* incurved, turned to the right. The last *whorl* is narrowly angled from the apex to about the middle of the length, laterally compressed, the right and left margin convex, the anterior margin very narrowly rounded. *Interior* of shell not seen.

Length, 28 mm.; diameter, 16 mm.; height, 13 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 170 = Awamoa beach and creek, North Otago: McKay, 1876.—Miocene.

Fam. NATICIDÆ.

Polinices planispirus nov. sp. Plate III, figs. 1, 2.

Shell large, globose, solid, with flat spire, microscopically spirally lirate, umbilicated. *Sculpture:* A good lens reveals dense, fine, spiral lines; growth-lines distinct, oblique and sinuous, otherwise the shell is smooth. *Spire* flat, the protoconch only being a little raised. *Protoconch* small, papillate. *Whorls* 5, the first four narrow, but the last very large, spire-whorls flat, body-whorl convex, globose. *Suture* covered, leaving a linear impression. *Aperture* vertical, large, ovate, angled above. *Outer lip* broken off. *Columella* vertical, slightly excavated. *Inner lip* thick and callous, spreading as a thick pad over part of the body, rounded and narrow towards the base. *Umbilicus* deep, quite open.

Height, 54 mm.; diameter, estimated at about 45 mm. (holotype).

Holotype in the Canterbury Museum, Christchurch; presented by Mr. M. C. Gudex.

Loc.—Sandy clay, lying immediately on top of the limestone, Blue Cliffs, near St. Andrews, South Canterbury: M. C. Gudex.—Miocene.

Polinices (Neverita) sagenus nov. sp. Plate III, fig. 3.

Shell moderately large, ovato-rotund, solid, with a low spire, umbilicated, aperture semilunar, callus of the inner lip partly extending into the umbilicus. *Sculpture* consisting of sinuous growth-lines, receding from the suture; on the upper part the umbilicus is bordered by a broad shallow sulcus, limited by sharp keels, getting obsolete on the lower part. *Spire* low, conoidal, with a blunt apex. *Protoconch* flatly convex, of $1\frac{1}{2}$ whorls. *Whorls* $3\frac{1}{2}$, the last very large, the spire-whorls flattish, body-whorl convex, lightly depressed below the suture on approaching the aperture; base oblique, flattish. *Suture* not much impressed. *Aperture* somewhat oblique, semilunar, angled above, narrowly rounded at the base. *Outer lip* regularly convex, strong, with a sharply rounded edge. *Columella* oblique, straight, slightly angled. *Inner lip* strongly callous, forming a solid pad on the body, part of it spreading over the umbilicus, tapering below. *Umbilicus* large, oval, deep, with folds of successive growth on its walls.

Height, 30 mm.; diameter, 30 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 165 = White Rock River, Upper Pareora Valley, South Canterbury: McKay, 1876.—Miocene.

Sinum fornicatum nov. sp. Plate III, fig. 5.

Shell of moderate size, auriculate, somewhat ventricose, with a small umbilical perforation, finely spirally striated, and with a large oblique aperture. *Sculpture:* The protoconch smooth, the succeeding whorls finely and fairly regularly striated (about 3 per millimetre); the riblets are at first simple, the interstices of nearly the same width, but on approaching the outer lip they are becoming somewhat broader, usually bearing a sulcus, and the interstices filled with one or two fine spiral threads; the arcuate growth-lines in some places decussate the spiral ornamentation. *Spire* low, convex. *Protoconch* small, planorbiform, of $2\frac{1}{2}$ convex volutions. *Whorls* 4, convex, the last very rapidly enlarging, narrowly rounded at the base, which is excavated behind the pillar. *Suture* very distinct, appressed. *Aperture* ample, ovate, oblique, angled above, convex below, basal lip receding. *Outer lip* simple, acute, broadly convex. *Columella* gyrate, slightly excavated below. *Inner lip* narrow, callous, extending above over the basal excavation, forming a distinct and fairly deep *umbilical chink.*

Height, 11 mm.; diameter, 18 mm. (holotype).

Holotype in my collection.

Loc.—Right bank of Maerewhenua River, North Otago: G. H. Uttley.—Miocene.

Sinum (Eunaticina) elegans nov. sp. Plate III, fig. 4.

Shell small, globose, with depressed spire, smooth, but microscopically spirally lirate, umbilicate. *Sculpture:* On the last two whorls the growth-lines are forming, for a short distance only, irregular oblique riblets below the suture, leaving the remainder of the volutions smooth and polished; a good lens, however, reveals fine close spiral striation, 8 to 9 threads per millimetre, more prominent upon the base of the body-whorl. *Spire* low, conoidal, with a blunt apex, its height about one-third that of the aperture. *Protoconch* small, smooth, planorboid. *Whorls* $4\frac{1}{2}$, first very slowly increasing, convex, the last whorl large, globose. *Suture* very distinct, impressed. *Aperture* large, ovate, angled above, somewhat effuse below. *Outer lip* thin and sharp, convex, the basal lip narrowly rounded. *Columella* vertical, slightly excavated, smooth. *Inner lip* a little expanded, covering the parietal wall, partly hiding from view the moderately large, deep *umbilicus.*

Height, 15 mm.; diameter, 13 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Holotype from loc. No. 630 = Teaneraki (Enfield), near Oamaru, North Otago: T. Esdaile. Also from loc. No. 642 = Waihao Bridge, one mile and a half below Waihao Forks, South Canterbury: McKay, 1880.—Miocene.

Ampullina waihaoensis nov. sp. Plate XI, fig. 10.

Shell rather small, globose, with little raised spire, smooth, umbilicated, with a prominent limb bordering the umbilicus. *Sculpture* none, except fine growth-lines receding in a curve from the suture. *Spire* low, conoidal, its height one-third that of the aperture, angle about 112°. *Protoconch* but little raised, flatly convex, of $2\frac{1}{2}$ convex whorls. *Whorls* $4\frac{1}{2}$, first very slowly increasing, convex, the last large, globose, base flattish. *Suture* well impressed, simple. *Aperture* large, vertical, almost semilunar, angled above, convex below. *Outer lip* acute, regularly arched. *Columella* subvertical, straight in the middle, turned to the right on the parietal wall. *Inner lip* forming a thick callous pad on the parietal wall. *Umbilicus* moderately large, deep, margined by a very prominent limb which descends from the upper part of the umbilicus, and is limited by a narrow groove on the outside

Height, 16 mm.; diameter, 16 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 642 = Waihao Bridge, one mile and a half below Waihao Forks, South Canterbury: McKay, 1880.—Miocene.

Fam. Cypræidæ.

Cypræa (Luponia) trelissickensis nov. sp. Plate XI, fig. 11.

Shell small, ovate, ventricose, gradually tapering towards the anterior beak, the outer lip much thickened, projecting beyond the apex. *Sculpture:* The whole surface is smooth. *Spire* concealed, not depressed. *Whorl* ventricose on the back and base, slowly narrowing anteriorly; the anterior part is broken off, but there was most likely only a short beak. *Aperture* narrow, widening towards the front, a little curved posteriorly, ending in a channel which leads to the apex. *Outer lip* convex, much thickened, extending posteriorly some distance beyond the apex; the no doubt toothed inside hidden by matrix. *Columella* curved, rounded; the slender ridges which are most likely present remain also invisible.

Length, 17 mm.; width, 11 mm.; height, 9·5 mm. (imperfect holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 241 = Tufaceous greensands, Whitewater Creek, Trelissick Basin, Canterbury: McKay, 1879. Found also at Kakanui by Mr. G. H. Uttley.—Miocene.

Remarks.—This pretty species may be classed under the section *Eocypræa*, Cossmann (Essais Paléoconch. Comp., livr. 5, 1903, p. 162) of the subgenus *Luponia*. The section is characterized by Cossmann as follows: Shell ventricose, somewhat attenuated anteriorly, spire completely hidden, aperture narrowed behind, the posterior channel directed towards the apex, the outer lip projecting backwards; peristome callous, rounded, the outer lip thickened, plicated the whole of its length; columella finely crenate at its entrance, with an anterior excavation, not twisted anteriorly, the anterior lip formed by the lowest and stronger crenation of the columella.

This species has some resemblance with *C. murraviana* Tate, from the Tertiary of Victoria, but is certainly distinct.

Erato neozelanica nov. sp. Plate III, figs. 6, 7.

Shell large, pyriform, ventricose, abruptly rounded to the slightly elevated spire, tapering rapidly to a straight, short, and truncated anterior beak, aperture narrow, both lips ridged. *Sculpture* none, the whole shell being covered with smooth enamel. *Spire* low, conical, raised above the outer lip, acute. *Protoconch* small, rounded. *Whorls* 5, the spire-whorls small, body-whorl large, ventricose, contracted below. *Suture* hidden by enamel, but where this is broken off the suture is seen to be canaliculate. *Aperture* narrow, long, slightly oblique, narrowly angled above, with a very short anterior canal. *Outer lip* thickened and rounded, externally margined, extending above over the penultimate whorl, with about 20 tooth-ridges. *Columella* convex above, faintly excavated below. *Inner lip* with 10 short and slender ridges, wider apart anteriorly, 3 to 4 oblique ridges at the base.

Length, 19 mm.; width, 13 mm.; height, 10·5 mm. (holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Shell-bed, Target Gully, Oamaru: Marshall.—Miocene.

Remark.—This is the first species of the genus recorded from New Zealand.

Fam. Tonnidæ.

Genus Ficus Bolten, 1798.

Bulla (sp.) Linné, Syst. Nat., ed. 12, p. 1184, 1767.

Ficus (sp.) (anonymous), Mus. Calonnianum, p. 32, 1797; *Bulla ficus* Linné.

Ficus Bolten, Mus. Boltenianum, p. 148, 1798; sole example, *Bulla ficus* Gmelin.

Pyrula Lamarck, Prodrome, p. 73, 1799; sole example, *Bulla ficus* Linné; Syst. des Anim. s. Vert., p. 82, 1801, same type.

Pirula Montfort, Conch. Syst., ii, p. 486, 1810; same type.

Ficula Swainson, Malac., pp. 85, 307, 1840; same type.

Sycotypus Mörch, Cat. Yoldi, p. 110, 1852.

Sycotyphus Conrad, Am. Jour. Conch., i, p. 151, 1865.

The name *Ficus* Bolten, based on the same type, and derived from early eighteenth-century authors before Linné, has a year's priority over *Pyrula* Lamarck, and must be adopted (Dr. W. H. Dall, "The Miocene of Astoria and Coos Bay, Oregon," 1909, p. 74).

Ficus parvus nov. sp. Plate III, fig. 8.

Shell small, pyriform, with slightly elevated spire and reticulating ornamentation. *Sculpture* consisting of fine, rather close spiral threads, reticulated by axial striæ parallel to the fine lines of growth. *Spire* low, conoidal, its height about one-fourth the height of the aperture with canal. *Protoconch* lost. *Whorls* about 3, convex, the last large, medially ventricose, narrowed towards the base. *Suture* simple, not much impressed. *Aperture* large, narrowly pyriform, angled above, produced below into an open canal, the lower part of it broken off in the unique specimen before me. *Outer lip* convex, thin, acute. *Columella* smooth, slightly oblique and excavated at the middle, inflected towards the canal. *Inner lip* indistinct.

Height, 18 mm.; diameter, 11 mm. (holotype).

Holotype in my collection.

Loc.—Calcareous band in blue tuff below limestone, Rifle Butts, Oamaru: G. H. Uttley.—Miocene.

Remarks.—I do not think the shell is adult, and the species may attain much larger dimensions in the gerontic stage.

The genus *Ficus* is an addition to the fauna of New Zealand. The Recent species inhabit the warm seas of the Antilles, the Indian Ocean, and the Philippines. Fossil *Ficus* first appears in the Cretaceous, and then in the Older Tertiary of Europe, North America, India, Java, Patagonia, Chile, and Tasmania (*Ficus altispira* Pritchard).

Ficus transennus nov. sp. Plate III, fig. 9.

Shell ovate, thin, rather small, reticulated, with a considerably raised spire. *Sculpture* consisting of rather close, regularly spaced, narrow and convex axial ribs which vanish upon the base, about 24 on the penultimate whorl, with the interstices slightly broader, crossed by equally strong spiral ribs, the points of intersection gemmate, dividing the surface into small squares. A paratype has part of the shell preserved, and this shows that there are 1 to 3 fine threads in the interspaces between the cinguli, and that the surface is ornamented with close, well-developed growth-lines or axial riblets, reticulating the fine threads in the spiral interstices. *Spire* conic, exceptionally high for the genus, outline convex, angle about 68°. *Protoconch* lost. *Whorls* about 4, convex, the last large, somewhat ventricose, excavated below. *Suture* not deep, covered up (the holotype, a cast only, has an apparently deeply canaliculate suture, the whorls separated, but this is the result of the loss of shell-substance). *Aperture* large, pyriform, angled above, gradually narrowing below to form a moderately long, open canal (the lower part broken off in all the specimens before me). *Outer lip* thin and sharp, convex, smooth inside. *Columella* slightly sinuous, plain. *Inner lip* very thin and narrow.

Height, 28 mm.; diameter, 16 mm. (imperfect holotype).

Holotype in the collection of the New Zealand Geological Survey; presented by Mr. G. H. Uttley.

Loc.—Allday Bay, North Otago: G. H. Uttley. Also Wharekuri, Waitaki Valley. —Miocene.

Fam. ARCHITECTONICIDÆ.

Architectonica ngaparaensis nov. sp. Plate I, fig. 6.

Shell very small, discoidal, spire very little elevated, with wide scalar umbilicus, the carinate periphery adorned with a moniliform rib, a second one below the suture, the intervening space between the two ribs finely spirally striated. *Sculpture:* Protoconch apparently smooth, the following whorls finely spirally striated, the striæ unequal and crossed by inconspicuous flattish radiate riblets on the last whorl; periphery with a sharp moniliform rib, a similar but less strong rib margining the suture on the outer side; umbilicus with a sharply toothed carina, and a second toothed spiral rib a little farther inward. *Spire* very little elevated. *Protoconch* flattish, with a sunken nucleus. *Whorls* 4, regularly increasing, flattish, the last sharply keeled. *Suture* impressed, bimargined. *Aperture* subquadrangular. *Peristome* continuous, thin and sharp. *Umbilicus* wide, scalar, showing all the whorls.

Height, 2 mm.; diameter, 6 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 487 = Concretions with fossils overlying coal-beds, Ngapara, North Otago: McKay, 1882.—Miocene.

Heliacus imperfectus nov. sp. Plate II, fig. 4.

Shell small, thin, orbicular, smooth, widely umbilicated, whorls rounded. *Sculpture* consisting of oblique growth-lines and traces of a few radiate tubercular riblets on the last whorl, the outer layer, bearing the ornamentation, having been lost. *Spire* depressed, its height about half that of the aperture. *Protoconch* lost, but evidently small and flattish. *Whorls* about 4, the last more rapidly increasing, flatly convex, narrowly rounded at the periphery. *Aperture* oblique, ovate, subangled above. *Peristome* thin, acute, continuous. *Umbilicus* wide, perspective, a little less than half the greater diameter.

Diameter, max. 9·5 mm., min. 8 mm.; height, 4 mm. (holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Shell-bed, Target Gully, Oamaru, North Otago: Marshall.—Miocene.

Fam. EPITONIIDÆ.

Epitonium (Clathroscala) cylindrellum nov. sp. Plate XI, figs. 12, 13.

There are only two fragments before me, yet they are so distinct from any Australasian form known to me that I do not hesitate to describe and figure them here. Better and more perfect specimens may turn up later on, when the diagnosis can be amended and corrected.

Shell medium size, turriculated, imperforate, the spire apparently high and only very gradually tapering, with distant, not very prominent, rounded axial ribs and close spiral liræ. *Sculpture:* There are 9 to 10 rounded, not much raised, axial ribs, some continuous, most others discontinuous over the suture, stopped at the base by a peripheral keel, the broad interstices concave; the spiral sculpture consists of 8 to 9 distinct rounded cords with almost linear interstices, passing over the ribs; the base with a somewhat stronger spiral, and three cords below it, of which the median one is stronger; the remainder of the base most likely smooth. *Spire* very gradually increasing in width towards the anterior end. *Suture* not very deep, very likely covered. *Whorls* not high, convex, the base flattish. *Aperture* almost circular.

Height, 9 mm.; diameter, 7 mm. (piece of 2 whorls). Height, 13 mm.; diameter, 6 mm. (piece of 3½ whorls), (holotype and paratype).

Holotype and *paratype* in the collection of the New Zealand Geological Survey.

Loc.—No. 241 = Tufaceous greensands, Whitewater Creek, Trelissick Basin, Canterbury: McKay, 1879. Also from loc. No. 243 = Fan-coral beds, Trelissick Basin: McKay, 1879.—Miocene.

Epitonium (Clathroscala) elatum nov. sp. Plate XI, fig. 14.

Shell small, slender, fragile, turreted, imperforate, axially costate and finely spirally striate. *Sculpture* consisting of slightly oblique, well-raised, and narrowly rounded axial ribs, with slightly broader concave interstices which are irregularly microscopically punctated by growth-lines, the ribs continuous or discontinuous over the whorls, but not passing over the suture; upon the base they are nearly obsolete; the spiral threads are inequidistant and of different strength, passing over the axials, and varying in number from about 10 to 15 on the lower whorls; keel of the body-whorl, which arrests the progress of the axials to a great extent, without any specially strong cord, base finely spirally striate. *Spire* high, subulate, angle 20°. *Protoconch* broken off. *Whorls* about 10 or more, regularly increasing, convex, the uppermost of them indistinctly shouldered, the body-whorl sharply angled, base flat. *Suture* well impressed, but not separating the volutions. *Aperture* rotundly ovate, vertical. *Peristome* continuous, slightly produced at the angle of the whorl.

Height, 27·5 mm.; diameter, 5 mm. (holotype of 8 whorls).

Holotype in the Canterbury Museum, Christchurch; presented by Mr. M. C. Gudex.

Loc.—Sandy clay lying immediately on top of the limestone, Blue Cliffs, near St. Andrews, South Canterbury: M. C. Gudex.—Miocene.

Epitonium (Acrilla) gracillimum nov. sp. Plate XI, fig. 15.

Shell small, very fragile, turriculate, axially obliquely ribbed and very distinctly spirally lirate. *Sculpture:* There are thin, rather sharply raised, fine, retractive axial riblets, crossed by very conspicuous equal spiral threads, 7 to 8 on the body-whorl, and extending over the base, which is not marked off by an angle or keel, the interstices of the same width as the threads. *Spire* high, subulate, angle about 20°. *Protoconch* broken off. *Whorls* about 12, convex, a little flattened above, regularly increasing, the body-whorl rounded towards the convex base. *Suture* well impressed, but not separating the whorls. *Aperture* vertical, ovate, slightly effuse below. *Peristome* continuous, not much thickened, but the only specimen before me is most likely not quite adult.

Height, 16 mm.; diameter, 5 mm. (imperfect holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Left bank of Waitaki River, opposite Wharekuri: Marshall.—Miocene.

Remark.—The lower part of the figure shows some fibres of cotton-wool which unfortunately stuck to the gum with which the specimen was fixed on cardboard.

Fam. PYRAMIDELLIDÆ.

Turbonilla (Pyrgiscus) oamarutica nov. sp. Plate I, fig. 7.

Shell small, cylindro-conic, with many convex whorls, well-developed axial ribs, and strong spiral striations, columella without a fold. *Sculpture:* Protoconch smooth, the succeeding whorls with slightly oblique, broadly rounded, axial riblets, about 14 on a whorl, vanishing towards the base of the last whorl, the interstices of about the same width, crossed by rather distant well-pronounced spiral cords, 5 on the penultimate whorl, the interstices slightly broader than the cords on the upper part of the whorls, nearly equal on the lower part, and linear upon the base. *Spire* cylindro-conic, much higher than the aperture. *Protoconch* with the nucleus set up at an angle to the adult axis, of 2 convex whorls. *Whorls* about 10, regularly descending, slightly convex, faintly flattened below the suture, the last whorl somewhat narrowed below. *Suture* well impressed, submargined below. *Outer lip* convex, acute, smooth within. *Columella* oblique, straight, forming a wide angle with the nearly straight parietal wall. *Inner lip* very thin and narrow, without plication.

Height, 8 mm.; diameter, 2·2 mm. (holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Shell-bed, Target Gully, Oamaru: Marshall.—Miocene.

Turbonilla (Mormula) prisca nov. sp. Plate III, fig. 10.

Shell small, subulate, strongly axially costate and spirally lirate, with very distinct varices, without a basal keel. *Sculpture:* The post-embryonic whorls have vertical, narrowly rounded axial riblets, about 12 on a whorl, the interstices somewhat wider than the costæ, and, besides these, broad moderately convex discontinuous varices; there are well-pronounced spiral liræ with narrow interstices, about 9 on a whorl, the lowest more prominent and margining the upper part of the suture; they extend half-way down upon the base. *Spire* high, subulate. *Protoconch* lost. *Whorls* 7 on the imperfect holotype, flattish, the body-whorl convexly bent towards the base, without a keel. *Suture* deep, margined. *Aperture* oval, higher than broad, slightly effuse below. *Outer lip* slightly convex, strengthened on the outside by a varix. *Columella* vertical, nearly straight. *Inner lip* smooth, narrowly expanding as a well-limited callosity over the body.

Height, 9·5 mm.; diameter, 2·8 mm. (imperfect holotype).

Holotype in the Canterbury Museum, Christchurch; presented by Mr. M. C. Gudex.

Loc.—Sandy clay lying immediately on top of the limestone, Blue Cliffs, near St. Andrews, South Canterbury: M. C. Gudex. Also Allday Bay, Kakanui, North Otago: G. H. Uttley.—Miocene.

Fam. EULIMIDÆ.

Niso neozelanica nov. sp. Plate XI, fig. 16.

Shell subulate, sharply pointed, polished, smooth, the last whorl and the umbilicus keeled, the inner lip of the aperture broadly expanded. *Sculpture* consisting of very fine growth-lines only, and an occasional fine vertical groove. *Spire* high, subulate, acute, the outlines straight, nearly four times the height of the aperture, angle 30°. *Protoconch* minutely papillate, acute. *Whorls* 13, very regularly increasing, very slightly convex, the last lightly keeled at the periphery, base faintly convex. *Suture* not much impressed, simple. *Aperture* pyriform, angled above and below. *Outer lip* thin and sharp. *Columella* short, rounded, very faintly excavated.

Inner lip broadly expanded towards the umbilicus, and also at the base. *Umbilicus* very deep, margined by a keel, its width about one-third of the diameter.

Height, 9·3 mm.; diameter, 4 mm. (holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Left bank of Waitaki River, opposite Wharekuri: Marshall.—Miocene.

Remarks.—This is a very interesting discovery, as the genus has never before been recorded from New Zealand, either fossil or recent. One species, *Niso darwini* Koninck, has been recorded from the Lower Devonian of the Yass district, New South Wales (Memoirs of the Geol. Surv. of N.S. Wales, Palæontology, No. 6, 1898, p. 191, pl. iv, figs. 11, *a-c*). A second species, *Niso psila*, T.-Woods (Proc. Linn. Soc., N.S.W., vol. iv, 1880, p. 18, pl. i, fig. 6) occurs in the Lower Miocene of Muddy Creek, Victoria. The latter is a larger species, and has distant spiral striation.

Fam. TURBINELLIDÆ.

Tudicla neozelanica nov. sp. Plate XI, figs. 17, 18.

Shell small, broadly fusiform with a conoidal spire, imperforate, solid, with a row of spines close to the lower suture, continued upon the carina of the body-whorl, spirally striate, and most likely with a long canal. *Sculpture:* The lower two whorls bear small tubercles or spines, about 10 on a whorl, continued as low axial ribs on the body-whorl, and there are traces of rather fine spiral striation. *Spire* low, conoidal, its height about two-thirds that of the aperture without canal, angle 85°. *Protoconch* small, the nucleus lost. *Whorls* 4, first slowly then more rapidly increasing, the spire-whorls flat, the body-whorl with a keel starting from the suture, flat upon the shoulder, convex below the carina, and gradually contracted towards the neck of the canal. *Suture* not impressed, strongly undulated by the close proximity of the tubercles. *Aperture* imperfect in the unique specimen, slightly oblique, ovate, angled above, produced into a canal below, which is broken off, but is no doubt long. *Outer lip* imperfect, angled above at the keel. *Columella* vertical, concave, with a very distinct plait at the juncture with the canal. *Inner lip* narrow, very moderately callous.

Height, 29 mm.; diameter, 22 mm. (imperfect holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No 164 = Coal-beds, Kakahu River, South Canterbury: McKay, 1876.—Miocene.

Remarks.—This is the first record of the genus occurring in New Zealand. Three species from the Tertiary of Victoria have been described by Tate (Trans. Roy. Soc., South Aust., vol. x, 1888, p. 159). The Recent species of *Tudicla* are confined to the Indo-Australian region.

Streptosiphon (Streptopelma) reticulatum nov. sp. Plate XI, fig. 25.

Shell ovately fusiform, imperforate, with conical spire, strongly convex whorls which are bearing strong spiral cords, reticulated by fine axial riblets, columella with a prominent oblique fold below and 2 minor ones above. *Sculpture:* Post-embryonic whorls with conspicuous spiral cords, 2 to 3 finer ones below the suture, 3 much stronger and more distant spirals below, the interstices of the latter broader than the cinguli, rather deep, flat; the spirals are reticulated by axial threads, slightly nodulous at the points of intersection; body-whorl with distant strong cinguli down to the neck of the canal. *Spire* conical, about twice the height of aperture and canal. *Protoconch* lost. *Whorls* 5 without the protoconch, regularly descending.

strongly convex, somewhat flattened below the suture, the last much contracted towards the canal. *Suture* not much impressed, simple. *Aperture* pyriform, channelled above, with an evidently narrow open canal, lightly turned to the left, but the lower part is unfortunately broken off, as is a great part of the outer lip. *Columella* vertical, with a distinct oblique fold at the deflection towards the canal, and 2 smaller folds higher up.

Height, 15 mm.; diameter, 7 mm. (imperfect holotype).

Holotype in my collection.

Loc.—Waihao River, South Canterbury: G. H. Uttley.—Miocene.

Remarks.—A genus new to our fauna. The type of the subgenus *Streptopelma* Cossmann (Essais Paléoconch. Comp. livr. 4, 1901, p. 74) is *Peristernia lintea* Tate (Trans. Roy. Soc., South Aust., vol. x, 1888, p. 157, pl. viii, fig. 11) from the lower beds of Muddy Creek, Victoria, considered to be of Oligocene age.

Galeodes (Pugilina) angusta nov. sp. Plate XI, fig. 19.

Shell fusiform, turreted, imperforate, axially distantly costate and spirally lirate. *Sculpture:* There are distant axial ribs extending from the keel to the anterior suture, and nearly to the base on the last whorl, forming sharp tubercles upon the carina, crossed by rather coarse spiral cords of which only traces are visible on the unique specimen. *Spire* narrowly conic, turreted, very likely rather high. *Whorls* prominently shouldered, the shoulder flat, spire-whorls straight below the keel, but slightly convex on the last whorl. *Suture* well impressed. *Aperture* somewhat oblique, angled above, widened below. *Siphonal fasciole* present.

Height, 26 mm.; diameter, 13 mm. (holotype of 2 whorls).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 164 = Coal-beds, Kakahu River, South Canterbury: McKay, 1876.—Miocene.

Remarks.—The only specimen just now available is undoubtedly a young shell of only 2 whorls, a few of the earlier volutions being lost. It seems very probable that the adult shell will have a body-whorl of considerably greater diameter, and will have a general aspect of a somewhat higher and narrower form of *Hemifusus subcarinatus* (Lamarck), which is considered to be a *Galeodes (Pugilina)* by Cossmann. For a figure of this species see Zittel, Text-book of Palæontology (translated and edited by Eastman), 1900, p. 476, fig. 967.

The generic name *Galeodes* Bolten, Mus. Bolten., 1798, p. 53, type *Murex melongena* Gmel. (not *Galeodea* Link, 1807), is here adopted, having priority over *Melongena* Schumacher, 1817. Authorities consider the name *Galeodes* sufficiently distinct from *Galeodea*, allowing both to be used.

Galeodes biconica nov. sp. Plate XI, fig. 20.

Shell of medium size, biconic, the last whorl with a row of spines upon the angle of the periphery. *Sculpture:* Protoconch and spire-whorls smooth, the body-whorl with 9 short conical spines upon the angle, which is situated a little above the middle; there are traces of spiral striation and distinct flexuous growth-lines upon the body-whorl. *Spire* conic, its outlines a little concave above, angle 58°, height about half that of the aperture. *Protoconch* of 1 papillate whorl. *Whorls* $4\frac{1}{2}$, first slowly increasing, flat, the last large, angled, flat or faintly concave above, slightly convex below, very gradually contracted towards the base. *Suture* not much impressed, simple. *Aperture* somewhat oblique, high, pyriform, narrowly angled above, with a very short, widely open canal, which is notched at the base. *Outer lip* acute, angled, retrocurrent at the suture and towards the canal. *Columella* oblique. *Inner lip* narrow, with a callous pad above. *Siphonal fasciole* very distinctly raised, oblique.

Height, 31 mm.; diameter, 20 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 164 = Coal-beds, Kakahu River, South Canterbury: McKay, 1876.—Miocene.

Galeodes (Pugilina) liræcostata nov. sp. Plate XI, figs. 21, 22.

Shell of moderate size, ventricose, with short spire, the whorls carinated, with low distant axial ribs, produced into spines upon the keel, spirally lirate, 1 spiral cord below the carina and 3 strong distant spirals on the lower half of the body. *Sculpture:* The spire-whorls are carinated and bear triangular spines close to the lower suture, the body-whorl has 9 distant convex axial ribs, but faintly indicated upon the shoulder, and short below the keel, produced into blunt triangular spines; the whole surface is ornamented with subequal spiral cords; a short distance below the carina is a strong spiral cord, duplicating the keel, and on the lower half of the body-whorl there are 3 distant very strong spiral cords, the lowest near the canal; the oblique growth-lines are receding from the suture. *Spire* depressed, conoidal, its height somewhat less than half that of the aperture. *Protoconch* of 1 papillate whorl, a little excavated at the centre. *Whorls* about 4, sharply carinated, the shoulder broad, concave, body-whorl large, flat below the keel and narrowing towards the base. *Suture* impressed, undulating. *Aperture* oblique, somewhat pyriform, broadly angled above. *Outer lip* acute, sharply angled. *Columella* oblique.

Height, 24 mm.; diameter, 22 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 164 = Coal-beds, Kakahu River, South Canterbury: McKay, 1876.—Miocene.

Remark.—Somewhat allied species are *G. proteiformis* and *G. octocostata* Cossmann, from the coast of Karikal, Coromandel, India.

Galeodes maoriana nov. sp. Plate III, fig. 11.

Shell ovato-pyriform, ventricose, with a short acute spire, and a row of spines upon the middle of the body-whorl. *Sculpture:* The only ornamentation consists of a single row of low conical spines at about the middle of the last whorl; flexuous growth-lines are distinctly visible, faintly advancing from the suture. *Spire* short, conic, its height about one-third that of the aperture. *Protoconch* papillate, broadly convex. *Whorls* about 4, the spire-whorls slowly increasing, flattish, the body-whorl very large and ventricose, convex above, straightened down to the row of spines, contracted towards the base on the right anterior side, but very little on the left. *Suture* not much impressed, simple. *Aperture* pyriform, high, angled above, with a widely open short canal below. *Outer lip* convex, acute *Columella* oblique, nearly straight, smooth. *Siphonal fasciole* very prominent, oblique, rounded.

Height, 44 mm.; diameter, 28 mm. (imperfect holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 164 = Coal-beds, Kakahu River, South Canterbury: McKay, 1876.—Miocene.

Galeodes modesta nov. sp. Plate XI, figs. 23, 24.

Shell elongate-pyriform, imperforate, with a short spire, turreted at its lower part, body-whorl high and somewhat ventricose, with 2 keels not very distant from the suture, the upper more strongly nodulous than the lower. *Sculpture:* Protoconch smooth, the post-embryonic whorls with a carina at the middle which bears blunt but distinctly raised oval tubercles; this row of tubercles is continued over the body-whorl, a second row emerging from the angle of the aperture, whose tubercles are smaller, but increase in size on approaching the outer lip; farther down, extending to the base are distant slender cinguli, with 1 to 4 fine threads in the interstices, more or less cut up by growth-lines. *Spire* short, conical, sharply pointed, turreted, outlines straight, angle about 70°, its height two-fifths the height of the aperture. *Protoconch* minute, papillate, of about 2½ whorls. *Whorls* about 6, at first slowly increasing, the post-embryonic spire-whorls keeled at the middle, concave above and below the carina; body-whorl with an excavated shoulder, ventricose on the upper part, the anterior right side contracted towards the base, the left remaining convex. *Suture* not deep, a little uneven. *Aperture* very high and narrow, angled above, with a short widely open siphonal canal, its base notched. *Outer lip* regularly convex, acute. *Columella* long, vertical, smooth, rounded, slightly turned to the left towards the canal. *Inner lip* inconspicuous. *Siphonal fasciole* distinct, rounded, oblique.

Height, 36 mm.; diameter, 21 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 164 = Coal-beds, Kakahu River, South Canterbury: McKay, 1876.—Miocene.

Fam. FASCIOLARIIDÆ.

Fusinus bicarinatus nov. sp. Plate XII, fig. 1.

Shell small, fusiform, with a rather broad, short, and turreted spire, the body-whorl bicarinate, with faint axial ribs, produced into tubercles upon the keels, spirally lirate, and probably with a long straight canal, which, however, is broken off in all the specimens before me. *Sculpture:* The spire-whorls keeled at the lower third, body-whorl with a second, more feeble, carina below the first; all the whorls, except the smooth protoconch, with numerous, low, rounded axial ribs, more or less obscure upon the shoulder, not extending beyond the second keel on the last whorl, produced into vertically compressed tubercles upon the keels, about 12 on a whorl; the spiral ornamentation consists of fine, rather distant, threads, 7 to 8 above and the same number below the keel on the penultimate whorl; on the base there are about 7 much stronger spiral cords, the interstices contain a finer spiral thread; distinct growth-lines sometimes reticulate the spiral sculpture. *Spire* conical, turreted, a little higher than the aperture without canal, angle about 55°. *Protoconch* small, but the initial part is lost in all specimens. *Whorls* about 6, first slowly increasing, the body-whorl large in proportion, spire-whorls keeled at the lower third, the shoulder flattish, the part below the carina a little receding, body-whorl distinctly biangulate, contracted towards the neck of the canal. *Suture* not deep, simple. *Aperture* oblique, small, angled above, produced below into a canal which is most likely long and straight. *Outer lip* angled, straight above and convex below, rapidly approaching the canal. *Columella* short, rounded, excavated, slightly bent to the left towards the canal. *Inner lip* rather thin and narrow.

Height, 14 mm.; diameter, 9·5 mm. (imperfect holotype).

Holotype and two *paratypes* in the collection of the Geological Survey.

Loc.—Tuffs interbedded with "Amuri limestone," Coleridge Creek, Trelissick Basin, Canterbury: J. A. Thomson, 1914.—Miocene or older.

Fusinus kaiparaensis nov. sp. Plate XII, fig. 2.

Shell moderately large, fusiform, with a high, acute, turreted spire, and long straight canal, axially costate, the ribs produced into more or less raised compressed spines or nodules, with prominent spiral liration. *Sculpture:* Protoconch smooth, the succeeding spire-whorls are carinated below the middle and bear broadly rounded axial ribs, rather faint on the last whorl and upon the shoulder, from 8 to 10 on the body-whorl, raised into compressed nodules on the carina of the upper whorls, but forming vertically compressed blunt spines on the last whorl, disappearing towards the base; the shoulder bears fine spiral cords which are getting coarser on approaching the keel, and have a fine thread in the interstices, a conspicuous spiral cord upon the keel and 1 of the same strength below it, which is nodulous; on the body there are strong spiral cords below the carina, sometimes containing a fine thread in the interstices, getting finer and closer together towards the neck of the canal; growth-lines distinct, sometimes rendering the spirals on the body slightly nodulous. *Spire* acute conic, turreted, about 2½ times the height of the aperture without canal, angle about 42°. *Protoconch* very small, of 2 convex whorls, the nucleus blunt. *Whorls* 10, first slowly then more rapidly descending, carinated a little below the middle, excavated above and slightly convex below the keel, body-whorl moderately convex below the carina, suddenly contracted towards the neck of the canal. *Suture* not much impressed, slightly undulating. *Aperture* subvertical, pyriform, channelled above, with a long, straight, and open canal below, its length being about equal to the height of the aperture. *Outer lip* sharp, angled above, then convex, but suddenly contracted towards the canal, strongly lirate inside. *Columella* vertical, rounded, short, very little excavated, truncated at the base where the canal begins. *Inner lip* narrow, somewhat callous, drawn out to a fine cord on the margin of the canal.

Height, 41 mm.; diameter, 23 mm. (imperfect holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Komiti Bluff, Kaipara Harbour, North Auckland: Marshall.—Miocene.

Fusinus climacotus nov. sp. Plate III, fig. 12.

Shell small, fragile, subulate-fusiform, whorls keeled, spirally distantly lirate and axially costate. *Sculpture:* Protoconch smooth, post-embryonic whorls sharply keeled below the middle, shoulder with 3 equidistant narrowly rounded spiral cords, and 2 somewhat stronger spirals below the keel; 2 very fine threads margin the suture above and below; equidistant, feeble, narrow axial riblets, about 15 on a whorl, are raised into low triangular spines on the carina, and the spirals above and below the keel are raised into small tubercles at the points of intersection; the growth-lines are very distinct, crowded. *Spire* scalar, angle 22°. *Protoconch* pupoid, consisting of 3 strongly convex whorls. *Whorls* high, regularly increasing, strongly keeled, flat above and below the carina. *Suture* not much impressed, bimargined. The lower part of the shell is unfortunately missing.

Height, 17·5 mm.; diameter, 6 mm. (imperfect specimen of 9 whorls; holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 630 = Teaneraki (Enfield), near Oamaru, North Otago: T. Esdaile.—Miocene.

Fusinus congestus nov. sp. Plate XII, fig. 3.

Shell small, fusiform, with a low conoidal turreted spire, whorls with a spinous keel, the last axially costate and spirally lirate, canal long. *Sculpture:* The spire-whorls have the carina close to the lower suture, beset with short stout spines; the body-whorl has 12 broadly rounded axial ribs, starting from the keel and extending half-way down to the neck of the canal, on the carina they are produced into vertically compressed spines which are getting less prominent on approaching the outer lip, the interstices deep and narrower than the ribs; upon the broad shoulder of the penultimate whorl a few spiral threads appear, and increase to the number of 5 to 6 on the last whorl; from the keel downwards there are dense, convex, rather coarse spiral cords with narrow interstices, but on the neck of the canal they are finer and much more distant. *Spire* conoidal, a little higher than the aperture without canal, turreted, angle 65°. *Protoconch* lost. *Whorls* 4 without the protoconch, the last rather large, keeled just above the suture on the spire, with a broad and slightly concave shoulder, last whorl convex below the keel, thence much contracted towards the long canal. *Suture* well impressed, wavy. *Aperture* subvertical, pyriform, angled above, with a long open canal, slightly diverted to the left, its base truncated. *Outer lip* acute, slightly thickened, convex and angled above, concave below. *Columella* vertical, straight, slightly bent to the left towards the canal. *Inner lip* narrow and thin, tapering below and drawn out to a fine point at the middle of the canal-margin.

Height, 14 mm.; diameter, 7 mm. (imperfect holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 165 = White Rock River, Upper Pareora Valley, South Canterbury: McKay, 1876.—Miocene.

Remark.—This species somewhat resembles *F. tegens* (Hutton), but the latter is much smaller and more elongate, the spire more acute, and the spirals of the body-whorl less numerous, stouter.

Fusinus morgani nov. sp. Plate III, fig. 13.

Shell fusiform, with a high spire, carinated whorls, 5 to 6 wedge-shaped tubercles on the carina, spirally lirate, aperture triangular, with a long straight canal, outer lip lirate within. *Sculpture:* All the whorls are carinated, the carina being on the anterior third on the spire-whorls; the whole surface with fine spiral threads, usually a stronger thread alternating with 1 or 2 finer ones; on the body-whorl there are below the keel stronger, distant spiral cords, the interspaces with 2 or more fine spirals; growth-lines are sometimes very conspicuous, forming fine axial riblets on and around the tubercles; there are 5 to 6 axial plicæ, which are produced into wedge-shaped or conical high and pointed tubercles on the carina. *Spire* high, about the same height as the aperture with canal. *Protoconch* lost in all specimens before me. *Whorls* about 7 to 8, regularly increasing, the shoulder concave; body-whorl convex below the carina, contracted towards the canal. *Suture* linear. *Aperture* subvertical, triangular, angled above, produced below into a long, straight, narrowly open canal. *Outer lip* sometimes strengthened by an axial plication, lirate inside. *Columella* vertical, lightly truncated at the commencement of the canal. *Inner lip* narrow, smooth.

Height, 37 mm.; diameter, 13 mm. Height, 37 mm.; diameter, 24 mm. (Imperfect paratype and holotype.)

Holotype and *paratypes* (three) in the collection of the New Zealand Geological Survey.

Loc.—No. 542 = Lower Komiti Point beds, Kaipara Harbour, North Auckland: Park, 1885.—Miocene.

Remark.—This species is named in honour of Mr. Percy G. Morgan, M.A., Director of the New Zealand Geological Survey.

Fusinus solidus nov. sp. Plate III, fig. 14.

Shell (the first few whorls and part of the canal broken off) rather small, fusiform, solid, the whorls shouldered, axially costate and spirally lirate, with a long straight canal. *Sculpture:* All the whorls with strong, rounded, sub-vertical axial ribs, 11 on the body-whorl, the interstices slightly narrower; they vanish upon the shoulder towards the suture and towards the base of the body-whorl. The whole surface ornamented by strong spiral cords of unequal strength, 7 on the shoulder of the last whorl; on the penultimate whorl there are 3 much stronger spirals with a fine spiral line in the interstices; on the body-whorl these strong cords are continued to the beginning of the neck of the canal, first widely apart and having 3, 2, and 1 fine spiral threads in the interstices, but these are wanting between the cords of the base. Incremental lines are distinct, roughening the spiral sculpture. *Spire* conical, turriculate, of about the same height as the aperture with canal. *Whorls* 4 on the holotype, distinctly shouldered, the angle rounded, slightly concave above, convex below; body-whorl contracted towards the canal. *Suture* not much impressed, margined by a fine cord below. *Aperture* vertical, pyriform, angled above, and produced into a moderately long, straight, and narrowly open canal below. *Outer lip* strong, fortified on the outside by an axial rib, inside by a strongly lirate callosity. *Columella* slightly excavated, inflected at the origin of the canal. *Inner lip* narrow, moderately callous, separated by a shallow groove from the spiral cords, which, however, produce corresponding slight elevations upon the lip.

Height, 47 mm. (4 whorls); diameter, 20 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 630 = Teaneraki (Enfield), near Oamaru, North Otago: T. Esdaile. Also from loc. No. 831 = Cave Valley, Oamaru: Esdaile; and loc. No. 164 = Coal-beds, Kakahu River, South Canterbury: Monro, 1869.—Miocene.

Hemifusus (Mayeria) goniodes nov. sp. Plate III, figs. 15, 16.

Shell moderately large, elongated biconic, imperforate, whorls carinated. *Sculpture:* The axial ornamentation consists of strong oblique growth-lines, sinuate upon the shoulder, and often crenulating the carina; spirals fine and dense on the shoulder, more distant below the keel, especially so on the body-whorl, but still remaining inconspicuous until the base is reached; here the oblique spiral cords are distinct, with a fine thread sometimes intercalated between them. *Spire* gradate (the upper part broken off in both specimens). *Whorls* strongly carinated, the keel at about the middle or below it on the spire-whorls, excavated upon the shoulder, flat below the keel; body-whorl regularly tapering towards the base, somewhat concave below. *Suture* not much impressed, margined below by a rather broad band. *Aperture* oblique, subrhomboidal, narrow, angled above, the margins subparallel on the lower part, produced into a moderately long, straight, and open canal. *Outer lip* sharp, sinuate at the shoulder. *Columella* almost straight, oblique, smooth. *Inner lip* thin, spreading not very far over the body, in a half-circle outside the suture.

Height, 58 mm.; diameter, 24 mm. (imperfect specimen of 3 whorls; holotype).

Holotype and *paratype* in the collection of the New Zealand Geological Survey.

Loc.—No. 479 = Marly greensands, Waihao River, South Canterbury: McKay, 1880.—Miocene.

Remark.—Genus and subgenus are new to our fauna.

Euthriofusus spinosus nov. sp. Plate IV, figs. 1, 2.

Shell rather large, broadly fusiform, imperforate, with a row of compressed spines on the angle of each whorl, spirally striated, with a moderately long canal. *Sculpture:* Spire-whorls with a keel at the lower third, on which distant vertically compressed strong spines are situated, their number varying from 9 to 10 on a whorl; the keel with spines is continued on the body-whorl; very distinct growth-lines, much sinuated upon the shoulder, are present; the spiral sculpture consists of a few distant, sometimes obsolete, threads upon the shoulder, a cord connecting the spines upon the keel; below it are usually 3 to 4 distant liræ, followed by numerous, close, narrow cords extending over the whole of the neck of the canal. *Spire* conical, the angle varying from 50° to 58°, somewhat higher than the aperture. *Protoconch* polygyrate, small, pointed, of 2 whorls. *Whorls* 8, first slowly, then more rapidly increasing, distinctly angled, the keel on the lower third of the spire-whorls, shoulder broad, concave; body-whorl faintly convex below the keel, then suddenly contracted on reaching the neck of the canal. *Suture* uneven, not deep. *Aperture* oblique, pyriform, channelled above, somewhat dilated medially, suddenly contracted below, and terminating in a straight canal, directed to the left, truncated below, and of about the same length as the height of the aperture. *Outer lip* sharp, with a broadly rounded and rather deep sinus at the shoulder, smooth inside. *Columella* vertical, excavated above, inflected at the origin of the canal, sub-plicated. *Inner lip* moderately broad, thin, with an entering lamella below the suture, forming a distinct channel, roundly raised from the inflection of the columella downward, and ending in a point near the end of the canal.

Height, 65 mm.; diameter, 36 mm. (holotype). Height, 73 mm.; diameter, 45 mm. (largest specimen with the greater part of the canal lost; if perfect the height would be about 93 mm.). In the same locality a smaller form occurs, the dimensions being—height, 57 mm.; diameter, 29 mm.

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 480 = "Island sandstone," Waihao River, South Canterbury: McKay, 1880.—Miocene.

Remarks.—The genus *Euthriofusus* Cossmann (Essais Paléoconch Comp., livraison iv, 1901, p. 27. Type *Fusus burdigalensis* Basterot) is new to our fauna. It has been recorded by Cossmann from the Oligocene of Belgium, the Miocene of different parts of the Continent of Europe, North America, and Chile.

Exilia crassicostata nov. sp. Plate IV, fig. 3.

Shell small, fusiform, with strong axial ribs and rather coarse spiral liræ. *Sculpture* consisting of slightly oblique, equidistant, narrowly convex and considerably raised axial ribs, about 12 on a whorl, the interstices broader than the ribs; they extend over the whole height of the whorls, and on the body-whorl to the excavation of the base; the spiral ornamentation is formed by flat, subequal, rather coarse threads, 11 on the penultimate whorl, with linear interstices, passing over the axial costæ and rendering them slightly nodulous; upon the neck of the canal the spirals are much finer; growth-lines fine, dense. *Spire* subulate, about three times the height of the aperture without canal, angle 30°. *Protoconch* lost. *Whorls* about 9 when perfect, convex, but somewhat flattish above, contracted at the base of the body-whorl. *Suture* simple, not impressed. *Aperture* narrow, pyriform, angled above, drawn out below to a narrow, long, and straight canal, the lower end of which is broken off. *Outer lip* acute, convex, strengthened by an axial rib. *Columella* long, straight, rounded. *Inner lip* narrow and thin, with 2 fine entering lamellæ on the parietal wall just below the suture.

Height, 15 mm.; diameter, 5 mm. (imperfect specimen; holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 630 = Teaneraki (Enfield), near Oamaru, North Otago: T. Esdaile.—Miocene.

Remarks.—This species is not so slender as *E. dalli* Suter, has less axial costæ (12 against 20), and much coarser spiral striation.

Exilia waihaoensis nov. sp. Plate IV, fig. 4.

Shell small, fusiform, with close and well-pronounced axial ribs, crossed by flattish spiral liræ. *Sculpture* consisting of narrow, convex, and equidistant axial ribs, 20 on the last whorl, continuous over the whorls, flexuous over the body-whorl where they extend to the base, the interstices of about the same width as the ribs; there are equidistant, distinct, flattish spiral riblets crossing the axial sculpture, 6 on the penultimate whorl, now and again with a finer thread in the interspace. *Spire* subulate, its height about three times that of the aperture without canal, angle 23°. *Protoconch* lost. *Whorls* about 9 when perfect, regularly increasing, moderately convex, the body-whorl contracted towards the beak. *Suture* inconspicuous. *Aperture* vertical, pyriform, angled above, produced below into a canal which is broken off in the unique type specimen. *Outer lip* convex, no doubt strengthened by an axial rib when perfect. *Columella* straight, rounded, faintly inflected towards the canal below. *Inner lip* narrow and thin, with a rather inconspicuous entering lamella on the parietal wall below the suture.

Height, 20 mm.; diameter, 6 mm. (imperfect specimen; holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 642 = Waihao River Bridge, a mile and a half below Waihao Forks, South Canterbury: McKay, 1880.—Miocene.

Remark.—This species can at once be separated from *E. dalli* Suter by the coarse spiral sculpture, and from *E. crassicostata* Suter by the much more numerous axial ribs.

Ptychatractus nodosoliratus nov. sp. Plate XII, fig. 23.

Shell small, elongated fusiform, imperforate, turreted, axially costate and rather coarsely spirally lirate, the points of intersection raised into gemmules at the carina and on one or two spirals near it, columella with 2 very faint plaits. *Sculpture:* Protoconch smooth, the following whorls with narrow rounded axial riblets extending over the whole volution, but getting obsolete on the lower half of the body-whorl, the interstices broader than the riblets, the latter numbering about 15 on a whorl; the shoulder with 2 fine distant spiral threads, absent on the upper whorls, carina with a fairly strong spiral cord, a smooth space of the same width below it, followed by 1 strong and 2 finer spirals on the upper whorls, but on the penultimate whorl there are 4 cinguli of unequal strength; the body-whorl spirally lirate down to the neck of the canal, but the lower cinguli have somewhat wider interspaces; on the carina the crossing-points with the axials are raised into small nodules, giving the spiral cord an undulating aspect; the cinguli above and below the keel have more or less distinct gemmules at the points of intersection. *Spire* turreted, very narrowly conic, angle 32°. *Protoconch* very small, papillate, of 2 convex whorls, the nucleus tilted. *Whorls* 8, regularly descending, with a distinct keel at the middle of the spire-whorls, lightly excavated shoulder, somewhat convex below the carina; body-whorl slightly angled, then broadly rounded and contracted towards the base. *Suture* well impressed. *Aperture* slightly oblique, narrow, the margins subparallel, angled above, with a short open canal below, its base truncated. *Outer lip* damaged, broadly convex. *Columella* subvertical, with 2 low oblique plaits at the middle, slightly bent to the left below. *Inner lip* thin and narrow.

Height, 11 mm.; diameter, 3·5 mm. (holotype).

Holotype in the Canterbury Museum, Christchurch; presented by Mr. M. C. Gudex.

Loc.—Sandy clay lying immediately on top of the limestone, Blue Cliffs, near St. Andrews, South Canterbury: M. C. Gudex.—Miocene.

Ptychatractus pukeuriensis nov. sp. Plate XII, fig. 24.

Shell small, narrowly fusiform, turreted, with distant axial riblets and strong spiral cords, columella with 2 plaits, anterior canal very short. *Sculpture:* Protoconch smooth, the post-embryonic whorls with vertical, rounded, distant axial costæ extending over the whole volution, about 10 on a whorl, the interstices of nearly the same width as the riblets; they are crossed by 3 fine spiral lines upon the shoulder, the keel is adorned with a strong spiral cord, sometimes grooved on the lower whorls, followed below by 2 equally strong cinguli, and in addition a finer one on the penultimate whorl; the lower part of the last whorl has similar cords, which, however, become fainter anteriorly, whence the axials also vanish; the spirals everywhere cross the axials. *Spire* narrowly conic, turreted, about twice the height of aperture with canal, angle 30°. *Protoconch* small, papillate, rounded, of 1½ whorls. *Whorls* 6 to 7, gradually descending, keeled above the middle on the spire, straight at the shoulder, slightly convex below, the body-whorl convex below the carina, very little contracted at the base. *Suture* not much impressed, somewhat wavy. *Aperture* a little oblique, trapezoidal, broadly angled above, with a short open anterior canal, its base truncated. *Outer lip* angled above, antecurrent towards the suture, lirate within, acute, convex on the lower half. *Columella* vertical, rounded, deflected to the left below, with 2 small oblique plaits at the middle. *Inner lip* narrow and thin.

Height, 6·5 mm.; diameter, 3 mm. (holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Pukeuri, near Oamaru: Marshall.—Miocene.

Remark.—The holotype, though having a perfect spire, is not quite adult; an imperfect larger paratype shows that the height of a full-grown specimen may be estimated at about 9·5 mm.

Ptychatractus tenuiliratus nov. sp. Plate VII, fig. 2.

Shell small, elongated oval, with broadly convex axial ribs, numerous fine cinguli, short canal, notched at its base, sinus on outer lip well defined, columella with about 4 oblique ridges. *Sculpture:* Protoconch smooth, the following whorls with distinct broadly rounded axial ribs, 12 on a whorl, vanishing on the lower half of the body-whorl, the interstices slightly narrower than the ribs; the spiral ornamentation formed by numerous fine threads with linear interstices passing over the axial ribs. *Spire* conic, somewhat higher than the aperture with canal, angle 40°. *Protoconch* consisting of 2 convex whorls, the nucleus not deviated. *Whorls* 6, regularly increasing, the last rather large in proportion, convex, but a little flattened below the suture, the body-whorl gradually tapering in front. *Suture* well marked. *Aperture* subvertical, narrowly ovate, angled above, with a short canal below which is notched at its base. *Outer lip* convex, anterior part broken off, with a well-pronounced sinus close to the suture. *Columella* short, straight, turned slightly to the left below. *Inner lip* narrow, thickened above, with about 5 oblique ridges on its lower half.

Height, 9 mm.; diameter, 4 mm. (holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Shell-bed, Target Gully, Oamaru.—Miocene.

Fam. MITRIDÆ.

Mitra (Cancilla) armorica nov. sp. Plate XII, fig. 4.

Shell small, fusiform, spire lightly scalar, spirally finely lirate, a few fine axial riblets on the first few post-embryonic whorls, aperture narrowed anteriorly to a short canal, columella with 4 plaits. *Sculpture:* Protoconch smooth, the following whorls spirally striated, about 9 threads on the penultimate whorl, the interstices narrower, crossed on the first two post-embryonic whorls by fine axial riblets, reticulating the surface; on the base the cinguli are getting a little stronger; growth-lines are taking the place of the axials on the lower whorls, but they are sometimes very faint. *Spire* elevated conic, somewhat scalar, about two-thirds the height of the aperture, angle 42°. *Protoconch* papillate, of 2 convex whorls, the nucleus slightly tilted. *Whorls* 7, regularly increasing, a little flattened below the suture, slightly convex; the body-whorl convex above, gradually contracted towards the base. *Suture* well impressed, simple. *Aperture* subvertical, high and narrow, faintly channelled above, narrowed below to a short open canal, its base truncated or very lightly notched. *Outer lip* acute, smooth within, convex above, concave at the base. *Columella* vertical, long, with 4 oblique plaits, the upper two of equal strength, the third thinner, and the lowest very small. *Inner lip* narrow and thin, drawn out to a fine point below.

Height, 20 mm.; diameter, 8 mm. (holotype).

Holotype in the Canterbury Museum, Christchurch; presented by Mr. M. C. Gudex.

Loc.—Sandy clay lying immediately on top of the limestone, Blue Cliffs, near St. Andrews, South Canterbury (holotype): M. C. Gudex. Also Otiake River, North Otago: G. H. Uttley.—Miocene.

Remark.—This species is closely allied to *M. atractoides* Tate, from the lower beds, Muddy Creek, Victoria (Trans. Roy. Soc., South Aust., vol. xi, 1889, p. 139, pl. iv, fig. 11).

Vexillum apicicostatum nov. sp. Plate XII, fig. 5.

Shell biconic, with the first three post-embryonic whorls axially ribbed, the ribs getting obsolete farther down, spirally finely lirate, columella with 4 plaits. *Sculpture:* Protoconch smooth, the succeeding three whorls with straight axial riblets, about 16 on a whorl, almost entirely vanishing on the later whorls; fine spiral threads with narrow interstices are present, but have almost completely been worn off on the holotype. *Spire* conic, lower than the aperture with canal, angle 53°. *Protoconch* papillate, of 1½ convex whorls, apex blunt. *Whorls* 6 to 7, first rather slowly increasing, the last ventricose, the spire-whorls very little rounded, the body-whorl abruptly contracted towards the base. *Suture* well impressed. *Aperture* narrowly pyriform, with a moderately long, straight, and open canal, its base truncated. *Outer lip* broken off. *Columella* with 4 lightly oblique strong plaits, the lowest smaller than the others. *Inner lip* very thin and narrow, tapering to a fine point below.

Height, 12 mm.; diameter, 5 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 479 = Marly greensands, Waihao River, South Canterbury: McKay, 1880.—Miocene.

Vexillum fenestratum nov. sp. Plate IV, fig. 8.

Shell small, fusiform, turreted, with distant axial ribs, and a few spiral cords, columella with 3 low plaits. *Sculpture:* Protoconch smooth, the following whorls with convex axial riblets, 10 on a whorl, interstices a little broader than the riblets; there are 2 spiral cords on the first two post-embryonic whorls, the upper one on the keel, leaving the shoulder smooth, but on the third whorl there appears a third fine spiral just above the suture; the points of intersection are produced into roundish nodules; body-whorl with faint spirals down to the neck of the canal; dense fine growth-lines are rather conspicuous. *Spire* narrowly conic, turreted, of the same height as the aperture with canal. *Protoconch* ovately globose, of 1 whorl. *Whorls* 5, regularly increasing, carinated above the middle, excavated above and very slightly convex below the carina; body-whorl contracted towards the base. *Suture* well impressed, somewhat undulating. *Aperture* narrowly ovate, high, narrowly angled above, produced below into a short, somewhat oblique canal, its base rounded. *Outer lip* convex, acute, strengthened on the outside by an axial riblet. *Columella* straight, vertical, with 3 oblique small plaits, the lowest weaker. *Inner lip* thin, narrow, drawn out to a fine point upon the margin of the canal.

Height, 8 mm.; diameter, 3·2 mm. (holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Pukeuri, near Oamaru: Marshall.—Miocene.

Remark.—The nearest ally is the Recent *V. waitei* Suter.

Vexillum ligatum nov. sp. Plate IV, fig. 9.

Shell small, biconic, turreted, with narrow straight axial riblets, a strong spiral cord upon the keel, obsolete cinguli below it, base of body-whorl with strong spiral liration, columella with 4 oblique plaits. *Sculpture:* Protoconch smooth, post-embryonic whorls with narrow, straight axial riblets, 18 on the penultimate whorl, extending over the whole surface on the spire-whorls, and half-way down on the body-whorl; keel ornamented by a conspicuous spiral cord with a deep groove below it, farther down obsolete spirals are present, but upon the base and extending over the neck of the canal there are prominent oblique cords. *Spire* turreted, narrowly conic, its height equal to that of the aperture with canal. *Protoconch* papillate, of about 1½ whorls, the apex blunt. *Whorls* 6½, regularly descending, narrowly shouldered above the middle, flat above and slightly convex below the carina, body-whorl convex and contracted below. *Suture* well impressed. *Aperture* high and narrow, with a short open canal below. *Outer lip* broken off. *Columella* straight, with 4 thin but high oblique plaits, the lowest not much raised. *Inner lip* narrow and thin, distinctly arresting the oblique sculpture.

Height, 9 mm.; diameter, 4 mm. (holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Left bank of Waitaki River, opposite Wharekuri: Marshall.—Miocene.

Vexillum (Costellaria) rutidolomum nov. sp. Plate IV, fig. 10.

Shell large, biconic, with rather low, turriculated spire, axially costate and spirally lirate, body-whorl contracted below, columella with 4 plaits, the lowest inconspicuous. *Sculpture:* Protoconch smooth, succeeding whorls with close, somewhat irregularly spaced, broadly convex straight axial ribs, 24 on the penultimate whorl, flexuous and gradually fading away towards the base on the last whorl; close narrow spiral cords are present over the whole surface, their width being somewhat unequal, the interstices linear. *Spire* low, turriculate, about three-fourths the height of the aperture, angle 48°. *Protoconch* small, papillate, of 1½ convex whorls. *Whorls* 8, prominently shouldered, flat above and straight to slightly concave below the rounded angle; body-whorl suddenly contracted below the angle, convex farther down, but excavated at the base. *Suture* not deep, margined below by a smooth band, broader than the following cinguli. *Aperture* somewhat oblique, narrow, widest at the middle, channelled above, and produced below into a short open canal. *Outer lip* solid, blunt, sinuous in its course. *Columella* almost straight, medially with 4 plaits, decreasing in size from above, the two upper ones nearly horizontal, the third slightly oblique, and the lowest but feebly developed. *Inner lip* thin, narrow.

Height, 30 mm.; diameter, 14 mm. (holotype).

Holotype in the Canterbury Museum, Christchurch; presented by Mr. M. C. Gudex.

Loc.—Sandy clay above limestone, foot of Mount Horrible (type locality), and Holme Station, Pareora, in shelly sandstone immediately above limestone: M. C. Gudex.—Miocene.

Fam. Chrysodomidæ.

Siphonalia compacta nov. sp. Plate IV, fig. 11.

Shell small, depressedly broadly fusiform, whorls keeled, with distant strong axial ribs from the keel downwards, and spiral riblets. *Sculpture:* Keel slightly above the middle, rendered nodulous by distant, strong, convex axial costæ, 9 on the body-whorl, extending from the keel to the suture below, and to within the base on the body-whorl, the interstices of the same width as the ribs; spiral sculpture almost completely effaced, but on the body-whorl there are traces of distant spiral cords and fine threads, reticulated by strong growth-lines in the interspaces; below the carina of the last whorl there is a distinct narrow groove. *Siphonal fasciole* excavated. *Spire* short, conoidal, turriculated, about the height of the aperture, angle about 65°. *Protoconch* lost. *Whorls* 5 to 6, carinated, the shoulder rather broad and concave, but convex below the keel; body-whorl large and somewhat ventricose, excavated at the base. *Suture* not impressed. *Aperture* vertical, oval, angled above, produced below into a short open canal, turned to the left and slightly backwards. *Outer lip* thin and sharp, angled above. *Columella* vertical, faintly excavated, strongly inflected below towards the canal. *Inner lip* narrow, inconspicuous.

Height, 30 mm.; diameter, 20 mm. (holotype).

Holotype in the Canterbury Museum, Christchurch; presented by Mr. M. C. Gudex.

Loc.—Broken River, Trelissick Basin, Canterbury: M. C. Gudex.—Miocene.

Siphonalia elegans nov. sp. Plate IV, fig. 12.

Shell rather small, fusiform, whorls with a narrow concave shoulder, axially sharply costate and finely spirally lirate, aperture with a moderately long and oblique siphonal canal. *Sculpture:* Protoconch quite smooth, the following whorls with about 12 elevated narrow and sharply rounded axial costæ, extending on the spire-whorls from the lower half of the shoulder to the suture below, and on the body-whorl down to the base; the interstices are of about $1\frac{1}{2}$ times the width of the ribs; fine undulating spiral threads cross the ribs and inter-spaces, being cut up by very distinct growth-lines; towards the base the spirals are getting much stouter, the interstices containing 1 fine spiral thread. *Spire* turreted, a little higher than the aperture without canal. *Protoconch* globose, of 2 convex turns. *Whorls* regularly increasing, the post-embryonic volutions with a narrow concave shoulder, slightly convex below; there are 7 whorls, the last much contracted at the base. *Suture* well impressed, wavy. *Aperture* vertical, narrowly ovate, lightly channelled above, produced below into an oblique recurved and open canal, truncated at its base, its length being somewhat less than the height of the aperture. *Outer lip* acute, angled above, smooth inside. *Columella* vertical, bent to the left below. *Inner lip* thin and narrow, drawn out to a long fine point upon the edge of the canal.

Height, 30 mm.; diameter, 15 mm. (holotype).

Holotype and one *paratype* in the collection of the New Zealand Geological Survey.

Loc.—Oaro Creek valley, Amuri Bluff district: C. A. Cotton, 1912.—Pliocene.

Siphonalia excelsa nov. sp. Plate IV, fig. 13.

Shell small, elongated, fusiform, thin, axially nodulously costate, prominently spirally ribbed, the whorls keeled, canal long, deflected. *Sculpture:* Protoconch smooth, the post-embryonic whorls keeled at about the middle, with but little raised axial ribs, 10 to 12 on a whorl, distinct upon the lower half of the shoulder, but vanishing towards the base of the body-whorl, somewhat nodulous on the intersections with the spirals; shoulder with 2 fairly strong spiral cords, the interstices with 1 or 2 fine spiral threads; a smooth band margins the suture below; a strong spiral cord marks the keel, on the spire-whorls 2 equally strong cinguli follow below with a fine spiral thread in each interstice; on the body-whorl strong cinguli alternate with finer ones, but on the neck of the canal they are of equal strength, fine, very little raised, oblique; growth-lines are very conspicuous, and they sometimes reticulate the finer spirals. *Spire* elevated conic, turriculate, of about the same height as the aperture with canal. *Protoconch* slightly tilted, small, consisting of 2 convex whorls. *Whorls* 8, regularly increasing, slightly convex above and flat below the carina on the spire, body-whorl convex below the keel, much contracted towards the base. *Suture* deep. *Aperture* ample, oval, broadly angled above, extended below into a long, open, oblique canal, turned to the left and slightly backwards, its base rounded. *Outer lip* convex, thin, acute, lirate inside. *Columella* subvertical, somewhat excavated, inflected below towards the canal. *Inner lip* moderately thick, spreading over the parietal wall, narrowly over the pillar, and drawn out to a long fine point upon the margin of the canal.

Height, 31 mm.; diameter, 13 mm.

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Shell-bed, Target Gully, Oamaru: Marshall.—Miocene.

Remark.—This species is allied to the Recent *S. caudata* Q. & G., which occurs also in the Pliocene and Miocene.

Siphonalia nodosa (Martyn) nov. subsp. **acuticostata**. Plate IV, fig. 14.

Shell small, ovate, with distant sharp axial ribs, spire-whorls keeled, body-whorl bicarinate, spirally lirate. *Sculpture:* Protoconch smooth, but the following whorls have rather distant, narrowly rounded and strong axial ribs, 12 on the body-whorl, slightly directed backward, not extending over the base, the interstices broader than the ribs; the spiral ornamentation consists of regularly arranged fine cords, simple on the shoulder of the upper whorls, but below the keel and also upon the shoulder of the last whorl with a fine spiral thread in the interstices, two of them below the keels; the growth-lines are mostly very distinct, reticulating the spiral sculpture. *Spire* conic, turriculate, about one-third higher than the aperture without canal, angle 53°. *Protoconch* small (the upper part lost). *Whorls* 5, regularly increasing, keeled at the middle, the body-whorl bicarinate, the shoulder and part below the keel flat, concave and contracted at the base. *Suture* distinct, but not much impressed. *Aperture* oblique, pyriform, broadly angled above, produced below into a moderately long oblique and open canal, bent backwards, truncated at its base. *Outer lip* biangulate, slightly callous and distinctly lirate within. *Columella* subvertical, straight, inflected towards the canal. *Inner lip* narrow and thin, ending in a point below. *Siphonal fasciole* with distant transverse lamellæ.

Height, 26 mm.; diameter, 14 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Waihao greensands, Waihao River, South Canterbury: J. A. Thomson, 1913.—Miocene.

Euthria callimorpha nov. sp. Plate XII, fig. 6.

Shell small, fusiform, solid, spire turreted, with distant broadly rounded axial ribs and fine spiral liræ, suture simple. *Sculpture:* Protoconch smooth, the post-embryonic whorls with moderately elevated, broadly rounded axial costæ, 7 on a whorl, not extending over the shoulder, and very soon vanishing towards the base on the body-whorl, the interstices slightly concave and a little broader than the ribs; the whole surface ornamented with spiral threads, finer upon the shoulder than below the keel, where they are also more distant; on the body-whorl there is, now and again, a very fine thread intercalated; fine flexuous growth-lines are slightly reticulating the spirals on the shoulder. *Spire* conical, turriculate, higher than the aperture with canal, angle 40°. *Protoconch* papillate, of 1½ convex whorls, the pullus slightly tilted. *Whorls* 6, regularly descending, the last comparatively large and somewhat inflated, the lower spire-whorls keeled at about the middle, excavated upon the shoulder, convex below, body-whorl contracted towards the base. *Aperture* slightly oblique, narrowly ovate, indistinctly channelled above, produced below into a short open canal which is faintly turned to the left and truncated at its base. *Outer lip* convex, sharp, obscurely lirate within. *Columella* subvertical, straight at the middle, extending with a slight curve to the base. *Inner lip* narrow, thin, smooth. *Siphonal fasciole* indistinct.

Height, 16 mm.; diameter, 7·5 mm. (holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Waitaki Valley, opposite Wharekuri: Marshall.—Miocene.

Remark.—The species is very much like *E. stirophora* Suter, but the latter is considerably smaller, has 10 axial ribs, and the suture is margined.

Euthria (Dennantia ?) mystica nov. sp. Plate XII, fig. 7.

Shell elongate, slightly turreted, surface reticulated, the whorls separated by a deep suture. *Sculpture* consisting of spiral cords, about 8 on the penultimate whorl, with linear interstices, crossed by less distinct axial riblets of the same strength as the spirals, producing low tubercles at the points of intersection, and reticulating the whole surface. *Spire* narrowly conic, about the same height as the aperture, angle about 33°. *Protoconch* lost. *Whorls* 4½, but very likely about 7 in a perfect shell, very lightly and narrowly shouldered, flat below, the body-whorl a little convex, contracted anteriorly. *Suture* deep, producing a somewhat scalar aspect of the shell. *Aperture* ovate, apparently with a canal directed to the left, but, unfortunately, the specimen is too imperfect to make out further and important details.

Height, 20 mm.; diameter, 9 mm. (imperfect holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 164 = Coal-beds, Kakahu River, South Canterbury: McKay, 1876.—Miocene.

Remarks.—It is not quite certain whether this species is correctly placed in the subgenus *Dennantia* (Tate, Trans. Roy. Soc., South Aust., vol. x, 1888, p. 161), as the special features of the aperture—a very distinct dentate plait on the anterior portion of the columella, and a small denticle projecting from the outer margin anteriorly—are obliterated in the only specimen available. However, the elongate form, the relatively small aperture, the conspicuous spiral sculpture, and the deep suture induce me to class the species provisionally under *Euthria (Dennantia)*. Tate described two species from the Lower Miocene of Victoria.

Euthria stirophora nov. sp. Plate IV, fig. 16.

Shell small, fusiform, solid, with keeled and axially costate whorls, spirally striated, suture margined. *Sculpture:* Protoconch smooth, the following whorls keeled slightly above the middle, with 10 rounded axial costæ, obsolete upon the shoulder, on the last half of the body-whorl, and upon the base, slightly nodulous on the keel, the interstices concave and a little narrower than the ribs; a smooth band margins the suture below; on the shoulder fine spiral threads with linear interstices are present, 6 to 7 on the penultimate whorl, but below the keel the spirals are coarser and the interstices a little broader. *Spire* conical, turriculate, a little higher than the aperture. *Protoconch* small, papillate, of 1½ convex whorls, the nucleus slightly tilted. *Whorls* 6, gradually increasing, carinated, concave above and slightly convex below the keel, body-whorl slightly ventricose and contracted below. *Suture* impressed, margined below. *Aperture* somewhat oblique, faintly channelled above, produced below into a rather short open canal which is truncated at its base. *Outer lip* convex, the edge broken off, smooth inside. *Columella* vertical, straight at the middle, deflected below towards the canal. *Inner lip* thin, narrow, smooth.

Height, 11·5 mm.; diameter, 6 mm. (holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Shell-bed, Target Gully, Oamaru: Marshall.—Miocene.

Remarks.—This is the smallest New Zealand species of the genus known to me. It has in part the aspect of a miniature form of *E. linea traversi* Hutton.

Fam. Buccinidæ.

Cominella exsculpta nov. sp. Plate IV, fig. 17.

Shell small, solid, ovoid-conic, turreted, with distant high axial ribs, crossed by very fine spiral threads. *Sculpture:* Protoconch smooth, the following whorls with distant, rather sharply raised narrowly convex axial costæ, 9 on a whorl, continuous over the whorls, and extending to the base on the last whorl, the interstices concave and nearly twice as broad as the ribs; the spiral ornamentation consists of very fine, unequal, and sometimes inequidistant threads, 9 on the penultimate whorl; upon the base the spirals are a little more distant and stronger, and on the body-whorl their number amounts to about 15; on top of the axials the cinguli are slightly nodulous. *Spire* turreted, conical, its height $1\frac{1}{2}$ times that of the aperture without canal, angle 40°. *Protoconch* small, of 2 whorls, the nucleus flat. *Whorls* 6, regularly descending, distinctly shouldered, convex below the angle, the body-whorl contracted towards the short beak. *Suture* well marked, but not deep, undulating. *Aperture* vertical, oval, channelled above, produced below into a short open and curved canal with a deeply notched base. *Outer lip* convex, angled above, most of it broken off. *Columella* excavated towards the parietal wall, straight and smooth below, then twisted and inflected towards the canal. *Inner lip* thin, narrow and smooth, drawn out to a point at the end of the canal. *Siphonal fasciole* distinct, high, keeled on the outside.

Height, 16 mm.; diameter, 7 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Mount Harris, South Canterbury: J. A. Thomson, 1913.—Miocene.

Cominella intermedia nov. sp. Plate IV, fig. 18.

Shell moderately large, solid, ovoid-conic, axially costate and spirally lirate, the whorls faintly shouldered. *Sculpture:* Protoconch smooth, the succeeding whorls slightly angled at the middle, with distant, broadly convex low axial costæ, 11 on a whorl, the interstices of the same width as the ribs; they start from the angulation of the whorls downwards, and on the body-whorl they vanish towards the base; the whole surface ornamented by fairly regular spiral cords, sometimes grooved, the interstices of the same width as the spirals, often containing a fine spiral thread. *Spire* conical, subturreted, its height equal to that of the aperture, angle 48°. *Protoconch* papillate, consisting of $2\frac{1}{4}$ convex whorls. *Whorls* 6, first slowly increasing, but the last whorl large and high, somewhat ventricose; they are flat from the suture to the median angle, convex below it; body-whorl contracted at the base. *Suture* well impressed. *Aperture* subvertical, oval, channelled above, with a short widely open and deeply notched canal below. *Outer lip* convex, acute but solid, faintly lirate within. *Columella* vertical, straight, rounded, inflected below. *Inner lip* moderately callous, narrow, smooth, slightly more callous below the suture, terminating below in a fine point. *Siphonal fasciole* very distinct, lamellate and keeled on the outside.

Height, 30·5 mm.; diameter, 15 mm. (holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Shell-bed, Target Gully, Oamaru: Marshall.—Miocene.

Remark.—The Recent *C. nassoides* Reeve and *C. zealandica* Reeve are species belonging to the same group; both occur in the Pliocene and Miocene.

Cominella pulchra nov. sp. Plate IV, fig. 19.

Shell small, ovate, solid, with sharply raised spire, rather acute distant axial ribs and close spiral liræ, the whorls shouldered. *Sculpture:* The protoconch is quite smooth, the succeeding whorls have sharply raised axial ribs, continuous over the whorls, and extending on the body-whorls down to the base; their number is 8 on a whorl, and they are much depressed on the shoulder of the whorls, but acute below the keel; interstices broad, excavated; the whole surface is beset with fine spiral threads of somewhat unequal strength, faintly nodulous upon the keel at the intersection with the axial ribs, the interstices narrow, mostly linear, but broader above and below the carina. *Spire* elevated, conic, its height equal to that of the aperture with canal. *Protoconch* large, globose, of 1½ convex whorls. *Whorls* 6, shouldered, slightly excavated above the keel, straight below it; body-whorl moderately large, convex, contracted at the base. *Suture* not much impressed, wavy. *Aperture* somewhat oblique, oval, channelled above, produced below into a short, recurved, open, and deeply notched canal. *Outer lip* convex, acute, smooth within. *Columella* vertical, rounded, very slightly concave, inflected below toward the canal. *Inner lip* narrow, smooth, with a low plait below the suture, extending along the canal as a tapering lamella, and having a shallow groove at the inflection of the columella. *Siphonal fasciole* elevated, convex, finely striated, keeled above.

Height, 16·5 mm.; breadth, 9 mm. (holotype).

Holotype in the Canterbury Museum, Christchurch; presented by Mr. M. C. Gudex.

Loc.—Sandy clay lying immediately on top of the limestone, Blue Cliffs, near St. Andrews, South Canterbury: M. C. Gudex.—Miocene.

Remark.—Of Recent species *C. lurida* and *C. huttoni* are nearest allied to this species, but decidedly distinct.

Cominella purchasi nov. sp. Plate IV, fig. 20.

Shell moderately large, ovate, solid, axially very prominently costate, and spirally distinctly lirate. *Sculpture:* Protoconch smooth, the post-embryonic whorls with numerous, narrowly rounded, elevated, flexuous axial ribs, 20 on the last whorl, the interstices of about the same width as the ribs; on the body-whorl the costæ extend to within a short distance of the base; the whole surface ornamented by equidistant fine spiral cords, about 8 on the penultimate whorl, the interspaces of the same width as the cinguli, but broader upon the base; siphonal fasciole with a sharp keel upon the neck. *Spire* broadly conical, a little higher than the aperture, angle 35°. *Protoconch* large, papillate, of 2½ convex whorls. *Whorls* 5, convex, but slightly flattened below the suture, regularly increasing, base slightly contracted and concave. *Suture* not deep, uneven. *Aperture* slightly oblique, ovate, channelled above, with a very short, wide, open, and deeply notched canal below. *Outer lip* regularly convex, solid, strengthened by a rib on the outside. *Columella* vertical, arcuate, smooth, inflected below towards the canal (the lowest part broken off). *Inner lip* narrow, with a faint tubercle below the suture.

Height, 27 mm.; diameter, 15 mm. (holotype).

Holotype in the Canterbury Museum, Christchurch; presented by Mr. Alban Purchas.

Loc.—Waikari Valley, near the Greta Railway-station, right on the bank of the stream.

Remarks.—This species is allied to *C. huttoni* Kobelt, though quite distinct. Named in honour of Mr. Alban Purchas, an ardent student and collector of our fossil shells.

Tritonidea acuticingulata nov. sp. Plate IV, fig. 5.

Shell small, ovate, solid, with oblique axial ribs and very prominent sharp spiral riblets, canal short, outer lip varicose and lirate within, inner lip with 3 tubercles on the parietal wall and 2 plaits below. *Sculpture:* Protoconch smooth, the following whorls with well-raised, oblique, rather narrowly convex axial ribs, about 9 on a whorl, which have vertically compressed nodules at the intersections with the spirals, extending over the whole of the volutions and down to the base of the body-whorl; there are equidistant sharply raised spiral riblets, 3 on the penultimate whorl, 8 to 9 on the body-whorl, the interstices much broader than the riblets, concave, bearing one or several very fine inconspicuous spiral threadlets. *Spire* conical, of the same height as the aperture with canal, angle 47°. *Protoconch* of 1 moderately convex volution. *Whorls* 4, rather rapidly increasing, convex, the base very little contracted. *Suture* not much impressed. *Aperture* subvertical, ovate, distinctly channelled above, produced into a short open canal, its base a little notched. *Outer lip* convex, varicose, lirate within. *Columella* vertical, faintly excavated and a little inflected below. *Inner lip* moderately callous, with 3 tubercles on the parietal wall and 2 small plaits at the inflection of the columella, a smaller one upon the angle, and a longer one above it, both slightly descending towards the inner wall, the lip drawn out to a point along the canal.

Height, 13 mm.; diameter, 7 mm. (holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Shell-bed, Target Gully, Oamaru: Marshall.—Miocene.

Tritonidea compacta nov. sp. Plate IV, fig. 6.

Shell rather small, ovate-fusiform, axially costate and spirally lirate, solid, canal moderate, outer lip varicose, lirate within, inner lip with 1 tubercle on the parietal wall and 2 on the inflection of the columella. *Sculpture:* Protoconch smooth, post-embryonic whorls with narrowly convex axial ribs, 14 on a whorl, extending over the whole of the whorls, but getting rather inconspicuous on the body-whorl, where a strong rib strengthens the outer lip, and they do not extend below the periphery, the interstices of the same width as the ribs; they are crossed by fairly equidistant spiral cords with wide interspaces which usually contain a spiral thread; there are 5 major cords on the penultimate whorl and about 20 on the body-whorl. *Spire* sharply conical, its height equal to that of the aperture with canal, angle 49°. *Protoconch* small, papillate, of $1\frac{1}{2}$ convex whorls. *Whorls* 6, first slowly, then rather rapidly increasing, convex, the body-whorl contracted below. *Aperture* vertical, oval, channelled above, below with a moderately long, open, oblique canal, truncated at the base. *Outer lip* convex, varicose, thick, lirate within. *Columella* vertical, rounded, inflected towards the canal. *Inner lip* rather thin and narrow, with 1 grooved tubercle on the upper part of the parietal wall, and 2 tubercles below at the angle of the pillar, tapering to a fine point along the canal, and leaving just a trace of an umbilical chink.

Height, 20 mm.; diameter, 10 mm. (holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Holotype from shell-bed, Target Gully, Oamaru: Marshall. Also Mount Harris.—Miocene.

Tritonidea elatior nov. sp. Plate IV, fig. 7.

Shell rather small, fusiform, thin, imperforate, axially costate and spirally lirate, columella with a few tubercles, outer lip denticulate within, canal moderately long. *Sculpture:* Protoconch smooth, the post-embryonic whorls with oblique, broadly rounded, low axial ribs, about 10 on a whorl, extending from suture to suture, but on the body-whorl they vanish below the periphery, the interstices rather shallow and concave; there is spiral ornamentation present, consisting of fine threads on the spire-whorls, the interstices broader than the spirals and containing on the lower half of the volutions 1 or 2 very fine spiral threads; on the body-whorl the spirals are a little stronger and more distant, with a fine thread intercalated, but upon the base they are closer together, the interstices simple; growth-lines fine and close, often reticulating the fine spiral threadlets. *Spire* narrowly conical, very little higher than the aperture with canal, angle 40°. *Protoconch* small, papillate, of 2 convex whorls. *Whorls* 7, regularly increasing, convex, body-whorl contracted below. *Suture* well impressed. *Aperture* vertical, oval, lightly channelled above, with a moderately long, oblique, open canal below, its base truncated. *Outer lip* convex, acute, denticulate within. *Columella* straight, inflected below towards the canal. *Inner lip* rather thin, narrow, with a fine plait above on the parietal wall, an entering fine lamella at the point of inflection, and 2 small tubercles above it, ending along the canal in a fine point, and leaving a trace of an umbilical chink.

Height, 21 mm.; diameter, 9 mm. (holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Shell-bed, Target Gully, Oamaru: Marshall.—Miocene.

Fam. ALECTRIONIDÆ.

Alectrion (Tritia) latecostata nov. sp. Plate I, fig. 8.

Shell small, ovate, imperforate, ventricose, rather fragile, with broad flattish axial ribs, numerous spiral cords, very slightly callous inner lip, and a short deflected anterior canal. *Sculpture:* The two minute volutions of the protoconch are smooth, the third whorl has 2 to 3 fine spiral threads, the succeeding whorls are broadly axially costate, the ribs flatly convex, about 13 on the last whorl, with linear interstices; crossed by equal, convex, spiral cords, 6 to 7 on the penultimate whorl, with linear interspaces; base of the inner lip with 3 oblique cords upon the neck of the canal. *Spire* conic, about the same height as the aperture without canal. *Protoconch* minute, conical, of 2 slightly convex whorls, the pullus blunt. *Whorls* 6, convex, the last large in proportion and ventricose, base contracted towards the canal. *Suture* well impressed. *Aperture* subvertical, narrowly ovate, with a short canal below, which is turned to the left and truncated at the base. *Outer lip* convex, smooth inside. *Columella* short, vertical, rounded. *Inner lip* smooth, broadly expanded as a thin callus over part of the body-whorl.

Height, 8 mm.; diameter, 4·5 mm. (holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Pukeuri, near Oamaru: Marshall.—Miocene.

Fam. Muricidæ.

Murex zelandicus nov. var. komiticus. Plate IV, fig. 21.

This variety differs from the species only in some details of the sculpture. The varices extend down to the neck of the canal, the cinguli are much stronger, more distant, and in consequence there are more tubular spines, up to the number of 10; these spines are developed only on alternate varices, the varix between those with spines being rather obsolete on the body-whorl. The distant spiral cords are more prominent, and the interstices are ornamented with very distinct spiral threads, reticulated by close growth-lines, the spirals extending upon the neck of the canal.

The size is the same as in the species.

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Komiti Bluff, Kaipara Harbour, North Auckland: Marshall.—Miocene.

Trophon (Kalydon) lepidus nov. sp. Plate V, figs. 1, 2.

Shell small, fusiform, imperforate, turreted, with distant axial ribs, a few of which are sometimes a little foliated, crossed by cinguli which are slightly nodulous where they pass over the axial costæ, whorls shouldered, outer lip toothed within. *Sculpture* consisting, the protoconch excepted, of narrowly convex axial ribs, 9 to 10 on a whorl, part of them continuous over the whorls, interstices about the same width as the costæ and with thread-like growth-lines; on the body-whorl there are 3 foliated varices in the holotype, denoting arrests of growth; the spiral ornamentation consists of roundish cords. 5 on the penultimate whorl, 2 of which are upon the shoulder, and they render the axials a little nodulous at the points of intersection, the interstices about the same width as the cinguli. *Spire* conical, turreted, its height about the same as that of the aperture with canal. *Protoconch* of 2 convex smooth whorls, the pullus minute, pointed. *Whorls* about 7 when perfect, narrowly shouldered, moderately convex below the angle, body-whorl contracted anteriorly. *Suture* not deep, wavy. *Aperture* subvertical, ovate, broadly angled above, produced below into a fairly long oblique and open canal, its base notched. *Outer lip* angled above, convex, acute, thickened and dentate within. *Columella* rather short, vertical, inflected with a distinct angle towards the canal. *Inner lip* narrow, rather thin, drawn out to a point below. *Siphonal fasciole* not much raised.

Height, 9·5 mm.; diameter, 6 mm. (holotype). Height, 16 mm.; diameter, 8 mm. (paratype).

Holotype and *paratype* in the Otago University Museum; presented by Professor P. Marshall.

Loc.—Holotype from shell-bed, Target Gully, Oamaru: Marshall. Also from Allday Bay, Kakanui: G. H. Uttley.—Miocene.

Trophon (Kalydon) minutissimus nov. sp. Plate V, fig. 3

Shell minute, fusiform, turreted, imperforate, with broad shoulder, distant axials; spire-whorls with 2, body-whorl with 3, strong cinguli above the suture; base spirally lirate; siphonal canal moderately long; outer lip toothed within. *Sculpture:* Protoconch smooth, the first following whorl with about 12 oblique curved axial riblets extending over the whole whorl, the succeeding whorls with about 10 axial riblets, obsolete on the shoulder, the interstices on the last whorl broader than the riblets, with fine lamellar growth-lines; the spire-whorls have 2 conspicuous spiral cords, one on the carina and one below it; the body-whorl has in addition a finer spiral above the keel, and 7 oblique cinguli on the base, but leaving the neck of the canal smooth; at the points of intersection there are broad low tubercles, rendering the cinguli somewhat undulating. *Spire* narrowly conical, acute, turriculate, its height the same as that of the aperture with canal. *Protoconch* papillate, of 2½ convex whorls, the pullus minute, pointed. *Whorls* 5½, first slowly, but then rather rapidly increasing, broadly shouldered, flat above and slightly convex below the keel; body-whorl convex below the keel, thence concavely contracted towards the neck of the canal. *Suture* well impressed, simple. *Aperture* rather large, pyriform, broadly angled above, produced below into a moderately long and open canal, its base truncated. *Outer lip* strongly arched, thickened, prominently toothed within. *Columella* vertical, straight, slightly bent to the left towards the canal. *Inner lip* thin, rather broadly expanded.

Height, 3·8 mm.; diameter, 1·8 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 165 = White Rock River, Upper Pareora Valley: McKay, 1876.—Miocene.

Trophon (Xanthochorus) pulcherrimus nov. sp. Plate XII, fig. 8.

Shell small, bucciniform, imperforate, with strong nodose spirals, rather short siphonal canal, and toothed outer lip. *Sculpture:* Protoconch smooth, the succeeding whorls with 3 to 4 strong cinguli; body-whorl spirally ribbed down to the neck of the canal, the interstices narrower than the cinguli; there are 12 low, broadly convex axial ribs, vanishing towards the base, which produce oval low tubercles on the crossing-points with the spirals, the interspaces slightly narrower than the ribs. *Spire* conic, a little lower than the aperture with canal, angle 55°. *Protoconch* conic, of 2½ strongly convex whorls, the nucleus minute. *Whorls* 5, the first three slowly increasing in size, the last relatively large, ventricose; the spire-whorls flatly convex, the last whorl convex and contracted below. *Suture* well impressed. *Aperture* ovate, vertical, channelled above, with a short oblique canal below, rounded at the base. *Outer lip* convex, acute but solid, slightly thickened inside, and distinctly toothed. *Columella* straight, vertical, obliquely truncated below. *Inner lip* narrow, distinctly marked off from the spiral sculpture by a fine groove. *Siphonal fasciole* distinct, rounded, lamellate.

Height, 12 mm.; diameter, 6·8 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Starborough Creek, Awatere Valley, Marlborough, from mudstones above the waterfall: J. A. Thomson, 1912.—Pliocene.

Fam. Thaisidæ.

Rapana neozelanica nov. sp. Plate XII, fig. 9.

Shell rather small, ventricose, carinated, with low spire, deeply umbilicated (the anterior part unfortunately broken off). *Sculpture:* The cast has only some traces of shell left, and all that can be made out is that there are axial ribs, nodulous upon the keel, and spiral liration. *Spire* low, broadly conoidal, its height less than that of the aperture. *Protoconch* lost. *Whorls* about 3 to 4, the last large, keeled, the shoulder concave, flat below the keel, much narrowed towards the base. *Aperture* large, broadly angled above. *Outer lip* acutely angled, straight above, broadly convex below. *Columella* oblique, straight. *Umbilicus* large and deep, about one-fourth of the greatest diameter, with a sharply rounded border.

Height, 17 mm.; diameter, 19 mm. (imperfect holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 479 = Marly greensands, Waihao River, South Canterbury: McKay, 1880.—Miocene.

Remarks.—This and the following species are represented by casts only, but the genus being quite new to our fauna I do not hesitate to name, describe, and figure them; better-preserved specimens may turn up later on. This species seems to resemble the much larger *R. rapa* Gmelin from the Fiji Islands, a Recent shell. One species, *Trophon succinctus* T.-Woods, from the Oligocene, Muddy Creek, Victoria, has been assigned to *Rapana (Ecphora)* by Cossmann.

Rapana waihaoensis nov. sp. Plate XII, fig. 10.

Shell moderately large, bucciniform, with comparatively high spire, large body-whorl, an open canal, and deep umbilicus. *Sculpture:* The cast of this species has only part of the inner layer of the shell on it, and there is no trace of sculpture. *Spire* conical, a little less than half the height of the aperture. *Whorls* about 3, very likely slightly angled, the last large, high, somewhat ventricose and convex, concavely narrowed towards the canal. *Suture* probably canaliculate. *Aperture* a little oblique, broadly pyriform, gradually narrowed below into an open canal. *Outer lip* convex. *Columella* long, somewhat concave. *Umbilicus* deep, limited by a sharp border, its width about one-fourth of the diameter of the shell.

Height, 39 mm.; diameter, 30 mm. (imperfect holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 480 = "Island sandstone" (*i.e.*, lower part of greensands), Waihao River, South Canterbury: McKay, 1880.—Miocene.

Fam. Volutidæ.

Fulgoraria (Alcithoe) arabica nov. var. turrita. Plate V, fig. 4.

Distinguished from the species by the elongate form with high, narrow, and acute spire, having an angle of 30° only; the whorls much more rapidly descending, with sharp, distant axial ribs, from 11 to 13 on the last whorl; columella with 5 oblique plaits.

Height, 110 mm.; diameter, 39 mm. (holotype, devoid of the protoconch).

Holotype in the Canterbury Museum, Christchurch; presented by Mr. M. C. Gudex.

Loc.—Holotype from sandy clay lying immediately over limestone, Blue Cliffs, near St. Andrews, South Canterbury: M. C. Gudex. Also from loc. No. 479 = Marly greensands, Waihao River, South Canterbury: McKay, 1880.—Miocene.

Remark.—*F. aculeata* (Hutton) may be considered as a very small dwarf form of this variety.

Fulgoraria (Alcithoe) biconica nov. sp. Plate V, figs. 5, 6.

Shell of medium size, biconic, solid, with a row of nodules on the body-whorl, and 4 columellar plaits. *Sculpture:* The upper spire-whorls are smooth, the penultimate whorl has a few distant small tubercles close to the suture below, and it is continued over the body-whorl, the tubercles getting larger, sometimes forming short, pointed, conical spines which are a little more distant on approaching the outer lip; their number is 9. The whole surface is adorned with strong, slightly oblique growth-lines. The siphonal fasciole with strong transverse concave lamellæ. *Spire* low, conical, about half the height of the aperture. *Protoconch* lost. *Whorls* 3 in the holotype, but in perfect adult specimens their number would very likely be about 6; they are quite flat in the holotype, but an imperfect paratype shows a swelling below the suture, forming a narrow shoulder; body-whorl with a nodulous keel at the upper third of height, very flatly convex beneath it, and contracted towards the base. *Suture* very little impressed, somewhat undulating. *Aperture* high, ovate, angled above, narrowed and very slightly notched below. *Outer lip* sharp, the specimen being evidently not quite adult, very faintly retrocurrent towards the suture. *Columella* slightly oblique, with 4 strong oblique plaits, the lowest a little smaller than the others. *Inner lip* thin and narrow, tapering below. *Siphonal fasciole* distinct, limited on both sides by a keel.

Height, 62 mm.; diameter, 38 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 480 = "Island sandstone" (*i.e.*, lower part of greensands), Waihao River, South Canterbury: McKay, 1880.—Miocene.

Athleta necopinata nov. sp. Plate V, fig. 7.

Shell ovato-fusiform, rather fragile, axially costate, the ribs raised into sharp tubercles in front of the suture, body-whorl with a second row of tubercles a little farther down, and spiral grooves reticulated by growth-lines between the tubercles; columella with 4 plaits. *Sculpture:* The spire-whorls have about 12 sharply raised, laterally compressed axial ribs which are produced into pointed tubercles in front of the suture, the interstices are broader than the ribs and excavated; on the body-whorl there is a second row of smaller tubercles about 3 mm. below the upper one; the interstices and tubercles are crossed by about half a dozen fine liræ, which are sometimes reticulated by growth-lines; the base, to which the axials extend, is spirally ribbed, this zone having a height of 9 mm. *Spire* has only one whorl left, the remainder having unfortunately been broken off. *Whorls* angularly convex, the last but little convex, narrowing gradually towards the beak. *Suture* inconspicuous. *Aperture* narrow, high. *Columella* vertical, convex at the middle, excavated below. *Inner lip* thin, broadly expanded over the body, with 4 not much raised oblique plaits.

Height, 30 mm.; diameter, 14 mm. (holotype; imperfect specimen).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Waihao greensands, Waihao Downs, South Canterbury: J. A. Thomson, 1913 (holotype). Also from loc. No. 479 = Marly greensands, Waihao River: McKay, 1880; and No. 164 = Coal-beds, Kakahu River: McKay, 1876.—Miocene.

Remarks.—Unfortunately the specimens are imperfect, but still good enough to establish a new species. It is allied to *Voluta antiscalaris* McCoy, from the Eocene of southern Australia, but evidently distinct from it.

Lapparia hebes (Hutton). Plate V, fig. 8; Plate XII, figs. 11, 12.

1873. *Pleurotoma hebes* Hutton, Cat. Tert. Moll., p. 4.
1885. *Pleurotoma hebes* Hutton, Quart. Journ. Geol. Soc., vol. xli.
1887. *Pleurotoma hebes* Hutton, P.L.S. N.S.W. (2), vol. i, p. 213.
1914. *Pleurotoma hebes* Hutton, Suter, Palæontological Bulletin No. 2, pt. i, p. 2.

Shell of medium size, fusiform, biconic, imperforate, with angular whorls, and distant axial costæ produced into blunt spines upon the angle, spirally striated, columella with 4 oblique plaits. *Sculpture:* Protoconch smooth, the succeeding whorls with broadly rounded distant axial ribs, extending from the angle to the suture below, produced into tubercles and on the lower whorls into blunt spines upon the angle, about 10 on a whorl; on the body-whorl these ribs extend usually half-way down; the spiral sculpture consists of distant cords, sometimes a coarser with a finer one alternating; they are cancellated by distinct growth-lines. *Spire* conical, shorter than the aperture, but its height is variable; the angle is typically 40–45°. *Protoconch* rather large, of several concave whorls, the nucleus slightly lateral and pointed. *Whorls* about 7 to 8, first slowly, then more rapidly increasing, angular above the middle on the spire-whorls, the shoulder slightly concave, straight below the angle; body-whorl but little convex, somewhat contracted towards the base. *Suture* not deep, wavy in consequence of the axial costation. *Aperture* but little dilated, the margins subparallel, angled above, not much contracted below, deeply notched at the base. *Outer lip* subvertical, slightly angled above, straight, curved towards the base. *Columella* vertical, somewhat excavated below, with 4 oblique equidistant plaits of nearly equal strength on the lower half. *Inner lip* broad, very little callous. *Siphonal fasciole* very distinct, broadly convex, surface with curved lamellæ.

Height, 23 mm.; diameter, 12 mm. (according to Hutton: Plate V, fig. 8). Height, 40 mm.; diameter, 22 mm. (imperfect specimen showing the columella plaits; perfect, this specimen would be about 50 mm. by 25 mm.). Height, 28 mm.; diameter, 14 mm. (smaller perfect specimen).

Holotype missing. *Plesiotypes* in the collection of the New Zealand Geological Survey.

Loc.—No. 164 = Coal-beds, Kakahu River, South Canterbury: McKay, 1876. No. 480 = Island sandstone" (*i.e.*, lower part of greensands), Waihao River, South Canterbury: McKay, 1880.—Miocene.

Remarks.—The plesiotypes were selected from Kakahu River specimens. Hutton gives as localities Oamaru and Poverty Bay, and most likely the missing holotype was from Cape Oamaru.

Hutton's diagnosis is quite inadequate to recognize the species, and he evidently had no specimen showing columellar plaits. Fortunately there is a drawing of Hutton's type available, made by the late Mr. J. Buchanan, and this helped me to identify the species. This drawing is here reproduced, but it should be noted that the suture is *not* margined, as shown in the figure; it is simply a part of the reticulation produced by growth-lines and spirals.

This shell seems to be rather abundant in the localities mentioned, but there is no really perfect specimen amongst the two lots. Most of them have lost all spiral sculpture, few show the columellar plaits, and only two the protoconch.

The species is a typical *Lapparia*, being very nearly allied to the type, *Mitra dumosa* Conrad, from the Eocene of Mississippi.

Voluta tabulata Tate (Trans. Roy. Soc., South Aust., vol. x, pl. xiii, fig. 3; vol. xi, p. 132) from a well-sinking, Murray Desert, is either nearly allied to Hutton's species or identical. In the latter case Hutton's name has priority.

Scaphella elegantissima nov. sp. Plate V, fig. 9.

Shell rather small, elongately narrowly ovate, smooth, columella with 5 plaits. *Sculpture:* All the whorls are smooth, except for a few faint spiral striæ on the spire-whorls, and growth-lines over all the whorls. *Spire* narrowly conical, rather high, nearly as high as the aperture. *Protoconch* obtusely scaphelloid, consisting of 2 whorls, with the nucleus granular, rising to an obtuse point. *Whorls* 7, first slowly, then rapidly increasing, flat, the body-whorl convex and attenuated towards the base. *Suture* somewhat uneven, covered up by the succeeding volutions.

Aperture slightly oblique, narrowly oblong, angled above, with a very short open canal below. *Outer lip* thin, sharp. *Columella* medially slightly convex, with 5 oblique plaits, the uppermost smaller than the others. *Inner lip* narrow, the lower part with a shallow groove outside.

Height, 47 mm.; diameter, 15 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Shell-bed below the uppermost Mount Brown limestone, Weka Pass Stream, Weka Pass, North Canterbury: J. A. Thomson, 1913.—Miocene.

Remarks.—This species is very nearly allied to *Voluta protorhysa* Tate, from the Eocene of South Australia, which, however, has the 3½ post-embryonic whorls axially costate, and only 4 plaits on the columella.

Fam. OLIVIDÆ.

Ancilla waikopiroensis nov. sp. Plate V, fig. 10.

Shell narrowly ovate, with acuminate spire and a moderate labial pad. *Sculpture* consisting of axial growth-lines upon the smooth zone, crossed by fine microscopic spiral lines, sometimes obsolete; the callosity of the spire limited below by a shallow groove; siphonal fasciole bicarinate, smooth, the narrow band above it with arcuate striation, its upper groove running out into a small tooth. *Spire* high and acuminate, angle about 50°, of the same height as the aperture, outlines straight. *Protoconch* small, mostly hidden by enamel. *Whorls* about 5, those of the spire flat, the last large, somewhat tumid, convex, narrowed towards the base; the smooth zone occupies one-third of the height of the shell. *Suture* hidden by enamel. *Aperture* vertical, narrowly oval, canaliculate above, truncated and deeply notched below. *Outer lip* slightly convex, acute, with a small tooth below. *Columella* vertical, convex on the body, concave and twisted below. *Inner lip* narrow and plicated anteriorly, getting broader and forming a narrow pad outside the posterior part of the mouth, extending as a thin smooth callous layer over the spire.

Height, 24 mm.; diameter, 11 mm. Aperture: Height, 13 mm.; breadth, 5 mm. (holotype).

Holotype in my collection.

Loc.—Waikopiro, near Ormondville, Hawke's Bay, North Island. Also loc. No. 630, Teaneraki (Enfield), near Oamaru, North Otago, T. Esdaile; and No. 642, Waihao Bridge, one mile and a half below Waihao Forks, South Canterbury, McKay, 1886.—Miocene.

Fam. MARGINELLIDÆ.

Marginella (Glabella) fraudulenta nov. sp. Plate XII, fig. 13.

1873. *Marginella albescens* Hutton, Cat. Tert. Moll., p. 8; not of Cat. Mar. Moll., p. 19.

Shell very small, ovate, smooth, with a moderately raised spire, outer lip with a prominent smooth varix, columella with 4 oblique plaits. There is no *sculpture*. *Spire* conoidal, half the height of the aperture, apex narrowly convex. *Protoconch* broadly rounded, with a minute indistinct nucleus. *Whorls* 3, the spire-whorls small, slightly convex; body-whorl large, convex, gradually narrowing anteriorly. *Suture* superficial, simple. *Aperture* oblique, narrow, the margins nearly parallel, a little channelled above, truncated at the base. *Outer lip* somewhat convex, with a strong varix, smooth inside, extending a short way up the spire and round the base, with a distinct posterior sinus. *Columella* oblique, with 4 subequidistant sharp plaits, the two upper ones transverse, the lower two a little nearer together, oblique, the lowest extended to the basal margin *Inner lip* thin, rather broadly spread over the body.

Height, 4·5 mm.; diameter, 2·5 mm. (holotype from Pukeuri). Height, 3·7 mm.; diameter, 2 mm. (paratype from Awamoa).

Holotype and *paratypes* in the collection of the New Zealand Geological Survey.

Loc.—The holotype is from loc. No. 253, Pukeuri, near Oamaru, Traill, 1874; and the paratypes from loc. No. 170, Awamoa beach and creek, McKay, 1876.—Miocene.

Remarks.—I have never come across a fossil *Marginella albescens* Hutton, either in the Pliocene or in the Miocene, and I am confident that Hutton took the smaller form from Awamoa as his species. These latter shells may not be quite adult, or simply represent a slightly dwarfed form. I selected the only large specimen as the holotype because it is perfect and has an empty mouth, whereas the specimens from Awamoa have the mouth all filled with matrix.

The species is very nearly allied to the Recent *M. amœna* Suter and *M. hebescens* Murdoch and Suter (Man. N.Z. Moll., p. 462), but is distinct from both.

Fam. Harpidæ.

Harpa (Eocithara) neozelanica nov. sp. Plate V, fig. 11.

Shell moderately large, oval, solid, with a low spire, suture covered, body-whorl with regular axial ribs, nodulous at the periphery, growth-lines very distinctly laciniate, and distant, regularly spaced cinguli. *Sculpture:* The spire-whorls of the only specimen before me are smooth, the body-whorl is axially costate, the costæ inconspicuous on the slope below the suture, but upon the angle of the whorl they are raised into elongated roundish tubercles; they number about 20, and are continued as laciniated low ribs to the base; the interstices are ornamented with one or several laciniated riblets; growth-lines very prominent, retrocurrent towards the suture above; the ribs are crossed by distant spiral cords, indistinct upon the shoulder, but conspicuous below the angle of the body-whorl, and having upon them the angles of the axial laciniations; their number is about 16, and they are somewhat closer together towards the base. *Spire* short, conoidal, about one-fourth the height of the aperture. *Protoconch* dome-shaped, smooth. *Whorls* 4, the last very large and ventricose, convex upon the shoulder, flattish below the angle of the periphery and somewhat contracted towards the base; the penultimate whorl is biangulate. *Suture* covered. *Aperture* ovate, much higher than broad. *Siphonal fasciole* raised, composed of fine lamellæ.

Height, 57 mm.; diameter, 45 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 480 = "Island sandstone" (*i.e.*, lower part of greensands), Waihao River, South Canterbury: McKay, 1880.—Miocene.

Remark.—This is the first species of the genus recorded from New Zealand, and it seems to be allied to, though no doubt distinct from, the South Australian *Harpa clathrata* Tate.

Fam. Turritidæ.

Clavatula (Perrona) mackayi nov. sp. Plate V, fig. 12.

Shell small, narrowly fusiform, imperforate, with the whorl succeeding the protoconch axially finely costate, the following whorls smooth, but having a spiral groove below the suture, base distinctly spirally striated, aperture narrow, with a short canal below, labial sinus not deep, rounded. *Sculpture:* Part of the protoconch is lost in all three specimens, but it evidently is smooth, the following whorl is axially finely costate, the two succeeding whorls are quite smooth, the next two whorls have a spiral groove margining the suture below, the body-whorl has about 8 very shallow spiral grooves, and the base is distinctly spirally lirate with linear interstices; growth-lines show the presence of a broadly rounded shallow labial sinus, distant from the suture; one paratype has the sinus deeper and the growth-lines below it strongly antecurrent, whilst in the holotype they are nearly vertical. *Spire* high, narrowly conical, outlines nearly straight, its height about 1½ times that of the aperture with canal, angle 22°. *Whorls* 6, regularly increasing, the body-whorl high in proportion, moderately convex, suddenly contracted towards the base, ending in a narrow beak. *Suture* well impressed, margined below on the lower whorls. *Aperture* elongated pyriform, slightly channelled above, with a short and straight canal below, its base rounded. *Outer lip* broken off. *Columella* vertical, straight, but inflected below towards the canal. *Inner lip* narrow.

Height, 12 mm.; diameter, 4·5 mm. (holotype, without protoconch).

Holotype and two *paratypes* in the collection of the New Zealand Geological Survey.

Loc.—The holotype is from loc. No. 479 = Marly greensands, Waihao River, South Canterbury: McKay, 1880. The two paratypes are from loc. No. 480 = "Island sandstone," or lower part of the same greensands: McKay, 1880.—Miocene.

Remark.—The species is named in honour of Mr. Alexander McKay, who collected the fossils.

Leucosyrinx alta Harris nov. subsp. transenna.

The subspecies is distinguished from the species by the sculpture and the smaller size. The sculpture consists in the holotype of 3 nearly equidistant spiral threads between the suture above and the keel, the uppermost stronger than the others, and distant from the suture; below the keel there is no spiral ornamentation, except a well-pronounced cord margining the upper part of the suture, and extending over the body-whorl; on the latter there are below this cord 7 equidistant spirals, followed by about 5 finer ones upon the neck of the canal; the axial sculpture shows the incremental lines developed into equidistant, flattish, fine riblets, vertical in the space between first and second spiral, retrocurrent and inconspicuous between first and second spiral, arcuate from the second spiral over the third to the keel, antecurrent below the latter. These axial riblets vanish on the body-whorl towards the base. This beautiful reticulating axial sculpture is absent in specimens from Waikopiro, showing only more or less pronounced growth-lines, but the spiral sculpture is well developed. A specimen from Petane has a fine spiral thread between the keel and the suture below, the latter being only very narrowly margined above. Angle of spire 30°.

Height, 11 mm.; diameter, 4 mm. (holotype of 8 whorls). Height, 13 mm.; diameter, 5 mm. (a specimen from Mount Harris of 7 whorls, the protoconch lost).

Holotype in my collection.

Loc.—The holotype is from Awamoa, North Otago. Paratypes are from loc. No. 475 = Mount Harris, near Waihao, South Canterbury, McKay, 1880; also from Petane and Waikopiro (near Ormondville), Hawke's Bay.—Miocene and Pliocene.

Turris bimarginatus nov. sp. Plate V, fig. 13.

Shell small, fusiform, turreted, fragile, spire-whorls with a strong median gemmate carina, the suture bimargined, body-whorl with 2 distant sharp cinguli below the gemmate keel; base spirally lirate, sinus deep, upon the keel. *Sculpture* consisting of a very prominent keel, median on the spire-whorls, beset with slightly oblique, pyriform nodules, about 16 on a whorl; the keel and the concave space above it are adorned with fine spiral threads; the suture is margined above by a fine spiral cord, below by a broader one bearing a fine groove; on the last whorl there are 2 strong distant spiral cords below the keel, and the base is distinctly spirally striate; the whole surface is marked with flexuous growth-lines. *Spire*, the upper part of which is lost, higher than the aperture, narrowly conic, turreted. *Whorls* carinated, excavated above and flat below the keel, the last volution contracted towards the beak. *Suture* linear, narrowly margined above, broader below. *Aperture* pyriform, angled above, with a moderately long canal below. *Outer lip* acute, with a deep triangular sinus upon the keel. *Columella* vertical, rounded. *Inner lip* thin, narrow, smooth.

Height, 10 mm.; diameter, 4 mm. (holotype; very imperfect specimen).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 630 = Esdaile collection, Teaneraki (Enfield), near Oamaru, North Otago.—Miocene.

Remarks.—Although the only specimen is very imperfect and apparently not adult, yet I do not hesitate to describe this new species, as the sculpture is very characteristic, and by it the shell can always be identified.

Turris complicatus nov. sp. Plate V, fig. 14.

Shell rather small, fusiform, turriculated, the whorls with a nodulous keel, the suture margined, canal straight, sinus upon the carina. *Sculpture:* Protoconch smooth, the next whorl with oblique sharp axial costæ, the succeeding whorls with oblique, oval, and elevated nodules upon the carina, about 14 on a whorl, the interstices of the same width; a few spiral liræ cross the lower half of the nodules; the suture is margined below by a slightly convex band which, on the lower whorls, shows traces of spiral threads; the fine growth-lines of the sinus are distinct on the lower whorls; base with spiral riblets, finer and closer towards the beak. *Spire* high, conical, turriculate, nearly twice the height of the aperture without canal, angle 30°. *Protoconch* conic, of $2\frac{1}{2}$ convex whorls, the nucleus pointed. *Whorls* about 10, regularly descending, carinated, the shoulder excavated, the carina at the middle of the whorls, base suddenly contracted towards the beak, convex above the contraction. *Suture* well impressed, broadly margined below. *Aperture* pyriform, angled above, produced below into a most likely moderately long (the lower end is broken off) and straight canal. *Outer lip* thin, acute, convex at the middle, with a deep angular sinus at the keel. *Columella* straight, smooth. *Inner lip* narrow, thin, tapering below towards the canal.

Height, 22 mm.; diameter, 8 mm. (holotype; imperfect specimen).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 642 = Waihao River Bridge, one mile and a half below Waihao Forks, South Canterbury: McKay, 1880.—Miocene.

Turris duplex nov. sp. Plate V, fig. 15.

Shell small, fusiform, thin, whorls turreted, bicarinate, with 2 rows of small tubercles, suture margined above, canal moderately long, straight, sinus deep upon the lower more prominent carina. *Sculpture:* Part of the protoconch is lost, and the sculpture on the two upper whorls has been worn off; whorls bicarinate, the lower carina more prominent, both bearing small roundish tubercles, about 16 on a whorl, the interspaces slightly narrower; the suture margined above by a very distinct smooth cord; body-whorl adorned below the lower carina with distant spiral cords, which, however, are finer and close together upon the neck of the canal;

they are crossed by very strong, oblique, and arched lines of growth. *Spire* conic, turreted, its outlines straight, height about 1½ times that of the aperture with canal, angle 28°. *Protoconch* apparently smooth. *Whorls* 7, gradually increasing, bicarinate, excavated between the two keels, body-whorl convex below the lower carina, then suddenly much contracted. *Suture* inconspicuous, margined above. *Aperture* narrowly pyriform, angled above, with a straight moderately long and open canal, its base rounded. *Outer lip* acute, smooth within, convex at the middle, with a deep triangular sinus at the lower keel. *Columella* straight, rounded, slightly bent to the left on reaching the canal. *Inner lip* narrow, smooth, well circumscribed, tapering to a fine point below.

Height, 14 mm.; diameter, 5·5 mm. (holotype; not quite perfect).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 479 = Marly greensands, Waihao River, South Canterbury: McKay, 1880.—Miocene.

Turris neglectus nov. sp. Plate VI, fig. 1.

Shell small, fusiform, turreted, whorls keeled, below the middle on the spire, with rather distant sharp tubercles upon the carina, sinus deep upon the keel, canal fairly long. *Sculpture:* There is a moderately raised keel, below the middle on the spire-whorl, with sharply raised roundish tubercles, about 12 on a volution, the interstices of about the same width as the tubercles; the suture is margined below by a rather broad, flattish band; the whole surface ornamented by very fine spiral threads, obsolete on the upper whorls; base distinctly narrowly spirally striated; the flexuous growth-lines are distinct on the lower whorls. *Spire* high, conic, turreted, somewhat higher than the aperture with canal, angle 35°. *Protoconch* lost. *Whorls* 6 in the imperfect specimen, excavated above the keel, the last whorl suddenly contracted and ending in a rather long straight beak. *Suture* not much impressed, broadly margined below. *Aperture* pyriform, broadly angled above, extending below into a slightly oblique, moderately long and open canal, its base rounded. *Outer lip* convex at the middle, with a deep narrowly triangular sinus at the keel. *Columella* vertical, very little curved to the left below. *Inner lip* thin, narrow, smooth, ending in a fine point anteriorly.

Height, 14 mm.; diameter, 6 mm. (imperfect and immature specimen; holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 630 = Esdaile collection, Teaneraki (Enfield), near Oamaru, North Otago.—Miocene.

Turris regius nov. sp. Plate XII, fig. 14.

Shell rather small, narrowly fusiform, turreted, axially costate, keel with sharp tubercles, with distant spiral cords, more distinct on the lower whorls, siphonal canal long and straight, anal sinus upon the keel. *Sculpture:* Protoconch smooth, the next whorl with about 16 strongly arched oblique sharp axial riblets, which, on the next whorl, are more distant, their number being reduced to about 12, the succeeding whorls have the same number of axials, very fine and receding upon the shoulder, produced into minute elongated tubercles close to the suture above; from the carina down to the suture the axials are much stronger, directed forwards, forming rather sharp tubercles on the keel; with the growth of the shell the axials increase in number up to about 20 on the last volution; upon the shoulder there are 3 distant spiral threads, sometimes obsolete, the tubercles are crossed by about 4 close cinguli, followed by 1 or 2 spiral cords; body-whorl devoid of axial ribs below the keel, with distant strong cinguli, closer together on approaching the neck of the canal, on which they extend nearly to the end. *Spire* narrowly conical, turreted, about three times the height of the aperture without canal, angle 25°. *Protoconch* conical, small, the pullus minute. *Whorls* 9 to 10, regularly increasing, strongly keeled a little below the middle, the shoulder concave, the body-whorl flat below the keel, concavely contracted towards the neck of the canal. *Suture* well impressed, simple. *Aperture* subvertical, narrowly oval, channelled above, with a fairly long, straight, and open canal, its base rounded (the lower part broken off in the holotype). *Outer lip* acute, angled at the carina, slightly convex, with a rather deep narrowly rounded sinus upon the keel. *Columella* straight, somewhat excavated on the body, very little turned to the left below. *Inner lip* thin and narrow, stopping the spiral liration.

Height, 14 mm.; diameter, 5 mm. (imperfect holotype).

Holotype in my collection.

Loc.—Greensands, McCulloch's bridge, right bank of Waihao River, South Canterbury: G. H. Uttley.—Miocene.

Turris uttleyi nov. sp. Plate VI, figs. 2, 3.

Shell of medium size, fusiform, turriculated, with oblique nodules upon the carina, finely spirally striated, anal sinus on the keel, aperture with a long canal, shorter than the spire. *Sculpture:* Spire-whorls with arcuate axial riblets, about 16 on a whorl, inconspicuous above and below the keel, but produced into conspicuous, oblique, elongated nodules upon the angle of the whorls, and into rather inconspicuous round tubercles below the suture; on the second half of the penultimate whorl and on the body the nodules upon the keel are getting irregular and obsolete; all the whorls are ornamented with fine and close spiral striæ, but on the body-whorl, for some distance below the carina, a number of coarser cinguli are interspersed between two or three of the finer ones. *Spire* high, turriculate, about 1½ times the height of the aperture with canal, outlines moderately convex, angle about 30°. *Protoconch* lost. *Whorls* about 10, regularly increasing, angled at the middle, slightly excavated above, and but little convex below the angle; body-whorl convex, much contracted below. *Suture* not deep, simple. *Aperture* somewhat oblique, narrowly ovate, angled above, produced below into a rather long, narrow, open canal, which is slightly bent backwards, the base rounded. *Outer lip* solid, acute, with a deep narrowly rounded anal sinus upon the angle. *Columella* slightly excavated towards the body, feebly convex farther down, rounded. *Inner lip* narrow, smooth, drawn out to a point on the margin of the canal.

Height, 36 mm.; diameter, 12 mm. (holotype).

Holotype in my collection

Loc.—The holotype is from Trig. Z, Otiake River, Waitaki Valley, North Otago: G. H. Uttley. The species also occurs at localities No. 251, Wharekuri, Waitaki Valley, North Otago, Traill, 1874; No. 479, marly greensands, Waihao River, South Canterbury, McKay, 1880; and No. 483, Hutchinson Quarry beds, Wharekuri, Waitaki Valley, North Otago, McKay, 1880.—Miocene.

Remark.—The species is named in honour of Mr. George H. Uttley, M.A., M.Sc., the well-known geologist, and a zealous collector of fossils.

Drillia callimorpha nov. sp. Plate VI, fig. 4.

Shell small, narrowly fusoid, turriculate, axially costate, spirally lirate on the lower half of the whorls, canal short, sinus not deep, situate below the suture on the excavation of the whorl. *Sculpture:* Protoconch smooth, the following whorls with thick convex axial ribs, 10 on a whorl, discontinuous over the whorls, and not extending to the suture above, the interstices narrower than the ribs, the lower half of the whorls with 4 to 5 spiral threads; on the body-whorl the spirals are present down to the end of the beak; the suture is lightly margined below. *Spire* turriculate, conic, its height about $1\frac{1}{3}$ that of the aperture with canal, angle 30°. *Protoconch* of 2 convex whorls, the nucleus obtuse, slightly tilted. *Whorls* 7, regularly increasing, with a slightly concave shoulder, convex below the angle, last whorl convex, contracted towards the base. *Suture* well impressed, margined below. *Aperture* narrowly pyriform, slightly channelled above, extending below into a short open canal, its base truncated. *Outer lip* convex, acute, but strengthened on the outside by an axial riblet, advancing at the middle, with a rounded not deep sinus below the suture, its upper margin slightly antecurrent. *Columella* vertical, rounded, somewhat inflected below. *Inner lip* narrow, callous, smooth, tapering to a point below.

Height, 11·5 mm.; diameter, 4 mm. (holotype).

Holotype in the Otago University Museum; presented by Professor P. Marshall.

Loc.—Shell-bed, Target Gully, Oamaru: Marshall.—Miocene.

Drillia (Crassispira) costifer nov. sp. Plate VI, fig. 5.

Shell small, narrowly fusiform, turriculate, axially costate and spirally lirate, with a moderate rounded sinus between suture and keel. *Sculpture:* The protoconch is quite smooth, the following whorls with oblique sharp axial ribs descending from the carina to the suture below, on the body-whorl they vanish on reaching the lower half; upon the keel they are produced into more or less distinct nodules; their number is 15 on the last whorl, and the interstices are a little broader than the ribs; the fine spiral striæ are distinct only upon the body-whorl, especially on the neck of the canal, very faint on the spire-whorls, none upon the shoulder, and they are crossed by flexuous growth-lines. *Spire* narrowly conic, turreted, about one-third higher than the aperture with canal, angle varying from 30° to 40°. *Protoconch* of $1\frac{1}{2}$ globose whorls. *Whorls* 6, regularly increasing, keeled, with a slightly excavated shoulder occupying one-third or a little more of the upper part of the volution, almost straight below the carina; body-whorl convex and gradually contracted towards the base. *Suture* superficial, not margined. *Aperture* subvertical, narrow, angled above, produced below into a short open canal, its base truncated. *Outer lip* thin and sharp, convex, angled above, with a rather shallow rounded sinus between suture and keel. *Columella* straight, but slightly bent to the left below. *Inner lip* thin and narrow, drawn out to a point towards the left margin of the canal, and separated from the spiral liration by a narrow groove. *Siphonal fasciole* imperceptible.

Height, 9·5 mm.; diameter, 3·4 mm. (holotype). Height, 8 mm.; diameter, 3·8 mm. (a shorter paratype, 6 whorls).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Pukeuri, six miles north of Oamaru: Marshall.—Miocene.

Remark.—This species is nearly allied to *D. callimorpha* Suter, but is distinguished from it by the non-margined suture, the more numerous and sharper axial riblets, and the much less distinct spiral lineation on the spire-whorls.

Drillia imperfecta nov. sp. Plate I, fig. 10.

Shell very small, fusiform, with a moderately high spire, strong axial costæ and fine spiral threads; canal short, open; outer lip thickened, with a moderately deep sinus below the suture. *Sculpture:* The protoconch, of 2½ whorls, has the first 1½ smooth and convex, the following volution smooth and carinated; the succeeding post-embryonic whorl is also carinated, having on the shoulder about 10 oblique riblets; the following whorls have strong acute vertical axial ribs, about 10 on a whorl, mostly discontinuous over the whorls, vanishing below towards the beak, the interstices of the same width, flat; the spiral sculpture is mostly worn off in the unique specimen, but there are traces of spiral threads, and the base is closely spirally striated. *Spire* conical, slightly turreted above, its height about 1¼ times that of the aperture with canal. *Protoconch* conoid, of 2½ whorls. *Whorls* 7, gradually increasing, the upper ones shouldered, slightly convex, the body-whorl contracted towards the beak. *Suture* not deep. *Aperture* somewhat oblique, elongated pyriform, channelled above, with a short open canal below, its base lightly notched. *Outer lip* varicose, angled above, with a fairly deep rounded sinus close to the suture. *Columella* vertical, rounded, deflected towards the canal. *Inner lip* rather thin, narrow, tapering below, with a pad opposite the sinus.

Height, 6 mm,; diameter, 2·6 mm. (holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Shell-bed, Target Gully, Oamaru: Marshall.—Miocene.

Surcula antegypsata nov. sp. Plate VI, fig. 6.

Shell fusiform, biconic, turriculate, with faint oblique axial riblets and spiral liræ. *Sculpture:* The whorls succeeding the smooth protoconch have a strong keel above the middle on the upper two volutions, and at the middle of the two following; oblique antecurrent flattish axial costæ extend from suture to suture, on the body-whorl they vanish towards the base, and they are sinuated upon the shoulder; their number is about 30 on the penultimate whorl; they are narrow on the shoulder, but much broader and flattish beneath the keel, mostly with smaller interstices; the spiral sculpture consists of fine threads, inconspicuous upon the shoulder, but prominent towards the base where they are transformed into flattish cords with interspaces of the same width containing 1 fine thread. *Spire* conical, turriculate, about the same height as the aperture with canal, angle 42°. *Protoconch* small, of about 2 convex whorls, the nucleus round, slightly raised. *Whorls* 7, rather rapidly increasing, keeled, somewhat excavated above, but flat below the keel; body-whorl convex, contracted below. *Suture* well marked, but not deep. *Aperture* vertical, pyriform, angled above, produced below into a most likely moderately long canal (part of it is lost in the holotype). *Outer lip* (partly broken off) with a shallow broadly rounded sinus on the shoulder. *Columella* straight. *Inner lip* very thin, spread over the body for a short distance.

Height, 30 mm.; diameter, 14 mm. (holotype, imperfect specimen).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Waihao greensands, Waihao River, South Canterbury: J. A. Thomson, 1913.—Miocene.

Remarks.—This species is very near *S. gypsata* Watson (Suter, Man. N.Z. Moll., p. 486, pl. xxi, fig. 13), which was found east of East Cape, in 700 fathoms, by the "Challenger" Expedition; and off east Africa, near Dar-es-Salâm, in 2,959 metres (= 1,618 fathoms) by the German Deep-sea Expedition "Valdivia."

Watson remarks (Chall. Exped., vol. xv, part 42, p. 298) that a species of the Eocene of England, *Pleurotoma rostrata* Solander, has great affinity with this species.

Surcula climacota nov. sp. Plate XII, fig. 15.

Shell of medium size, fusiform, turreted, with gemmate carina, spiral cords below it, pyriform aperture, moderately long canal, and deep sinus at the shoulder of the whorls. *Sculpture:* The post-embryonic whorls have a row of nodules upon the keel, produced by axial riblets which, however, do not quite extend from the carina to the suture below, their number is about 20 on a whorl; upon the shoulder are a few broad, very indistinct spirals, the axials are crossed by 6 fine close cinguli at the keel and a short distance below it, followed by 3 stouter spiral cords down to the suture, with narrow interstices; the body-whorl with fine and close cinguli extending over the neck of the canal, crossed by flexuous growth-lines. *Spire* high, narrowly conic, turreted, of the same height as the aperture with canal, angle 30°. *Protoconch* has the nucleus lost, and there is only one small, smooth, and flat whorl left. *Whorls* about 9, gradually increasing in size, strongly medially carinated, excavated above the carina, flat and receding below it, the body-whorl convex above, concavely contracted below. *Suture* well impressed, simple. *Aperture* subvertical, narrowly pyriform, angled above, gradually narrowing to a straight, fairly long, and open canal, its base truncated. *Outer lip* thin, acute, with a sharp angle at the keel, and a deep subtriangular sinus between the suture and carina. *Columella* vertical, very slightly arched, rounded. *Inner lip* thin and narrow.

Height, 22 mm.; diameter, 8 mm. (holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Komiti Bluff, Kaipara Harbour, North Auckland: Marshall.—Miocene.

Surcula laciniata nov. sp. Plate VI, fig. 7.

Shell moderately large, narrowly fusiform, turriculate, the spire-whorls with a nodular carina, body-whorl biangulate. *Sculpture:* Spire-whorls with a sharp median keel from which broadly rounded axial ribs descend to the suture, but being reduced to nodules upon the keel of the body-whorl; their number is 12; the suture is encircled below by a gemmate cord, and the remainder of the whorls bears distinct cinguli, of which there are 6 on the penultimate whorl from the keel to the suture below; on the body-whorl they are more conspicuous and have now and again a fine thread between them; growth-lines not very conspicuous, roundly sinuate upon the shoulder. *Spire* high, turriculate, narrowly conic, very little higher than the aperture with canal, angle 33°. *Protoconch* small, conic, the nucleus pointed, first two whorls smooth, the third with many axial riblets. *Whorls* 11, regularly increasing, with a sharp nodular keel at the middle, concave at the shoulder, convex below; body-whorl biangular, somewhat excavated between the two angles, concave and gradually contracted towards the canal. *Suture* rather inconspicuous, margined below. *Aperture* pyriform, narrow, angled above, drawn out to a long, open, and straight canal below. *Outer lip* thin, sharp, biangulated, with a roundish, not very deep sinus at the shoulder. *Columella* vertical, straight, slightly turned to the left below. *Inner lip* thin and narrow.

Height, 38 mm.; diameter, 12 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Waihao greensands, Waihao Downs, South Canterbury: J. A. Thomson, 1913.—Miocene.

Surcula mordax nov. sp. Plate VI, fig. 8.

Shell small, elongate fusiform, turreted, thin, with nodular axial ribs, the suture margined, canal long and straight, sinus upon the shoulder. *Sculpture:* Protoconch smooth, the following whorls with elevated convex axial costæ, extending from the shoulder to the suture below on the earlier whorls, but forming only elongated oblique nodules upon the keel of the lower whorls, their number on a whorl is about 15; the suture is margined below by a broad, slightly nodulous band, and on the lower part of the whorls there are 1 or 2 indistinct cinguli; the base of the last whorl is distantly and obsoletely spirally striated. *Spire* high, conic, turreted, a little higher than the aperture with canal, angle 30°. *Protoconch* polygyrate, conic, consisting of 5 convex whorls, the nucleus pointed. *Whorls* 10, regularly descending, carinated, the shoulder excavated, the lower part convex, body-whorl much contracted towards the long beak. *Suture* well marked, margined below. *Aperture* vertical, pyriform, angled above, extending below into a long, straight, and open canal, its base truncated. *Outer lip* acute, convex, with a not very deep roundish sinus upon the shoulder. *Columella* vertical, straight down to the canal. *Inner lip* narrow and thin, smooth, tapering to the end of the canal.

Height, 15 mm.; diameter, 6 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 479 = Marly greensand, Waihao River, South Canterbury: McKay, 1880.—Miocene.

Surcula oamarutica nov. sp. Plate VI, figs. 9, 10.

Shell fairly large, fusiform, with a high turriculated spire, axially obliquely costate and spirally lirate, with a moderately long canal and a deep sinus upon the shoulder. *Sculpture:* Protoconch smooth, the succeeding whorls with broadly rounded, oblique axial ribs which do not extend over the shoulder, more conspicuous on the upper whorls of the spire than on the lower ones, where they are much more flatly convex, vanishing towards the base; their number is 12 on the penultimate whorl; the spiral ornamentation consists of numerous close convex cords, now and again with a finer one intercalated; on the body-whorl they are stronger and more irregular, but on the shoulder of the whorls they are reduced to fine threads, leaving a smooth band below the suture; growth-lines distinctly marked, showing the sinus on the shoulder clearly, obliquely antecurrent below the keel in the same direction as the axial costæ. *Spire* high, conical, turriculate, about one-third higher than the aperture with canal, sharply pointed. *Protoconch* consisting of $2\frac{1}{2}$ convex whorls, the nucleus sharp. *Whorls* 11, first slowly increasing, but the body-whorl high in proportion; they are bluntly angled, concave on the shoulder, but flatly rounded below; the body-whorl much contracted towards the base. *Suture* not much impressed, margined below by a smooth band. *Aperture* pyriform, angled above, terminating below into a moderately long, open, faintly curved canal, truncated at its base. *Outer lip* acute, smooth inside, with a deep sinus between the suture and the angle. *Columella* straight at the middle, slightly bent to the left towards the canal. *Inner lip* narrow, thin, ending in a point near the end of the canal.

Height, 56 mm.; diameter, 21 mm. (holotype).

Holotype in my collection.

Loc.—Oamaru.—Miocene.

Remark.—The specimen has been in my collection for the last twelve years, and the exact locality where it was found is unknown to me. Quite recently, however, Professor J. Park has collected a number of specimens at Target Gully, Oamaru, so there can be but little doubt that the holotype was found in the same locality.

Surcula obliquecostata nov. sp. Plate VI, fig. 11.

Shell very small, turreted, fusiform, axially obliquely costate and spirally lirate, spire high, suture margined, and sinus upon the shoulder. *Sculpture:* Protoconch smooth, the next whorl with 11 strong oblique axial riblets, without spirals; on the two succeeding whorls the axials also extend over the whole surface, but are crossed by about 5 spiral threads; the remaining lower whorls show a reduction in the length of the axial riblets, having a tendency to form tubercles upon the angle of the whorls; the suture is margined by a strong cord with a groove, followed by 3 spiral flattish threads on the shoulder, the keel with 2 strong cinguli, and 2 to 3 below it; on the body-whorl there are strong, more distant spiral cords, with a fine thread in the interstices, but upon the neck of the canal the oblique spirals are much finer. *Spire* high, very narrowly conical, turreted, its height very little less than that of the aperture with canal, angle 30°. *Protoconch* conical, of $2\frac{1}{2}$ convex whorls, the apex acute. *Whorls* 8, regularly increasing, the lower ones with a blunt keel at the middle, the shoulder lightly excavated, flat below the keel; body-whorl convex below the carina, contracted towards the base. *Suture* not deep, conspicuously margined below by a grooved spiral cord. *Aperture* narrowly pyriform, subvertical, broadly angled above, with a rather long, open, and straight canal, its base rounded. *Outer lip* thin and sharp, convex above, concave below, with a moderately deep rounded anal sinus. *Columella* vertical, straight, slightly deflected below, rounded. *Inner lip* thin and narrow, drawn out to a fine point upon the edge of the canal.

Height, 9·3 mm.; diameter, 3·1 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc. No. 165 = White Rock River, Upper Pareora Valley, South Canterbury: McKay, 1876.—Miocene.

Surcula seminuda nov. sp. Plate XII, fig. 16.

Shell rather small, fusiform, turreted, the sharp keel with numerous small nodules, anal sinus deep, triangular. *Sculpture:* The only specimen available has lost nearly all of its sculpture, but on the body-whorl traces of spiral lines are visible in one place; keel with about 16 small tubercles. *Spire* turriculate, conic, a little higher than the aperture with canal, angle 40°. *Protoconch* much worn, convex, conoidal, small. *Whorls* about 7, gradually increasing, carinated a little below the middle, concave above the keel, flat and receding below it; body-whorl slightly convex below the carina, contracted towards the base. *Suture* simple, not much impressed. *Aperture* subvertical, oblong, angled above, produced below into a most likely moderately long canal (a small part of it is broken off). *Outer lip* thin, acute, concave above the angle produced by the keel, slightly convex below it; between suture and keel a rather deep triangular sinus.

Height, 15 mm.; diameter, 7 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Tuffs interbedded in Amuri limestone, Coleridge Creek, Trelissick Basin, Canterbury: J. A. Thomson, 1914.—Miocene.

Remark.—In sculpture this species, as far as can be made out, resembles *S. climacota* Suter, but the latter is a much more slender and larger species.

Surcula serotina nov. sp. Plate IV, fig. 15; Plate VI, fig. 12.

Shell of medium size, fusiform, spire turriculated, axially costate and spirally lirate. *Sculpture:* Protoconch smooth, the following whorls with prominent axial ribs, beginning at the angle of the whorls, and extending to the suture below, vanishing on the base only on approaching the neck of the canal; they are slightly directed forwards, rounded, the interstices of the same width, 15 on the last whorl; the spiral sculpture consists of fine dense threads, usually a coarser thread alternating with a finer one; upon the base this ornamentation is much stronger. *Spire* turriculate, slightly higher than the aperture with canal, angle 40°. *Protoconch* conical, convex (the nucleus missing). *Whorls* 6 to 7, regularly increasing, angled a little above the middle, shoulder excavated, slightly convex below it, body-whorl contracted at its base. *Suture* well impressed, margined below by a small smooth band. *Aperture* vertical, pyriform, with a nearly straight and rather short canal below. *Outer lip* with a semicircular sinus on the shoulder. *Columella* straight, slightly inflected towards the canal. *Inner lip* thin and narrow, ending in a point below. *Siphonal fasciole* not conspicuous, with a few transverse lamellæ.

Height, 36 mm.; diameter, 14 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Waihao greensands, Waihao Downs, South Canterbury: J. A. Thomson, 1913.—Miocene (holotype). No. 642 = Waihao River Bridge, one and a half miles before Waihao Forks, South Canterbury: McKay, 1880 (paratype). No. 480 = Island sandstone, Waihao River: McKay, 1880 (paratype).

Surcula sertula nov. sp. Plate VI, fig. 13.

Shell of moderate size, fusiform, with nodulous spire-whorls, slightly turriculate, and a well-pronounced infrasutural sinus. *Sculpture:* Spire-whorls angled, with large rounded nodules on and below the angle, 9 on the penultimate whorl, getting obsolete on the body-whorl; the suture margined below by a broad band bearing a few fine spiral threads; three distant spiral cords adorn the spire-whorls, one limiting the shoulder below, the other two crossing the tubercles; body-whorl with distant. irregularly spaced cinguli; growth-lines very well marked, rather deeply sinuous upon the shoulder, obliquely antecurrent below. *Spire* high, narrowly conic, lightly turriculated, very little higher than the aperture with canal, angle 32°. *Protoconch* broken off, but evidently sharply pointed. *Whorls* 10 to 12, first slowly descending, with a concave shoulder, convex below the angle; body-whorl gradually contracted towards the base. *Suture* distinct, but not much impressed, broadly margined below. *Aperture* narrowly ovate, somewhat oblique, narrowly angled above, extended below into a straight open canal of moderate length (part of the end broken off in the holotype). *Outer lip* thin, acute, smooth inside, with a fairly deep rounded sinus at the shoulder. *Columella* subvertical, straight, slightly inflected to the left below. *Inner lip* thin and narrow, terminating in a point below.

Height, 33 mm.; diameter, 11 m. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Waihao greensands below Waihao Downs, South Canterbury: J. A. Thomson, 1913.—Miocene.

Remark.—This shell is, though much smaller, nearly allied to *S. oamarutica* Suter.

Bathytoma antecostata nov. sp. Plate VI, fig. 14.

Shell narrowly conical, turreted, fragile, with rather high spire, fine axial riblets on the shoulder of the earlier whorls, and oblique axial riblets on the anterior part of the lower whorls, the whole surface with fine spiral liræ, and 2 strong spiral cords below the carina upon the spire-whorls, canal short, sinus slightly above the keel. *Sculpture:* Protoconch smooth, the post-embryonic whorls with fine, very little raised, axial riblets, more distinct upon the shoulder, the succeeding whorls have fine oblique axials below the carina only, but it seems most likely that they have been rubbed off on the shoulder; the cord upon the keel is slightly crenated by riblets;

there are fine spiral threads upon the shoulder of the whorls, and 2 conspicuous cords below the keel; the body-whorl is distinctly spirally striated. *Spire* rather high, conical, turreted, its height nearly $1\frac{1}{2}$ times that of the aperture with canal, angle 35°. *Protoconch* small, pointed. *Whorls* 8, regularly increasing, flat on the shoulder, but little convex below it; body-whorl convex, contracted towards the base. *Suture* deep, submargined below. *Aperture* vertical, subpyriform, angled above, produced below into a short open canal, its base slightly notched. *Outer lip* broken off, convex, the sinus just above the angle, not deep, rounded. *Columella* vertical, rounded, deflected below towards the canal. *Inner lip* narrow, thin, smooth, tapering below. *Siphonal fasciole* with a sharp carina on the outside.

Height, 18 mm.; diameter, 7 mm. (holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Shell-bed, Target Gully, Oamaru: Marshall.—Miocene.

Bathytoma eximia nov. sp. Plate VI, fig. 15.

Shell ovato-conic, turreted, axially ribbed on the lower part of the spire-whorls, and finely spirally striated, canal short, with siphonal fasciole on its back, sinus shallow, near the keel. *Sculpture:* Protoconch smooth, the following whorls with the angle below the middle, axial ribs extend from the keel to the suture below, but are disappearing on the last half of the body-whorl, their number is about 14 on a whorl, the interstices somewhat narrower than the ribs; the whole surface ornamented by fine spiral threads, stronger and finer ones alternating, reticulated by lines of growth. *Spire* conical, its height about that of the aperture without canal, angle 45°. *Protoconch* very small, pointed, of 2 convex whorls. *Whorls* about 7, carinated, the last large, slightly concave upon the shoulder, convex below; the body-whorl flattened at the periphery, then slowly narrowing to the base. *Suture* not deep, submargined below. *Aperture* narrow, oblique, angled above, extending below into a short widely open canal, its base notched. *Outer lip* angled, concave above and convex below the angle, with a shallow sinus slightly above the keel. *Columella* vertical, rounded, straight, but slightly deflected towards the canal. *Inner lip* narrow and thin, with a few fine axial ridges, tapering below. *Siphonal fasciole* distinct, with growth-lines only.

Height, 22 mm.; diameter, 11 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 493 = Pareora beds, Kyeburn, Maniototo, Otago: McKay, 1883.—Miocene.

Bathytoma perlata nov. sp. Plate VI, fig. 16.

Shell of variable size, broadly fusiform, solid, turreted, with numerous close oblique axial riblets cut up into oblong nodules by spiral grooves, canal short, slightly deflected, sinus upon the shoulder. *Sculpture:* Protoconch smooth, the post-embryonic whorls with close, slightly oblique, and convex axial ribs, about 18 to 20 on a whorl, extending from the lower half of the shoulder to the suture below, and on the last whorl to near the base, the interstices quite narrow; the shoulder is finely spirally striated, a strong spiral cord is situate upon the keel, and below it there are two less strong spirals, cutting up the axials into oval nodules; a more prominent spiral thread, bearing a groove, is margining the suture below; base of the last whorl spirally striate, the cinguli cut up into squarish nodules by numerous axial grooves. *Spire* conic, turreted, its height about $1\frac{1}{2}$ times that of the aperture and canal, angle 40°. *Protoconch* small, papillate, of $1\frac{1}{2}$ convex whorls. *Whorls* 7, regularly increasing, nodulously keeled, concave upon the shoulder; the last whorl convex below the keel, but contracted towards the base. *Suture* inconspicuous, margined below. *Aperture* pyriform, vertical, angled above, narrowed below to a short flexuous canal, slightly deflected to the right. *Outer lip* broken off, the sinus upon the shoulder, not very deep, semicircular, its upper margin antecurrent towards the suture. *Columella* straight, rounded, deflected below towards the canal. *Inner lip* narrow, somewhat callous, extending below to the end of the canal.

Height, 14·5 mm.; diameter, 6·5 mm. (holotype). Height, 26 mm.; diameter, 10 mm. (ideotype, minus protoconch).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Holotype from shell-bed, Target Gully, Oamaru: Marshall. Also loc. No. 165 = White Rock River, Upper Pareora Valley: McKay, 1876.—Miocene.

Bathytoma sulcata Hutton, nov. subsp. **excavata.** Plate VI, figs. 17, 18.

Distinguished from the species chiefly by the more slender habitus, the prominent keel below an excavated shoulder, and the different axial sculpture. *Sculpture* consisting of spiral cords of very variable character; the shoulder of the whorls is ornamented with very fine spiral threads, reticulated by curved fine growth-lines; on the carina there are sometimes very distinct round tubercles, 18 to 20 on a whorl, but in some specimens they are wanting; the spirals from the keel down to the suture, and on the body-whorl to the base, are always similar to those of the species, but also very variable, sometimes rather broad and flat with linear interstices, or a fine cord between them, in other examples they are thin and high, with broader interstices containing 1 to 3 fine spiral threads. The axial sculpture on the upper spire-whorls is very often obsolete, but one specimen shows axial riblets below the keel; the holotype has only traces of tubercles on the carina of the last whorl; flexuous growth-lines are always present. The *whorls* are very prominently shouldered, the shoulder rather broader than in the species, and concave; the keel is much more conspicuous, sharp, rounded, or beset with nodules.

Height, 35 mm.; diameter, 16 mm. (imperfect holotype).

Holotype and three *paratypes* in the collection of the New Zealand Geological Survey.

Loc.—No. 542 = Lower Komiti Point beds, Kaipara Harbour, North Auckland: Park, 1885.—Miocene.

Mangilia blandiata nov. sp. Plate XII, fig. 17.

Shell small, fusiform, turreted, with broadly convex axial ribs, and faint spiral liration, margined suture, and short anterior canal. *Sculpture:* Protoconch smooth, the following whorls with 9 broadly rounded prominent ribs which are getting obsolete on the last whorl; interstices a little narrower than the ribs, the narrow shoulder smooth, but a broad band is margining the suture below; there are faint cinguli with linear interstices on the body-whorl which are also becoming very indistinct. *Spire* conical, turreted, a little higher than the aperture with canal, angle about 40°. *Protoconch* papillate, of 2 convex whorls. *Whorls* 6, regularly increasing, with a narrow excavated shoulder, convex below the keel; body-whorl convex, but little ventricose, contracted at the base. *Suture* not deep, broadly margined below. *Aperture* slightly oblique, narrowly ovate, angled above, with a short open anterior canal, its base truncated. *Outer lip* convex, with a hardly perceptible broad and shallow sinus. *Columella* vertical, straight, inflected towards the canal. *Inner lip* very narrow, slightly callous below.

Height, 8 mm.; diameter, 3·5 mm. (holotype).

Holotype in my collection.

Loc.—Trig. Z, Otiake River, Waitaki Valley, North Otago: G. H. Uttley.—Miocene.

Mangilia gracilenta nov. sp. Plate VI, fig. 19.

Shell small, narrowly fusiform, thin and fragile, with convex whorls which bear fine sharp axial riblets and numerous cinguli, aperture narrow, canal short. *Sculpture:* Protoconch smooth, the next whorl with fine, close, oblique axial riblets, the succeeding volutions have somewhat less oblique and more distant fine axial riblets, their number being about 20 on the last whorl, the interstices about twice the width of the riblets; with close flattish spiral threads, about 10 on the penultimate whorl, the upper two are very fine threads, thence the width of the cinguli gradually increases towards the lower suture, the interstices linear; on the body-whorl the axials vanish at about the middle, somewhat broader cinguli ornamenting the base to the end of the canal. *Spire* narrowly conical, slightly higher than the aperture and canal, angle about 30°. *Protoconch* papillate, of $2\frac{1}{2}$ convex whorls, the pullus minute, forming a sharp erect point. *Whorls* 6 to 7, gradually increasing in size, convex, imperceptibly straightened below the suture, the last whorl hardly ventricose, narrowed at the base. *Suture* well impressed, simple. *Aperture* subvertical, narrowly ovate, with a short open canal below, which is a little turned to the left, base truncate. *Outer lip* convex, thin, acute. *Columella* vertical, rather long and straight, deflected to the left below. *Inner lip* thin and narrow.

Height, 6 mm.; diameter, 2·2 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 165 = White Rock River, tributary of Upper Pareora: McKay, 1876. —Miocene.

Remark.—In sculpture the species approaches *M. cophinodes* Suter, which, however, has fewer and much stouter axials, the cinguli are also less numerous, and the shell is not so slender and fragile.

Mangilia præcophinodes nov. sp. Plate XII, fig. 18.

Shell small, elongate fusiform, turreted, with oblique fine axial riblets, rather faint cinguli, well-pronounced canal, and shallow sinus. *Sculpture:* Protoconch smooth, the post-embryonic whorls keeled at a little above the middle, with 18 narrow, oblique, rounded axial riblets starting from the carina downwards, a little nodulous upon the keel, vanishing upon the middle of the body-whorl; spiral threads are very fine upon the shoulder, numerous and more distinct on the lower part of the whorls, continued and becoming stronger towards the neck of the canal. *Spire* narrowly conic, turriculate, very little higher than the aperture with canal, angle 35°. *Protoconch* small, papillate, of $1\frac{1}{2}$ convex whorls, the nucleus oblique. *Whorls* 6, regularly descending, strongly angled above the middle on the spire, the shoulder a little concave, almost straight and a little receding below the angle, the last whorl slightly convex below the carina, gradually contracted at the base. *Suture* well marked off, simple. *Aperture* slightly oblique, elongately oval, angled above, with a moderately long and open canal, which is truncated at the base. *Outer lip* acute, angled above, concave at the base, with a shallow rounded sinus. *Columella* subvertical, rounded, somewhat turned to the left towards the canal. *Inner lip* narrow, thin, smooth.

Height, 8 mm.; diameter, 3·5 mm. (holotype).

Holotype in my collection.

Loc.—Rifle Butts, Oamaru, North Otago: G. H. Uttley.—Miocene.

Remark.—This species also has some affinities with *M. cophinodes* Suter, but it is more elongate, the whorls keeled, the axial riblets are much more oblique and do not extend to the suture above, aperture and canal are longer.

Genus **Awateria** nov.

Shell compact, buccinoid. The *sculpture* is bold, strong, narrowly convex axial ribs are crossed by more or less strong spiral cords, rendering the axials to a certain extent nodulous. *Protoconch* consisting of 1½ whorls, the nucleus with its initial point erect, but is then suddenly immersed to the extent of one-quarter or one-half volution, leaving a triangular or semicircular depression. The *suture* is very prominently margined below by a nodulous, sometimes rope-like, cord. *Outer lip* with a not deep angular sinus below the suture, the angle lying in the groove below the cord margining the suture. *Aperture* lightly channelled above, with a short, open, and truncated anterior canal.

Genotype: Awateria streptophora Suter.

Awateria streptophora nov. sp. Plate XII, fig. 19.

Shell rather small, buccinoid, axially costate, a few weak spirals on the spire-whorls, the base with distant cinguli, suture margined by a rope-like band, pullus partly immersed, anterior canal short. *Sculpture:* Protoconch smooth, the following whorls with oblique narrowly rounded axial ribs, about 14 on a whorl, interrupted below the broad band margining the suture anteriorly, upon which they are receding, forming oval tubercles, with distinct growth-lines; the latter extend as fine riblets to within a short distance of the base; a spiral groove is sometimes crossing the axials of the spire-whorls on the lower third, or there are 2 spiral cords occupying the lower third; the body-whorl bears about 6 strong distant spiral cords from the end of the suture downwards, followed by much finer and close oblique threads upon the neck of the canal. *Spire* conical, 1⅔ the height of the aperture with canal, outlines slightly convex. *Protoconch* of 1½ carinated whorls, the tilted pullus minute, its little apex erect, then immersed into the spire, rising again, leaving a semicircular depression. *Whorls* 6, regularly increasing, convex, but narrowly contracted below the sutural band; body-whorl convex, narrowed at the base. *Suture* well impressed, sometimes margined above by a fine thread, below by a rope-like band. *Aperture* a little oblique, ovate, channelled above, with a short, open, and oblique anterior canal, truncated at the base. *Outer lip* convex, with an angular shallow sinus below the suture. *Columella* subvertical, rounded, slightly concave, deflected towards the canal. *Inner lip* narrow, smooth, with a callous pad below the suture.

Height, 11 mm.; diameter, 5 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Mudstone cliffs, Awatere River, left bank above Seddon Railway Bridge, Marlborough: J. A. Thomson, 1912.—Lower Pliocene.

Awateria streptophora nov. subsp. **evanida**. Plate XII, fig. 20.

Shell the size of the species, usually turreted, with 3 spiral cords on a whorl, rendered nodulous by close axial ribs, canal longer than in the species. *Sculpture:* The smooth protoconch is succeeded by whorls ornamented by about 18 but little raised axial riblets; there is a strong spiral cord close below the suture, followed by an excavation forming the shoulder, a strong spiral cord upon the keel, followed midway down to the suture by another of equal strength, all three distinctly nodulous at the points of intersection with the axials; above the suture there is a fine thread margining it; on the body-whorl the 3 principal cinguli are followed by 8 distant spiral cords extending to the base, not succeeded by finer threads upon the neck of the canal. *Spire* usually turreted, $1\frac{1}{4}$ the height of the aperture with canal, angle about 40°. *Protoconch* showing the same peculiar form as in the species. *Whorls* 6, distinctly angled, the shoulder concave; body-whorl convex below the angle, contracted anteriorly. *Suture* impressed, bimargined, above by a fine thread, below by a nodulous rope-like cord. *Aperture* oval, channelled above, anteriorly with a longer canal than in the species, first turned to the left, then straight in the direction of the axis of the shell, truncated below. *Outer lip* broken off; there is a not deep triangular sinus below the suture. *Columella* vertical, straight, suddenly inflected towards the canal. *Inner lip* narrow, thin, with a callous pad below the suture, tapering to a fine point upon the outer margin of the canal.

Height, 11 mm.; diameter, 5 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—The same as the species, Awatere River, Marlborough; also Awatere beds, east shore Lake Grassmere, half a mile from bar: J. A. Thomson, 1912.—Lower Pliocene.

Remark.—The subspecies may be at once separated from the species by the prominent nodulous cinguli, and the much narrower rope-like band below the suture. The spire is not always distinctly turreted, the interspace between the cord below the suture and the next following being sometimes quite narrow, the whorls becoming convex.

Borsonia (Mitromorpha) brachyspira nov. sp. Plate VI, fig. 20.

Shell small, biconic, axially costate and spirally lirate, canal short, columella with 2 plaits. *Sculpture:* The protoconch is quite smooth, the succeeding whorls have about 15 axial riblets each, which are obsolete on the body-whorl; they are crossed by flat spiral liræ, 6 on the penultimate whorl, with linear interstices. *Spire* short, conic, outlines slightly convex, its height a little less than that of the aperture with canal, angle 45°. *Protoconch* papillate, of 2 convex whorls, the nucleus deviated. *Whorls* 5, slowly increasing, but the last large, slightly convex, body-whorl attenuated at its base. *Suture* well impressed. *Aperture* slightly oblique, narrowly ovate, angled above, produced below into a short open canal. *Outer lip* slightly convex, sinus shallow, the anterior part broken off. *Columella* rather short, vertical, slightly deflected below towards the canal. *Inner lip* narrow, with 2 but little raised broadly convex plaits upon the lower part of the pillar.

Height, 8 mm.; diameter, 3 mm. (holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Shell-bed, Target Gully, Oamaru: Marshall.—Miocene.

Remark.—This species is nearly allied to *M. cincta* (Hutton), but the spire is much lower.

Borsonia (Cordieria) mitromorphoides nov. sp. Plate XII, fig. 22.

Shell moderately large, biconic-fusiform, imperforate, slightly turreted, with a very broad smooth shoulder, spirally striated below it, axial ribs rather inconspicuous, columella with 2 very distinct plaits, siphonal canal narrow, nearly of the same height as the aperture. *Sculpture:* The indistinctly turreted whorls have a broad shoulder showing deeply curved growth-lines, below the faint angle there are short axial costæ which are very little raised and broadly convex, about 10 on a whorl, on the last whorl they are very oblique, and vanish on the lower half; the axials are crossed on the spire by 5 fine spiral threads, and the whole of the body-whorl is spirally lirate; oblique curved growth-lines are distinctly visible. *Spire* conical, of nearly the same height as the aperture with canal, outlines straight, angle 50°. *Protoconch* broken off, but evidently very small. *Whorls* 6 without the protoconch, first slowly then more rapidly descending, angled at the lower third, the broad shoulder slightly concave, body-whorl convex below the angle and contracted at the base. *Suture* well impressed, slightly wavy. *Aperture* very narrowly pyriform, lightly channelled above, gradually narrowing below into a comparatively long, narrow, and open canal, its base truncated. *Outer lip* damaged, convex above, very faintly excavated farther down. *Columella* slightly oblique, with 2 well-pronounced oblique plaits at the middle, very faintly deflected towards the canal. *Inner lip* thin and narrow.

Height, 18 mm.; diameter, 8 mm. (holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Left bank of Waitaki River, opposite Wharekuri: Marshall.—Miocene.

Bela (Buchozia) canaliculata nov. sp. Plate VII, fig. 1.

Shell small, ovate, solid, spirally finely lirate, suture canaliculate, canal short, inner lip with oblique ridges. *Sculpture:* Protoconch smooth, on the first three post-embryonic whorls there are traces of narrow oblique axial costæ, but farther down strong growth-lines take their place; the spiral sculpture consists of fine cords with very narrow interstices, which are stouter upon the base of the last whorl. *Spire* conic, slightly gradate, a little higher than the aperture with canal, angle 40°. *Protoconch* small, whorls convex, the nucleus lost. *Whorls* 6, regularly increasing, convex, the body-whorl contracted towards the base. *Suture* canaliculate, being the cause of the gradation of the spire. *Aperture* narrowly ovate, slightly channelled above, produced below into a short but distinct open canal, its base truncated. *Outer lip* broken off, convex, with a shallow rounded sinus near the suture. *Columella* straight, rounded, bent to the left towards the canal. *Inner lip* thin and narrow, more callous below the suture, with a number of oblique ridges on its lower part, ending abruptly into a point at the base of the canal.

Height, 12 mm.; diameter, 5 mm. (holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Shell-bed, Target Gully, Oamaru: Marshall.—Miocene.

Remarks.—It seems to me possible that the perfect shell has not a canaliculate suture, as this character is absent, for a short distance only, on the last whorl after the outer lip had been broken and repaired again; however, the suture is canaliculate again farther on.

Bela (Buchozia) infelix nov. sp. Plate VII, fig. 3; Plate XII, fig. 21.

Shell very small, ovate, with light axial costæ on the upper whorls and fine spiral liræ, shallow sinus close to the suture, inner lip obliquely ridged below, canal short and wide. *Sculpture:* Protoconch smooth, the succeeding two whorls with about 10 axial costæ which are convex and not much raised, the last two whorls finely spirally lirate with linear interstices, crossed by curved growth-lines. *Spire* conic, of the same height as the aperture. *Protoconch* papillate, of 2½ convex whorls, nucleus minute. *Whorls* 6, the last rather large and inflated, convex, body-whorl but little contracted towards the base. *Suture* well impressed. *Aperture* elongated rhomboidal, narrowly angled above, with a very short widely open canal below, which is lightly notched at its base. *Outer lip* convex, acute, smooth inside, with a shallow roundish sinus close to the suture. *Columella* vertical, straight, but slightly turned to the left below. *Inner lip* callous, a little gibbous above, with 4 to 5 oblique ridges on its lower part, thence tapering to a sharp point below.

Height, 7 mm.; diameter, 3·2 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—The holotype is from loc. No. 165 = White Rock River, tributary of Upper Pareora River, South Canterbury: McKay, 1876. The species also occurs at Target Gully, Oamaru: Marshall.—Miocene.

Daphnella (Raphitoma) neozelanica nov. sp. Plate VII, fig. 4.

Shell small, ovate fusiform, thin, turriculated, with fine and sharp distant axial ribs, and spiral liræ, canal fairly long. *Sculpture:* Post-embryonic whorls with fine, sharp, and distant axial riblets, about 20 on a whorl, bent at the angle of the whorls, slightly antecurrent towards the suture, the broad interstices with well-marked numerous growth-striæ; upon the shoulder of the whorls there are about 5 inconspicuous spiral threads, spirals below the angle are more distinct, 6 on the penultimate whorl, producing minute nodules at the intersection with the axials; on the body-whorl the axial riblets are vanishing only towards the base, the spiral cords are wider apart than on the spire-whorls and bear sometimes a fine thread in the interstices, reticulating the growth-lines. *Spire* turreted, conical, its height about equal to that of the aperture and canal when in perfect condition. *Protoconch* lost. *Whorls* about 6 or more when adult and perfect, distinctly angled, flat above and slightly convex below the angle, the last whorl convex and contracted towards the neck of the canal. *Suture* distinct, simple. *Aperture* narrowly pyriform, angled above, produced below into a fairly long open canal, which is somewhat turned backwards, its base rounded. *Outer lip* broken off, no doubt acute, angled above, then convex, and concave farther down, with a shallow roundish sinus below the suture. *Columella* vertical, very slightly convex, rounded. *Inner lip* narrow and thin, polished, smooth, drawn out to a fine point along the margin of the canal.

Height, 14 mm.; diameter, 7 mm. (holotype; somewhat imperfect and no doubt not an adult specimen).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 630 = Esdaile collection, Teaneraki (Enfield), near Oamaru, North Otago.—Miocene.

Fam. Conidæ.

Conus (Leptoconus) armoricus nov. sp. Plate XII, fig. 25.

Shell rather small, biconic, with a low, conoidal, gradated spire and elongated tapering body-whorl. *Sculpture:* The spire-whorls have well-pronounced arched growth-lines which descend vertically over the body-whorl, the base of which is adorned with about 12 oblique rounded riblets; in some places there are indications of fine obscure spiral striation. *Spire* low, gradated, conoidal, its height about one-sixth of the whole length of the shell. *Protoconch* lost. *Whorls* 7 to 8, those of the spire strongly keeled a very short distance above the suture, the shoulder excavated; body-whorl elongated, tapering towards the base, where it is slightly contracted. *Suture* not much impressed, simple. *Aperture* narrow, widening a little anteriorly, the margins subparallel. *Outer lip* thin, acute, straight. *Columella* oblique, smooth, rounded.

Height, 23 mm.; diameter, 12 mm. (holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Komiti Point, Kaipara Harbour, North Auckland: Marshall.—Miocene.

Remark.—*C. heterospira* Tate, from Victoria, is a nearly allied form.

Conus (Conospira) deperditus nov. sp. Plate XII, fig. 26.

Shell rather small, elongately biconic, with a high gradated spire, the median angle of the whorls slightly crenate, body-whorl high, conic, narrow, margins of aperture parallel. *Sculpture:* One specimen only shows a small remnant of the shell with the crenation upon the angle, but all others are smooth casts. *Spire* high, gradate, but all the specimens have the upper whorls broken off. *Whorls* of the spire angled at the middle, the last whorl with a steep narrow shoulder, a little contracted below the angle, very little convex and gradually tapering towards the anterior end. *Aperture* narrow, oblique, the margins parallel. *Outer lip* slightly convex, with a deep sinus between suture and angle. *Columella* long and oblique, somewhat convex.

Height, 30 mm.; diameter, 13 mm. (imperfect holotype; a cast).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 44 = Brewery Creek, near mouth of Mokihinui River, South-west Nelson: McKay, 1874.—Miocene.

Conus (Chelyconus) fusellinus nov. sp. Plate XII, fig. 27.

Shell fairly large, ovate biconic, with a rather short conoidal spire and large body-whorl. *Sculpture* cannot be described, as two casts only are available. *Spire* conoidal, its height about two-sevenths the height of the aperture, angle about 85°. *Whorls* 7 to 8, rather slowly increasing, spire-whorls angled at the periphery; body-whorl large, gradually tapering towards the base, with a narrow convex band at the suture, and a slight excavation below it. *Aperture* oblique, high and narrow, somewhat widened below, the margins subparallel.

Height, 37 mm.; diameter, 25 mm. (holotype; a cast with nearly half of the body-whorl lost). Height, 55 mm.; diameter, 23 mm. (a much damaged paratype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 44 = Brewery Creek, Mokihinui River, South-west Nelson: McKay, 1874.—Miocene.

Fam. Terebridæ.

Terebra pareoraensis nov. sp. Plate VII, fig. 5.

1877. *Acus (Abretia) nitida* Hinds: Hutton, Trans. N.Z. Inst., vol. ix, 1876, p. 597, pl. xvi, fig. 12; not of Hinds.

1887. *Terebra nitida* Hinds(?): Hutton, P.L.S. N.S.W. (2), vol. i, 1886, p. 212; not of Hinds.

Shell rather small, subulate, axially finely costate, without sutural band. *Sculpture:* Protoconch smooth, the later whorls with equidistant, arcuate, sharply rounded axial riblets, the interstices broader than the costæ, of which there are about 20 on the penultimate whorl; on the body-whorl the riblets are getting more numerous and flexuous; there is no spiral sculpture. *Spire* high, subulate, about 2½ times the height of the aperture. *Protoconch* of 2 whorls, the nucleus oblique, broadly rolled up and leaving a central shallow perforation. *Whorls* 9, regularly descending, almost quite flat; body-whorl convex and contracted at the base. *Suture* impressed. *Aperture* slightly oblique, very lightly channelled above, with a very short and broad canal below, turned to the left and its base broadly emarginate. *Outer lip* thin and sharp. *Columella* subvertical, bent to the left below. *Inner lip* fairly solid, narrow, drawn out to a point below; a narrow rib arises underneath it, encircling the beak.

Height, 21·5 mm.; diameter, 5·5 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 165 = White Rock River, Upper Pareora Valley, South Canterbury: McKay, 1876. Also from Blue Cliffs, near St. Andrews, South Canterbury: M. C. Gudex.—Miocene.

Remarks.—The specimen which Hutton took to be *Terebra nitida* Hinds, and which ought to be in the Otago Museum, cannot be found. Fortunately a specimen, labelled *Acus nitida*, has turned up amongst the material of the Geological Survey. It is certainly not Hinds's species, but nearly allied to *T. tristis* Deshayes. It is more subulate and has more numerous riblets than the latter, and there are no spiral striæ.

Fam. Acteonidæ.

Acteon præcursorius nov. sp. Plate I, fig. 9.

Shell small, elevated ovate, narrowly umbilicated, spirally lirate, with fine axial lines, columella with one oblique fold. *Sculpture:* Protoconch smooth, the following whorls with convex, equidistant spiral liræ, 7 to 8 on the penultimate whorl, grooved where the sculpture has been partly worn off, the interstices of the same width, crossed by close, oblique, fine axial threads, more distinct in the interspaces. *Spire* elevated conic, about two-fifths higher than the aperture. *Protoconch* of 1 convex whorl. *Whorls* 5, the last large in proportion, slightly convex, somewhat contracted at the base of the body. *Suture* well impressed. *Aperture* subvertical, oval, angled above, narrowly rounded and slightly effuse below. *Outer lip* acute, convex, crenate on the outside, and somewhat lirate within. *Columella* short, vertical, excavated above towards the parietal wall. *Inner lip* narrow, with a deep-seated oblique fold on the upper part of the columella. *Umbilicus* very narrow, half-hidden by the inner lip.

Height, 6 mm.; diameter, 3 mm. (holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Shell-bed, Target Gully, Oamaru: Marshall.—Miocene.

Fam. SCAPHANDRIDÆ.

Cylichnella soror nov. sp. Plate I, fig. 11.

Shell small, narrowly ovate, truncated above, rounded at the base, the apex minutely umbilicated, with a few inconspicuous spiral grooves on the base. *Sculpture:* The last whorl appears to be quite smooth, but a strong lens reveals a few fine spiral grooves upon the base. *Spire* sunken, the last volution leaving only a very small perforation. *Body-whorl* forming the height of the shell, narrow and ovate, but more straightened towards the outer lip, narrowed below. *Aperture* as high as the shell, very narrow above, but widened below. *Outer lip* acute, slightly convex, the basal lip narrowly rounded. *Columella* short, obliquely truncated below, joining the convex parietal wall above without forming a distinct angle. *Inner lip* narrow, thick, carinated on the outside, with a very distinct oblique fold.

Height, 3·5 mm.; diameter, 2 mm. (holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Shell-bed, Target Gully, Oamaru: Marshall. One specimen was also found at Pukeuri, six miles north of Oamaru, by Professor Marshall.—Miocene.

Fam. LYMNOËIDÆ.

Lymnoëa subscalariformis nov. sp. Plate I, fig. 12.

Shell small, elongately oval, imperforate, axially very finely costate, with subscalar spire, thin and fragile. *Sculpture* consisting of fine, close, flexuous axial riblets extending over all the whorls, except the protoconch, which is smooth. *Spire* conic, subscalar, of about the same height as the aperture. *Protoconch* small, of 1 globular whorl. *Whorls* 5, moderately convex, rectangularly projected immediately below the suture, the body-whorl high and convex, the base flattened. *Suture* much impressed, subcanaliculate. *Aperture* oval, narrowly rounded above, sometimes a little effuse below. *Outer lip* flatly convex, thin and sharp; the basal lip narrowly convex. *Columella* oblique, rounded, distinctly twisted. *Inner lip* narrowly spreading over the nearly straight parietal wall and the umbilical tract.

Height, 6·5 mm.; diameter, 3 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—From a tufa (?) on an old terrace of Old Middlehurst Creek, Upper Awatere Valley, Marlborough. Very likely of Late Pleistocene age: J. A. Thomson.

Remarks.—This is the first fossil *Lymnoëa* known from New Zealand. In form it approaches the Recent *L. pusilla* Hutton, but is distinguished from it by the axial sculpture.

Fam. ENDODONTIDÆ.

Laoma (Phrixgnathus) thomsoni nov. sp. Plate I, fig. 13.

Shell minute, depressed globose, umbilicated, finely axially costate, thin. *Sculpture:* The protoconch is smooth, but the post-embryonic whorls are ornamented with somewhat unequal, oblique, retractive radial riblets, about 8 to 10 per millimetre; there is no spiral sculpture. *Spire* conoidal, convex. *Protoconch* of $1\frac{1}{2}$ broadly convex whorls. *Whorls* 4, regularly increasing, narrow, convex; periphery and base rounded. *Suture* much impressed. *Aperture* slightly oblique, rotundly lunate. *Peristome* thin and sharp, margins converging. *Columella* short, excavated. *Umbilicus* moderate, open and deep, about one-fifth of the greatest diameter.

Height, 1·3 mm.; diameter, 1·9 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—From a tufa (?) on the old terrace of Old Middlehurst Creek, Upper Awatere Valley, Marlborough. Very likely of Late Pleistocene age: J. A. Thomson.

Remarks.—This species stands nearest to the Recent *Laoma lateumbilicata* Suter, but is distinct from it. It is the first fossil species of the genus recorded from New Zealand. Named in honour of Dr. J. Allan Thomson, formerly Palæontologist of the New Zealand Geological Survey, now Director of the Dominion Museum, Wellington.

CHAPTER III.

Class PELECYPODA.

Fam. Nuculidæ.

Nucula sagittata nov. sp. Plate VII, fig. 6.

Shell rather large, subtriangularly oval, inequilateral, moderately ventricose, concentrically finely ribbed, the ribs divaricate on the lunular area, the whole disc with fine, close, radial striæ. *Beaks* small, rounded, opisthogyrate, approximate, at about the anterior fourth. *Anterior end* long, narrowly rounded, the dorsal margin convex, slowly descending. *Posterior end* short, broadly convex, the dorsal margin straight and rapidly descending. *Basal margin* broadly rounded, ascending behind. *Lunule* very narrow, long and impressed. *Escutcheon* distinct, lanceolate, bounded by a blunt ridge. *Sculpture* consisting of fine, flattish, subequal concentric riblets, some of them anastomosing, the interstices linear; they are reticulated by fine, close, radial striæ; on the back of the anterior dorsal margin the concentric riblets are getting stouter and form on the upper part a divaricate pattern, consisting of two rows of small arrow-heads. *Interior* pearly, faintly radially striated. *Margins* at the base crenulate inside. *Hinge* with a narrow oblique triangular resilifer, with two series of sharp elevated teeth, about 18 anteriorly, and about 10 on the posterior side. *Adductor-scars* well impressed, the anterior a little larger. *Pallial line* distinct, simple.

Length, 13 mm.; height, 10 mm.; diameter, 7 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Holotype and one paratype from sandstones between the Grey Marls and the Lower Mount Brown limestone, in Boby's Creek, between the bridge and the Waipara River, North Canterbury: J. A. Thomson, 1913. Also from Waihao district, South Canterbury, first outcrop after leaving Waitaki Plains: G. H. Uttley.—Miocene.

Fam. Arcidæ.

Arca (s. str.) subvelata nov. sp. Plate VII, fig. 7.

Shell rather thin, obliquely subquadrate, very inequilateral, with a broad cardinal area, wide byssal gape, the beaks almost anterior, radially costate and concentrically ridged, posterior end with a well-pronounced oblique carina. *Beaks* at about the anterior sixth, remote, sharply raised, keeled behind, prosogyrate. *Anterior end* very short, slightly convex, the margin oblique, very little arcuate, angled towards the straight dorsal margin. *Posterior end* long, produced, with a keel descending from the umbo to the lower part of the posterior margin, the dorsal margin somewhat excavated, forming an angle with the descending posterior margin, which is narrowly convex or angled towards the basal margin; the latter has a rather deep and broad sinus at the middle. *Cardinal area* long and broad, triangular, with transverse grooves for the resilium, leaving a free smooth space posteriorly. *Sculpture* consisting of numerous radial ribs, strong, elevated on the anterior half of the disc, those in front split up into 2 or 3 riblets, interstices mostly narrower than the ribs; the costæ in front of the posterior carina are sometimes finer and closer together than the others; on the posterior triangular area the radial ribs are flat and broad, composed of numerous fine riblets with the interstices obliquely reticulated; numerous elevated concentric lines produce well-marked imbrication or nodules on the ribs. *Margins* crenate anteriorly and posteriorly. *Hinge-line* long, straight and narrow, with numerous teeth, vertical and small medially, slightly larger and oblique in front, more distant, very oblique and longer posteriorly. *Adductor-scars* unequal, the anterior roundish, the posterior larger, ovate. *Pallial line* simple, fluted.

Height, 11 mm.; length, 36 mm.; diameter of single valve, 11 mm. (holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Shell-bed, Target Gully, Oamaru: Marshall.—Miocene.

Remarks.—Professor Marshall told me that he had been informed that this shell somewhat resembles *Arca velata* Sowerby, from the Indo-Pacific, but is distinct. Moreover, Sowerby's species is classed under the subgenus *Barbatia*, whilst the form here described belongs to the subgenus *Arca*, restricted, of which *Arca noæ* L. is the type.

Glycymeris subglobosa nov. sp. Plate VII, fig. 8.

Shell moderately large, solid, equilateral, ventricose, the posterior area indistinctly marked off, radially ribbed over the whole disc, the ribs considerably finer on the posterior end. *Beaks* convex, much raised above the dorsal margins, inflated and incurved. *Anterior end* convex, the dorsal margin rather long, almost straight and very slowly descending, narrowly rounded towards the broadly convex anterior margin. *Posterior end* similar to the anterior end, with an almost obsolete area; basal margin regularly broadly rounded. *Sculpture* consisting of narrow flattish radial ribs, which are getting slightly broader on the anterior end, but much finer upon the posterior end; their number varies from 45 to 50; in well-preserved specimens the ribs are shown to bear a number of fine radial threads, and these are particularly well pronounced on the upper posterior part of the disc; the interstices are narrow, sometimes almost linear; the whole valve ornamented with fine concentric lines, conspicuous in the interstices, and very often reticulating the fine radial striation. *Margins* deeply crenate inside. *Hinge-plate* strong, broadly curved, with 10 to 12 strong, sharp, lamellar teeth on each side, those under the beak small and vertical, those outside long and oblique. *Ligamental area* small, steep, grooved. *Anterior adductor-scar* large, trapezoidal; the *posterior scar* slightly smaller, ovate-triangular, limited in front by a ridge ascending towards the umbo. *Pallial line* simple.

Height, 50 mm.; length, 52 mm.; diameter of single valve, 20 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 164 = Coal-beds, Kakahu River, South Canterbury: McKay, 1876. Also found in the Target Gully shell-bed, Oamaru, by Professor Marshall.—Miocene.

Remarks.—The species is nearly allied to *G. globosa* (Hutton), but it is more inflated, has more radial ribs which are considerably differentiated at both ends, has secondary ornamentations upon the ribs, though rarely seen; the ribs extend over the whole disc; the interstices are not quite linear, and the dorsal margins are usually longer and straighter than in *G. globosa*.

The description of the finer sculpture and of the inside of the shell were drawn up from a specimen collected at Target Gully.

Fam. Limopsidæ.

Limopsis catenata nov. sp. Plate VII, figs. 9, 10.

Shell small, solid, orbicular, equilateral or the valves slightly oblique, moderately convex, with very fine catenate radial striæ and strong concentric growth-lines. *Beaks* median, small, pointed, close together. *Anterior end* regularly convex. *Posterior end* usually a little more produced than the anterior, rounded. *Sculpture* consisting of chain-like fine radial striæ, about 3 to the millimetre, more distinct on the posterior end, crossed by prominent concentric ridges of growth. *Interior* porcellanous, faintly radially striate. *Margins* smooth. *Hinge-plate* strong, with a triangular fossette under the beak, teeth increasing in size from the centre to the outside; they are straight or hooked, and number 7 to 8 on each side of the resilifer. *Anterior adductor-scar* small, narrowly triangular, close to the anterior end of the hinge-plate, with a distinct posterior edge. *Posterior adductor-scar* larger, situate at the end of the hinge-plate, quadrate.

Height, 15 mm.; length, 17 mm.; diameter of single valve, 3·5 mm. (holotype).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Shell-bed, Target Gully, Oamaru.—Miocene.

Remarks.—The ornamentation of the valves is similar to that of *L. aurita* (Brocchi), but the valves are nearly equilateral, and the straight, at the sides very distinctly angular, dorsal area is wanting. The valves are also more orbicular than those of *L. zitteli* Ihering, and the sculpture is different.

Limopsis morgani nov. sp. Plate VII, fig. 11.

Shell oval, very little oblique, rather ventricose below the beaks and at the anterior end, equivalve, slightly inequilateral, distantly concentrically lamellate. *Beaks* submedian, imperfect in the only specimen. *Anterior end* a little shorter, its margin broadly regularly curved. *Posterior end* slightly longer, the dorsal horizontal short margin slightly convex, acutely arched towards the broadly convex posterior margin. *Basal margin* narrowly convex. *Cardinal area* narrow. *Sculpture* consisting of distant sharp and fine concentric lamellæ, about 9 per centimetre at the base; there is no radial sculpture visible. *Interior* of shell not seen, as the two valves are closed.

Length, 27 mm.; height, 35 mm.; diameter, 20 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Cape Foulwind, South-west Nelson, horizon above limestone, probably 150 ft.: P. G. Morgan.—Miocene.

Remarks.—Not having seen the hinge of the shell, the generic position is not absolutely certain. The proportion of length to height is the same as in *L. insolita* (Sowerby), but our species is much less oblique, and is distinguished by the strong concentric lamellæ.

I have much pleasure in uniting the name of Mr. P. G. Morgan, M.A., Director of the New Zealand Geological Survey, with the species.

Fam. Mytilidæ.

Modiolus dolichus nov. sp. Plate VII, fig. 12.

Shell moderately large, narrowly elongated, vertically compressed in front, posteriorly winged above, with a very distinct carina extending from the umbo to the posterior part of the basal margin, concentrically striated. *Beaks* very near the anterior end, tumid. *Anterior end* narrowed, swollen, narrowly convex, the dorsal margin depressed below the elevation of the valves. *Posterior end* broader, laterally compressed behind, the dorsal margin raised, forming a moderate elongate wing, the posterior margin rounded; basal margin long, straight in front, descending somewhat behind. *Sculpture* consisting of concentric, somewhat distant, and not much raised ridges; in places where the outer layer has been lost the inner nacreous layer shows fine, close, concentric, and still finer radial striation.

Height, 21 mm.; length, 57 mm.; diameter, 18 mm. (holotype).

Holotype in the Canterbury Museum, Christchurch; presented by Mr. M. C. Gudex.

Loc.—Weka Pass, North Canterbury (holotype): M. C. Gudex. Also locs. No. 577 = Pareora beds, Kakahu River, Park, 1885; and No. 239 = "Fan-coral beds," Porter and Thomas Rivers, Trelissick Basin, Canterbury, McKay, 1879.—Miocene.

Remarks.—This species, of which a single specimen was found, is somewhat allied to *M. albicostus* Lamarck of Tasmania and S. Australia, and also to our much smaller species, *M. ater* Zelebor and *M. fluviatilis* Hutton.

Lithophaga nelsoniana nov. sp. Plate VII, fig. 13.

Shell rather small, cylindrical, very little compressed, equivalve, inequilateral, the anterior end very short, the beaks near the front, with shallow concentric grooves. *Beaks* inconspicuous, rounded, very near the *anterior end*, which is very short, convex, and but slightly concave in front of the beaks. *Posterior end* long, laterally somewhat compressed behind, a very faint and rounded ridge extending from the beaks towards the lower end of the posterior margin, which is narrowly convex, the dorsal margin slightly raised towards the end of the ligamental area, thence faintly curved. *Basal margin* straight. *Sculpture:* The surface of the valves is smooth and adorned with broad shallow concentric grooves, representing the periods of rest. *Ligament* long and narrow.

Length, 23 mm.; height, 10 mm.; diameter, 8·5 mm. (holotype).

Holotype and two *paratypes* in the collection of the New Zealand Geological Survey.

Loc.—Port Hills, Nelson: W. F. Worley.—Miocene.

Fam. Melinidæ.

Melina zealandica (Hutton) nov. sp. Plate VIII, fig. 4; Plate XIII, fig. 2.

1873. *Perna zealandica* Hutton, Cat. Tert. Moll., p. xiii (*nom. nud.*).
1873. *Perna*, sp. ind., Hutton, Cat. Tert. Moll., p. 26.
1877. *Perna quadrata* Park, Rep. Geol. Explor. for 1886–87, p. xviii, 1877, p. 53.
1886. *Perna*, sp. ind., Hutton, Trans. N.Z. Inst., vol. xviii, p. 365.
1886. *Perna*, sp. ind., Tate, Trans. Roy. Soc. South Aust., vol. viii, p. 122.
1887. *Perna*, sp. ind., Hutton, P.L.S. N.S.W. (2), vol. i, p. 232.
1893. *Perna*, Hutton, Macleay Mem. Vol., Plioc. Moll., p. 87.

There are a number of fragments and casts before me, but it is impossible to get a correct idea of the outline of the valve. The largest piece, from Shrimpton's, is part of a valve with convex margin, 118 mm. long and 96 mm. broad, but a considerable part of the valve is broken off. The shell is of moderate thickness, very thick and solid at the hinge-plate, which is about 25 mm. high; the resilifers are high and rather broad (about 22 mm. × 8 mm.), and subequidistant. The shell must grow to a considerable size, as the dorsal part of the valves is spreading out almost horizontally some distance before descending more rapidly towards the base. The anterior end is narrowly auriculated above. Some fragments show a ridge of tubercles descending from the beak. The shell is pearly and of lamellar structure.

Chirotypes in the collection of the New Zealand Geological Survey.

Loc.—No. 190 = Lower beds, Kereru, Hawke's Bay: McKay, 1877. No. 191 = Shelly limestones, Shrimpton's, Ngaruroro River, Hawke's Bay: McKay, 1877. No. 81 = Castle Point, east coast of Wellington: McKay, 1875. No. 633 = Blue clays at mouth of Kai Iwi River, near Wanganui: Park, 1886. No. 846 = Whakamarumaru, Matipiro, near Gisborne: Fulton coll. No. 708 = Limestone east of Takapau, Ruataniwha Plain: McKay, 1887.—Pliocene.

Fam. PECTINIDÆ.

Pecten (Chlamys, Æquipecten) devinctus nov. sp. Plate VII, fig. 14.

Shell of medium size, rather thin, orbicular, very little inflated, equilateral, with radial, not dichotomous smooth ribs, separated by narrow interstices. *Ears:* The anterior ear of the holotype, a right valve, is broken off, the posterior ear is fairly large, triangular. *Beaks* approximate, depressed obtuse. *Anterior* and *posterior ends* semicircular, the dorsal margins slightly concave, descending, forming at the beak an angle of about 110°. *Sculpture* consisting of 22 smooth, flatly rounded radial ribs, slightly angled at the sides, the interstices deep and about half the width of the ribs; the whole surface ornamented by microscopic concentric fine lineation, and besides this there is *Camptonectes* striation present; the posterior ear shows this same minute sculpture, and there are 2 distinct radial riblets besides a few obsolete ones. *Colour* well preserved in this specimen, consisting of dark-brown and white concentric bands of various width. *Interior* lirate towards the edges of the valves. *Margins* sharp, denticulate. *Hinge-plate* with fine cardinal crura, the auricular crura wanting. *Resilifer* vertical, triangular, small. *Adductor-scar* large, oval, high up and behind the vertical mesial line.

Height, 37 mm.; length, 38 mm.; diameter of single valve, 5 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Waihao greensands, above and below Waihao Downs, South Canterbury: J. A. Thomson, 1913. Apparently rare.—Miocene.

Pecten (Pseudamusium) waihaoensis nov. sp. Plate VII, figs. 15, 16.

Shell moderately large and solid, valves not much inflated, equilateral, slightly oblique, the sculpture discrepant on the two valves, the right valve smooth, the left with distant flattish radial ribs. *Beaks* small, sharply pointed. *Ears* large, narrowly triangular, the anterior longer than the others. *Anterior* and *posterior ends* semicircular, the dorsal margin slightly concave, and slowly descending. *Sculpture:* Right valve almost smooth, shining, with very fine concentric striation; left valve with 12 to 14 distant radial ribs, rounded near the apex, but flattish and much depressed towards the basal margin, the interstices of about the same width or a little wider, and containing traces of an intermediate radial rib; the whole disc with fine concentric striæ; ears transversely striated, the anterior ear with an indication of a median radial rib. *Margins* smooth inside. *Hinge-plate* broadly triangular, with a median triangular resilifer; the cardinal crura are inconspicuous, but the auricular crura are well developed. *Adductor-scar* large, rounded, above and slightly behind the centre.

Height, 58 mm.; length, 63 mm.; diameter of single valve, 10 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey

Loc.—Waihao greensands, Waihao Downs, South Canterbury: J. A. Thomson, 1913. Loc. No. 479 = Marly greensand, Waihao River: McKay, 1880. A right valve was also collected at Mount Harris, in the same district, by Professor P. Marshall. —Miocene.

Remark.—The right valve of this species is very similar to that of *Pecten (Pseudamusium) huttoni* (Park), but the latter is quite smooth, showing fine regular concentric striation only under the lens. The disc of *P. waihaoensis* is much more prominently and somewhat irregularly concentrically striated, and near the beak there are traces of radial costæ.

Fam. LIMIDÆ.

Lima imitata nov. sp. Plate VIII, fig. 1.

Shell (imperfect right valve) large, oval, thin, inequilateral, ventricose, radiately ribbed. *Beak* anterior, the greater part of it lost. *Anterior end* slightly convex. *Posterior end* produced above, more convex than the anterior end. *Basal margin* rather narrowly rounded. *Sculpture* consisting of close and narrow, slightly elevated and flatly convex radiating ribs, slightly undulating in their course, strongest on the lateral borders, and weakest on the middle of the valve; interstices much narrower than the ribs; the radial sculpture crossed by close concentric riblets, passing sometimes over the ribs, but always very distinct in the interstices. On the lower part of the middle of the disc about half a dozen ribs are fused together, forming a smooth area for a length of about 20 mm. only. *Hinge* unfortunately unknown.

Height, 150 mm.; length, 113 mm.; diameter of single valve, 31 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Weka Pass stone, between the Deans and Waipara River, North Canterbury: J. A. Thomson, 1913.—Miocene.

Remarks.—This giant *Lima* bears close resemblance to the sections *Callolima* Bartsch (Proc. U.S. Nat. Museum, vol. 45, 1913, p. 235) and *Acesta* H. and A. Adams (Gen. Rec. Moll., vol. ii, 1858, p. 558), neither of which, however, has been recorded in the fossil state. Our shell very much resembles *Lima (Acesta) celebensis* Bartsch, and also *L. (Callolima) philippinensis* Bartsch. The hinge being unknown, it is impossible to say whether *L. imitata* belongs to one of these groups, and to which of them; but the shape of the valve and the sculpture strongly suggest one of these sections, more especially *Acesta*.

For the Recent species of *Acesta*, nine altogether, the following localities are given by Dr. P. Bartsch—Norway (the type, *Lima excavata* Fabricius), Japan, Patagonia (one species having been found in both localities), Arabian Sea, Panama, Philippines, Celebes, near the Galapagos; and for *Callolima*—Philippines and Borneo. All are deep-water forms, the depth ranging from 161 to 775 fathoms, average 468 fathoms.

Lima (Plagiostoma) regia nov. sp. Plate IX, fig. 1.

Shell (left valve) very large, subtriangular, flat, inequilateral, with radial flat ribs which are very broad in the middle of the disc, but are gradually getting narrower towards the lateral borders. *Beak* slightly anterior, broadly rounded. *Anterior ear* wanting. *Posterior ear* rather large, triangular. *Anterior end* moderately convex, with the dorsal margin nearly straight and steep. *Posterior end* produced, more convex than the anterior, the dorsal margin convex, slowly descending, the median part of the margin somewhat straightened; basal margin semicircular. *Submargin* (or lunule) well marked, not excavated. *Sculpture:* The centre of the disc with a broad, perfectly flat radial rib, 23 mm. broad near the base, followed on each side by much-narrower flat ribs which gradually become narrower on approaching the anterior and posterior end, the former are much narrower and rounded, but the latter remain flat and broader; the interspaces over the whole valve remain linear and shallow. There are distant and distinct concentric lines which sometimes divert the ribs from their otherwise straight course. Submargin with strong, oblique rounded ribs, their number being about 12. The valve being embedded in matrix, no description of the interior parts can be supplied.

Height, 200 mm.; length, 175 mm.; diameter of single valve, 15 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 46 = Seal Rock, Woodpecker Bay, near Brighton, South-west Nelson: McKay, 1874.—Miocene.

Remark.—On the same slab are 3 valves of *Pecten delicatulus* Hutton.

Fam. Ostreidæ.

Ostrea (s. str.) gudexi nov. sp. Plate VIII, fig. 1.

Shell small, ovate, more or less winged posteriorly; left valve strongly convex, with the wing adpressed and flattish, sharply radiately ridged, attached by a very small area near the umbo; right valve more or less vertically convexly angled, sometimes flattish and swollen only round the beak, depressed opposite the wing of the left valve. *Beaks* not much produced, swollen, opisthogyrate, approximate. *Anterior end* convex, the short dorsal margin straight, slowly descending. *Posterior end* of right valve convex, sometimes produced below, that of the left valve straight or slightly concave, forming an approximate right angle with the shorter, straight or concave dorsal margin. *Sculpture:* Left valve with 7 to 8 principal strong, elevated, and narrowly rounded radial ribs, which sometimes bifurcate towards the margin, rendered slightly nodulous or imbricate by concentric indistinct ridges, the interstices broader than the ribs when they are not bifurcated, the depression of the wing with a few radial riblets; the ribs on the middle of the disc are straight, but the anterior ribs are curved upwards on approaching the margin. Right valve almost smooth, with close, concentric, undulating, and but slightly raised lamellæ. *Margins* deeply dentated, that of the left valve more than the other, with a few tooth-like granules on the right valve near the umbo. *Hinge-area* very small, broader than high. *Adductor-scar* fairly large, semilunar, posterior, at about the middle of the vertical axis.

Height, 23 mm.; length, 20 mm.; diameter, 14 mm. (holotype).

Holotype in the Canterbury Museum, Christchurch; presented by Mr. M. C. Gudex.

Loc.—Greensands and sandstone underlying the limestone, Kakahu, South Canterbury: M. C. Gudex.—Miocene.

Remarks.—This beautiful little oyster occurs in the locality in large numbers. Its nearest ally in New Zealand is the Recent *Ostrea glomerata* Gould. *O. schweinfurthi* Mayer-Eymar, from the Eocene of Egypt, very closely resembles our shell.

It gives me much pleasure in uniting with this species the name of its discoverer, Mr. M. C. Gudex, M.A., B.Sc., of Christchurch, a most enthusiastic collector and student of our Tertiary fauna.

Ostrea (s. str.) mackayi nov. sp. Plate VIII, fig. 3; Plate XIII, fig. 1.

Shell of moderate size, solid, but not very thick, oval, inequivalve, the left valve navicular, with crenate posterior margin (fixed to a flat *Ostrea* valve). *Beaks* not prominent, flat on the right valve, incurved on the left. *Anterior end* convex, with a dorsal triangular area extending to the object (a valve in this case) on which the shell is fixed. *Posterior end* convex, somewhat oblique; the basal margin narrowly rounded. *Sculpture* of both valves consisting of concentric distant lamellæ, but the surface of the left valve is rather smooth. Posterior dorsal *margin* very distinctly crenate inside. *Hinge-plate* triangular, much broader than high, transversely striated, the resilifer broadly triangular. *Adductor-scar* very little above the middle, near the posterior end, rather large, oval.

Right valve flat. Left valve: Height, 77 mm.; length, 65 mm.; diameter, 34 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 642 = Waihao Bridge, half a mile below Waihao Forks, South Canterbury: McKay, 1886.—Miocene.

Remark.—This shell was collected by Mr. Alexander McKay, geologist to the Geological Survey, in 1886, and it gives me great pleasure to unite his name with the species.

Fam. Crassatellitidæ.

Crassatellites cordiformis nov. sp. Plate XIII, fig. 3.

Shell small, cordate, subequilateral, compressed, broadly subtruncated posteriorly, with concentric folds. *Right valve: Beak* lightly swollen, and very little directed forward, level with the margin. *Anterior end* produced, flatly convex, the dorsal margin descending almost straight towards the convex anterior margin. *Posterior end* with the margin broadly convex, forming a wide angle with the arched basal margin. *Sculpture* consisting of broad concentric folds with linear interstices. *Interior* filled with matrix.

Height, 14 mm.; length, 13 mm.; diameter of single valve, 5 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Lower tuffs, Broken River, Trelissick Basin, Canterbury: J. A. Thomson, 1914.—Miocene.

Fam. Carditidæ.

Venericardia acanthodes nov. sp. Plate IX, figs. 2, 3.

Shell rather small, ovato-trigonal, ventricose, inequilateral, solid, with prickly sharp axial ribs. *Beaks* raised, approximate, prosogyrate, at about the anterior fourth, inflated and strongly incurved. *Anterior end* very short, semicircular towards the basal margin, excavated above. *Posterior end* not much produced, the dorsal margin convexly rather rapidly descending, the margin subtruncated towards the base. *Lunule* small, impressed, but not very deeply sunk, broadly ovate, the part on the right valve slightly larger than that on the left. *Escutcheon* narrow, deep. *Sculpture* consisting of about 22 sharply raised and rather narrow radial ribs, on the anterior half the interstices somewhat wider than the ribs, but on the posterior half the ribs and interstices are gradually getting narrower; all the ribs are adorned with pointed tubercles, more conspicuous on the front of the valves, but the median ribs are sometimes nearly smooth; interspaces with distinct close concentric growth-lines, more conspicuous on the lower posterior part of the disc. *Interior* porcellanous. *Margins* solid, plicated. *Hinge-area* large, triangular, heavy; the right valve with 3 transversely striated cardinal teeth, the anterior vertical, small, behind the lunule, the median tooth oblique, stout, tongue-shaped, flat, and the posterior cardinal long, narrow, slightly convex; left valve with 2 transversely striated cardinals, separated by a broad median space, both oblique, the anterior tooth short and triangularly elevated, the posterior tooth long, slender, slightly curved; there is a small sublunular pustule. *Ligament* external. *Adductor-scars* impressed, ovate, subequal. *Pallial line* simple.

Height, 24 mm.; length, 21 mm.; diameter of single valve, 11 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Waihao greensands, Waihao Downs, South Canterbury: J. A. Thomson, 1913.—Miocene.

Venericardia pseutes nov. sp. Plate XIII, fig. 4.

Shell medium size, orbicular-trigonal, inequilateral, slightly inflated, with flatly rounded radial ribs, separated by narrow interstices, lunule very deep and minute, cardinal teeth transversely striated, 3 in the right and 2 in the left valve. *Beaks* at about the anterior third, approximate, pointed, prosogyrate. *Anterior end* short, broadly convex, the dorsal margin somewhat concave. *Posterior end* produced, slightly truncated below, the dorsal margin long, rather slowly descending, slightly convex. *Basal margin* broadly rounded. *Lunule* very small, deep-seated, descending vertically from the umbo. *Escutcheon* linear. *Sculpture:* 20 to 22 broadly convex radial ribs ornament the valves; they are broader on the anterior half of the valves, but are gradually narrowing posteriorly; the interstices are typically much narrower than the ribs, but this is subject to a good deal of variation, specimens from Mount Harris having sometimes the interspaces of the same width as the ribs; incremental lines are distinct towards the base, and especially the escutcheon, roughening the radial ribs. *Interior* white, porcellanous. *Margins* thick, plicated. *Hinge-area* broad and heavy; the right valve with 3 transversely striated cardinal teeth, the anterior narrow and short, subvertical, the median long, slowly descending, solid, broadest medially, the posterior tooth long and slender, parallel to the dorsal margin; the left valve with 2 transversely striated cardinals, both oblique, the anterior tooth short and thin, the posterior cardinal long and slender, a sublunular pustule is present. *Ligament* external. *Adductor-scars* much impressed, the anterior scar oval, the posterior scar subquadrangular. *Pallial line* distinct, simple.

Height, 40 mm.; length, 42 mm.; diameter of single valve 11 mm. (holotype). Largest valve from Mount Harris: 30 × 31 × 10 mm.

Holotype in my collection.

Loc.—Awamoa Series, Oamaru: A. P. W. Thomas. Also from Mount Harris, South Canterbury, loc. No. 475: McKay, 1880, and J. A. Thomson, 1913. Left bank of Waitaki River, opposite Wharekuri: G. H. Uttley. Awamoa, North Otago: P. Marshall.—Miocene.

Remarks.—The specimen I now take as the holotype of the species was kindly given to me many years back by Professor A. P. W. Thomas, of Auckland, labelled *Cardita patagonica* Sowerby, Oamaru, Awamoa Series. I sent a valve, which seems to have been lost, and over a year ago an enlarged photo to Sao Paulo, asking Dr. von Ihering to kindly examine the species and let me know whether he considered it to correspond with a species of the Tertiary of Patagonia. Having never received a reply, I conclude that our species is not represented in the South American Tertiaries, and hence I describe and figure it as a new species. However, *Venericardia patagonica* (Sowerby) does occur in the New Zealand Tertiary. A specimen collected at Waikaia and in the possession of Dr. P. Marshall was sent to me for identification some years ago, and I assigned it to Sowerby's species.

Venericardia subintermedia nov. sp. Plate X, figs. 1, 2.

Shell rounded trigonal, inequilateral, swollen, with sharp radial ribs and distant concentric rows of small spines. *Right valve: Beak* at the anterior fourth of length, prosogyrate, high and convex, nearly level with the hinge-plate. *Anterior end* short, convex, the short dorsal margin a little excavated. *Posterior end* somewhat depressed at the posterior fourth of the disc, the dorsal margin long, very slightly convex, descending, the posterior margin convex and rounded off towards the broadly convex basal margin. *Lunule* small, deep-seated, broadly triangular. *Sculpture:* There are 30 sharply raised radial ribs, the interstices broader than the ribs, 3 ribs in the posterior depression are much finer and closer together, followed behind by 3 stouter ribs; the ribs are adorned with sharp small triangular spines, arranged in distant concentric rows, more conspicuous on the lower half of the disc; the posterior 8 ribs with much more numerous and smaller spines; the whole surface crowded with fine, unequal, undulating concentric growth-lines. *Interior* porcellanous. *Margin* thick, plicated. *Hinge-area* broad, heavy, with a very small anterior cardinal, one very large obliquely triangular median cardinal, finely striated at the vertical sides, and one long lamelliform posterior cardinal, parallel with the dorsal margin, finely striated on the anterior side. *Adductor-scars* unequal, the anterior vertically oval, the posterior rounded behind, sharply angled in front. *Pallial line* continuous, simple.

Height, 51 mm.; length, 52 mm.; diameter of single valve, 17 mm. (holotype; right valve).

Holotype in the Otago University Museum, Dunedin; presented by Professor P. Marshall.

Loc.—Komiti Point, Kaipara Harbour, North Auckland: Marshall.—Miocene.

Remark.—This species is nearly allied to *V. intermedia* Brocca, from the Pliocene of Asti, Italy.

Fam. Veneridæ.

Macrocallista pareoraensis nov. sp. Plate VIII, fig. 5.

Shell rather small, oval, inequilateral, ventricose, acuminate anteriorly, truncated posteriorly, concentrically finely ribbed. *Beaks* in front of the middle, prominent, somewhat inflated, approximate, incurved and directed forwards. *Anterior end* shorter, laterally slightly compressed, acuminate above, the dorsal margin faintly concave, the median margin narrowly convex above, but regularly arched towards the basal margin. *Posterior end* distinctly truncated, subangled above and below, the dorsal margin slowly descending, almost straight; basal margin convex, but somewhat straightened posteriorly. *Lunule* moderately large, lanceolate, both parts of equal size. *Escutcheon* indistinctly limited. *Sculpture* consisting of fine, close, sharp, concentric riblets, about 4 per millimetre on the centre of the valves, but much closer together on the nepionic part of the valves, which are distinctly marked off from the mature disc; the concentric lines are extending over the lunule; radiate lineation very faint. *Ligament* moderately strong.

Length, 28 mm.; height, 21 mm.; diameter 14 mm. (holotype).

Holotype and two *paratypes* in the collection of the New Zealand Geological Survey.

Loc.—No. 458 = Lower gorge of the Pareora River, South Canterbury: Enys, 1879.—Miocene.

Cytherea (Circomphalus) chariessa nov. sp. Plate X, figs. 3, 4.

Shell small, ovate-subtrigonal, rather thin, swollen, concentrically finely ridged. *Beaks* approximate, inflated, turned inwards and forwards, pointed, situate at about the anterior third. *Anterior end* shorter, convex, the margin narrowly rounded towards the slightly concave dorsal margin. *Posterior end* narrowly convex, the long and rather slowly descending dorsal margin slightly convex. *Basal margin* convex, somewhat raised in front. *Lunule* narrowly cordate, rather long, elevated, bordered by a narrow groove, finely striate. *Escutcheon* well defined by a keel, with close and fine striations, the portion on the left valve larger. *Sculpture* consisting of very close, erect, narrowly rounded, concentric riblets, about 3 to the millimetre on the middle of the disc; they are sometimes inequidistant, the interstices generally a little broader than the riblets, and containing one or several fine concentric threads; anteriorly the ridges are decidedly phyllate; there is fine radial sculpture underlying the concentric. *Margins* finely crenate inside. *Interior* smooth, porcellanous. *Hinge-plate* strong, concave below behind the beak; right valve with 3 cardinals, the anterior tooth small, oblique and shorter than the others, the medial tooth vertical, thin, simple, straight, and the posterior tooth oblique, large, deeply cleft; left valve with a rather stout, triangularly elevated anterior lateral, followed by a thick triangular cardinal, the median cardinal oblique, rather thin, straight, deeply grooved, the posterior cardinal next to the nymph, nearly horizontal, long, slender, sharp; margin of the lunule finely crenate inside. *Ligament* deep, with a strong inner resilium. *Adductor-scars* subequal, the anterior much more impressed, semicircular. *Pallial line* distinct, the pallial sinus short, triangular.

Length, 25 mm.; height, 22 mm.; diameter of single valve, 9 mm. (holotype).

Holotype in my collection.

Loc.—Trig. Z, Otiake River, Waitaki Valley, North Otago: G. H. Uttley. No. 175 = One mile south of Devil's Bridge, Oamaru Creek, North Otago: McKay, 1876. No. 241 = Tufaceous greensands, Whitewater Creek, Trelissick Basin, Canterbury: McKay, 1879.—Miocene.

Chione chiloensis (Philippi) nov. var. truncata. Plate XIII, fig. 5.

Shell solid, ovato-elliptical, truncated behind, very moderately swollen, inequilateral, with widely distant elevated concentric lines, and close, fine radiate riblets. Left valve: *Beak* on the anterior fifth, directed forwards. *Anterior end* slightly compressed, narrowly convex, obliquely descending, the dorsal margin lightly excavated, descending. *Posterior end* truncated, an obtuse ridge extending from the umbo to the lower angle of the truncation, the dorsal margin arched; the basal margin broadly convex, ascending in front. *Lunule* ovate, flat, slightly immersed. *Escutcheon* long, narrow, limited by a ridge running from the umbo to the upper angle of the posterior truncation. *Sculpture* consisting of inequidistant rounded concentric lines, most of them distant and strong, the whole surface ornamented with very distinct fine radial riblets, the interstices of the same width; escutcheon with fine concentric lines.

Length, 45 mm.; height, 40 mm. (holotype).

Holotype (left valve) in the collection of the New Zealand Geological Survey.

Loc.—No. 170 = Awamoa beach and creek, North Otago: McKay, 1876.—Miocene.

Remarks.—*Chione chiloensis* (Philippi) has been found in the Miocene of Castle Point; also in the Pliocene of Wanganui by Mr. J. C. McGill Nutt, formerly of the Geological Survey. An allied form is *Chione hormophora* Tate, from Table Cape, Tasmania.

Fam. Cardiidæ.

Cardium brachytonum nov. sp. Plate X, fig. 5.

Shell moderately large, triangularly ovate, somewhat ventricose, subequilateral, with smooth radial ribs, separated by much narrower interstices. Right valve, embedded in matrix: *Beak* broadly convex, incurved. *Anterior end* slightly angled at about the upper third, the dorsal margin straight, descending at an angle of about 40°, broadly convex below the angle. *Posterior end* very similar to the anterior, but the angle a little lower down; basal margin rounded. *Sculpture* consisting of about 30 but little raised, roundish, smooth, radiate ribs, with much narrower interstices between them, their width being about a quarter of the breadth of the ribs. Both ends of the valve have the sculpture obliterated, and therefore the number of the ribs could only be guessed.

Height, 67 mm.; length, 56 mm.; diameter, 11 mm. (holotype, right valve).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 212 = Ormond, Poverty Bay: McKay, 1874.—Pliocene.

Cardium (Fragum) dolichum nov. sp. Plate IX, fig. 4.

Shell rather small, inequilateral, elongately cordiform, much higher than broad, inflated, radially costate, with strong, distant concentric ridges, posteriorly subtruncate. *Beaks* somewhat inflated, incurved. *Anterior end* flatly convex, the margin descending almost in a straight line, or being slightly angled. *Posterior end* depressed below the beaks, subtruncate, the dorsal margin descending obliquely and forming at about the middle of the height of the valve a distinct angle with the descending and narrowly rounded basal margin. *Sculpture* consisting of numerous narrow radiate riblets, the interstices about twice the width of the riblets, crossed by distant concentric ridges, which are sometimes considerably swollen.

Height, 33 mm.; length, 18 mm.; diameter, 16 mm. (complete young shell; holotype). Height, 51 mm.; length, 31 mm.; diameter, 20 mm. (left valve, paratype).

Holotype and one *paratype* in the collection of the New Zealand Geological Survey.

Loc.—No. 757 = Cobden limestone quarries at Greymouth, North Westland, 1891.—Miocene.

Remarks.—On the label accompanying the two specimens Dr. J. A. Thomson wrote: "Hutton (Trans. N.Z. Inst., vol. xx, 1886, p. 268) mentions *Gryphæa tarda* (?) in the Cobden limestone. This is obviously the shell, but ? *Gryphæa*." I think Dr. Thomson was quite right, but the single valve has somewhat the appearance of a *Gryphæa*. Hutton himself was evidently doubtful about his identification.

Cardium facetum nov. sp. Plate XIII, fig. 6.

Shell very small, ovate, slightly ventricose towards the umbones, inequilateral, the anterior end much shorter, radially distantly ribbed. *Left valve: Beak* at about the anterior third, inflated, incurved and prosogyrate. *Anterior end* shorter, convex, the dorsal margin short and concave, the anterior margin narrowly convex and merging gradually into the gently rounded basal margin. *Posterior end* somewhat produced, with a narrow depression extending from the umbo to the lower end, dorsal margin straight, forming a wide angle with the slightly convex posterior margin, which descends obliquely towards the basal margin. *Sculpture* consisting of about 20 rather distant flattish radial ribs, the interspaces at the centre of the disc broader than the riblets, which are rendered scabrous or lightly nodulous by concentric sculpture. *Interior* of the valve filled with matrix.

Height, 14 mm.; length, 15 mm.; diameter of single valve, 4·5 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Tuffs under upper limestone, Whitewater Creek, Trelissick Basin, Canterbury: J. A. Thomson, 1914 (tufaceous greensands of McKay).—Miocene.

Cardium (Fragum) maorinum nov. sp. Plate XIII, figs. 7, 8.

Shell rather small, semicordate, posteriorly truncated, valves closed, radially ribbed, equivalve, inequilateral. *Beaks* incurved, carinated behind. *Anterior end* compressed towards the margin, rather short, the dorsal margin arched, short, the anterior margin broadly convex. *Posterior end* flatly impressed, with an oval depression below the beaks, a carina descending on each valve from the beak towards the margin a little above the basal margin, which is but slightly convex. *Sculpture* of the body consisting of somewhat irregularly spaced radiate ribs, which are smooth and rounded, the interspaces of about the same width; the posterior truncation with slightly stouter radial ribs, regular above, but getting irregularly spaced towards the base.

Height, 31 mm.; length, 34 mm.; diameter, 22 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey; presented by Mr. W. F. Worley.

Loc.—Port Hills beds, Nelson: W. F. Worley.—Miocene.

Cardium (Fragum) priscum nov. sp. Plate X, fig. 6.

Shell of medium size, triangularly ovate, inequilateral, ventricose, radially ribbed, subtruncated posteriorly. *Right valve: Beak* inflated, incurved, prosogyrate. *Anterior end* longer, flattish, the dorsal margin straight, rather rapidly descending to the very broadly rounded anterior margin, which is gradually receding towards the much more narrowly convex basal margin. *Posterior end* subtruncated, concave behind the median elevation of the disc, the dorsal margin abruptly descending, very little convex, the posterior margin almost straight and obliquely descending towards the base. *Sculpture* consisting of subequal, narrow, rounded radial ribs, of about 1 mm. in width near the middle of the basal margin, the interstices narrower than the ribs.

Height, 54 mm.; length, 35 mm.; diameter of single valve, 20 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—No. 45 = St. Kilda, near Brighton, west coast, Nelson: McKay, 1874.—Miocene.

Remark.—The species has a faint resemblance to the much larger *Cardium coxii* Hector, from Castles, Collingwood (Hector, Outline Geol. N.Z., 1886, p. 57, fig. 19A, No. 5), known to me only by the figure.

Cardium subcordatum nov. sp. Plate X, fig. 7.

Shell of medium size, equivalve, subequilateral, ovato-rotund, ventricose, subtruncated and angled posteriorly, radially ribbed. *Beaks* approaching, inflated, incurved and prosogyrate. *Anterior end* convex, the dorsal margin descending, slightly concave, the anterior and basal margins regularly arched. *Posterior end* lightly truncated, flattish, a little excavated, separated from the centre of the disc by a ridge extending from the umbo to the posterior part of the basal margin, the dorsal margin straight, much shorter than the anterior, posterior margin very broadly convex. *Sculpture* consisting of flattish narrow radial ribs, their width about 1·5 mm. near the central part of the base, the interstices about half the width of the ribs;

the posterior end has a broad flat rib descending just behind the angle, and behind it are narrower radial ribs than on the anterior part of the disc, the interstices very narrow.

Height, 45 mm.; length, 44 mm.; diameter, 30 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Shell-bed at base of "Pareora" beds, junction of Porter and Thomas Rivers, Trelissick Basin, Canterbury: J. A. Thomson, 1914.—Miocene.

Protocardia (Nemocardium) alata nov. sp. Plate X, fig. 8.

Only a fragment of the left valve is available, but the size and the sculpture are sufficient to characterize the species provisionally. *Beak* incurved, swollen. *Sculpture:* The anterior two-thirds of the disc with fine, flat, and close radial riblets, about 2 per millimetre on centre of the valve, with linear interstices; the posterior third with much more conspicuous fine convex radial riblets, growing slightly stronger on approaching the posterior end, with traces of minute spines; the interstices narrower than the riblets; nearly one-fourth of the posterior area, close to the dorsal margin, almost smooth, with a few indistinct radial ribs.

Height, 40 mm.; length, 56 mm.; diameter, 16 mm. (fragmentary holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Shell-bed below uppermost Mount Brown limestone, Weka Creek, North Canterbury: J. A. Thomson, 1913.—Miocene.

Fam. Corbulidæ.

Corbula (Aloidis) kaiparaensis nov. sp. Plate IX, fig. 5.

Shell small, oblong, subtrigonal, inequivalve and inequilateral, sharply angled behind, concentrically regularly ribbed. Left valve: *Beak* raised, directed forwards, with a posterior keel. *Anterior end* shorter, somewhat inflated above, the margin narrowly convex, the dorsal margin a little excavated, descending. *Posterior end* obliquely truncated, sharply angled below, the dorsal margin straight and slowly descending; basal margin broadly convex. *Lunule* not defined. *Escutcheon* long and broad, limited by a keel descending from the umbo towards the posterior angle. *Sculpture* consisting of regular, close concentric riblets, sometimes anastomosing, with linear interstices and no radial ornamentation; escutcheon with distant concentric sharp threads, the interspaces wide, with a few growth-lines.

Length, 10·5 mm.; height, 6·5 mm. (holotype).

Holotype (left valve) in the collection of the New Zealand Geological Survey.

Loc.—No. 542 = Lower Komiti Point beds, Kaipara Harbour, North Auckland: Park, 1885.—Miocene.

Remarks.—This species stands nearest *C. macilenta* Hutton, but is readily distinguished from it by the regular, close concentric riblets, and the fine threads on the escutcheon. The species also occurs at Awamoa, the specimens I have seen being nearly twice the size of the Kaipara specimen.

Fam. Pholadidæ.

Pholadidea thomsoni nov. sp. Plate X, fig. 9.

Shell transversely elongate, inflated, especially anteriorly, closed in front, very inequilateral, a sulcus descending from the umbo to the basal margin, anterior part with descending, close, curved and spinous riblets, posterior part with broad concentric folds. *Beaks* at about the anterior fifth of length. *Anterior end* very short, globose, the anterior margins of the shell notched at the middle, the callous plates regularly convex. *Posterior end* much longer, the dorsal margin lightly excavated, the posterior margin convexly truncated; basal margin broadly rounded. Remnants of *protoplax* and *metaplax* are present. *Sculpture:* The callous plates closing the shell in front are quite smooth, the small anterior part in front of the sulcus with close, spinous, convex riblets descending towards the groove; posterior large part of the valves with flattish concentric folds, getting indistinct towards the posterior end.

Height, 21 mm.; length, 36 mm.; diameter, 18 mm. (holotype).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Limestone, Anthony Bay, near Cabbage Bay, Hauraki Peninsula, Auckland: J. A. Thomson, 1914.—Miocene.

Remark.—This mollusc was found to be boring in shells of *Ostrea wuellerstorfi* Zittel. It is distinct from our Recent species, but it is nearer to *P. tridens* (Gray) than to *P. spathulata* (Sow.). Named in honour of the discoverer, Dr. J. A. Thomson, Director of the Dominion Museum, Wellington.

Genus **Martesia** Leach.

1825. *Martesia* Leach, in Blainville, Man. de Malac. et Conch., p. 632; pl. 80 *bis*, fig. 7.

Type: *Pholas striata* Linné. Distribution: Antilles, east coast of America; Indian Ocean, Australia. Living in floating wood. Fossil: Carboniferous–Tertiary.

Martesia concentrica nov. sp. Plate XIII, fig. 9.

Shell (left valve, embedded in matrix) small, transversely elongate, inequilateral, with an oblique groove from the beak to the middle of the basal margin, concentrically ridged. On the dorsum, which is narrowly flattened, there is, half the distance from the beak to the posterior end, a fairly large semioval sinus which is no doubt the place occupied by the protoplax. The valves seem to be slightly gaping in front. *Beak* at the anterior third, inconspicuous. *Anterior end* shorter, somewhat inflated, narrowly convex. *Posterior end* with a long and slightly concave dorsal margin, the posterior margin short, rounded, the basal margin broadly convex. *Sculpture:* A deep narrow radial groove divides the disc into two unequal halves; the whole surface is similarly concentrically ridged, but on the posterior half the ridges are less sharp and broadened.

Height, 5 mm.; length, 10 mm. (holotype, left valve).

Holotype in the collection of the New Zealand Geological Survey.

Loc.—Lower tuffs, Broken River, Trelissick Basin, Canterbury: J. A. Thomson, 1914.—Miocene.

Remark.—The shell has some resemblance with the type, *Martesia striata* (L.), but still more so with *M. patagonica* (Philippi) from the Eocene and Oligocene of Patagonia and Argentina. The genus is an addition to the New Zealand fossil fauna.

CHAPTER IV.

ON SOME CHANGES IN NOMENCLATURE.

Genus **Solariella** Searles Wood.

1842. *Solariella* Searles Wood, A.M.N.H., vol. ix, p. 531.
1860. *Minolia* A. Adams, A.M.N.H., vol. iv, p. 336.
1861. *Minosia* Dunker, Ind. Moll. Mar. Jap., p. 142.
1865. *Solariorbis* Conrad, Am. Journ. Conch., vol. i, p. 30.
1877. *Machæroplax* Friele, Arch. Math. Nat., vol. ii, p. 311
1913. *Minolia* A. Adams: Suter, Man. N.Z. Moll., p. 141.
Solarium sp., Lea, Conrad, De Gregori, &c.; not of Lamarck.

Type: *Solariella carinata* S. Wood.

Shell umbilicated, conical; whorls with spiral granose liræ; umbilicus with a carinated margin. Usually widely umbilicated, but there are forms which are imperperforate, yet by the totality of their characters evidently belong to the same assemblage (W. H. Dall).

In the report on the Mollusca of the British Antarctic ("Terra Nova") Expedition, 1910, Mr. Edgar A. Smith, I.S.O., remarks that the genus *Monilea* Swainson has been founded on some unknown species, and not upon the *Trochus calliferus* Lamarck, as stated by Pilsbry. Further, the genus *Minolia* A. Adams, 1860, with *Minolia punctata* A. Adams as type, is apparently equivalent to *Solariella* Searles Wood, 1842. The conclusion is that the following Tertiary New Zealand species have to be classed under *Solariella*:—

Solariella egena (Gould) *(Solarium)*.
Solariella prætextilis Suter.
Solariella stoliczkai (Zittel) *(Trochus)*.
Solariella sulcatina Suter.

Genus **Cerithiella** Verrill.

1878. *Lovenella* Sars, Moll. Reg. Arct. Norv., p. 187; not of Hicks, 1869.
1882. *Cerithiella* Verrill, Trans. Conn. Acad., vol. v, p. 522; not *Ceritella* Morris and Lycett, 1850.
1891. *Newtonia* Cossmann, Annuaire Géol., vol. viii, p. 721; not of Schlegel, 1866.
1893. *Newtoniella* Cossmann, Ann. Soc. Roy. Malac. Belg., vol. xxviii, p. 18.
1897. *Newtoniella* Cossmann: Harris, Cat. Tert. Moll. Brit. Mus., pt. i, p. 229.
1911. *Cerithiella* Verrill: Iredale, Proc. Mal. Soc. London, vol. ix, p. 260.
1913. *Newtoniella* Cossmann: Suter, Man. N.Z. Moll., p. 249.

Type: *Cerithium metula* Lovén.

It was pointed out by Iredale that Cossmann proposed the name *Newtoniella* for *Cerithiella* Verrill, claiming that it was preoccupied by *Ceritella* M. & L., but the two names are sufficiently distinct for both to stand, and Verrill's name has therefore to be used.

Crepidula monoxyla (Lesson).

1913 *Crepidula crepidula* Linné: Suter, Man. N.Z. Moll., p. 286, pl. 44, fig. 5; not of Linné.

"Although this species has a very close resemblance to the Mediterranean *C. crepidula*, there is one feature, at least, by which these two forms may be distinguished. Deshayes has pointed out that in *C. crepidula* the shells present a notch at the right extremity of the internal septum where it joins the wall of the shell. This is not met with in *C. monoxyla*. The septum is described by Lesson 'rectiligne à son bord libre,' and Quoy and Gaimard characterize it as 'lisse et droite.' I have examined a large series of the New Zealand shell, and have not found a trace of a notch." (E. A. Smith, "Terra Nova" Exped., Zool., vol. ii, No. 4, p. 81.)

Calyptræa tenuis (Gray).

1867. *Clypeola tenuis* Gray, Proc. Zool. Soc., p. 735.
1913. *Calyptræa scutum* Lesson: Suter, Man. N.Z. Moll., p. 284, pl. 44, fig. 4.
1915. *Calyptræa scutum* Lesson: Palæont. Bull. No. 3, pt. ii, p. 8.

"This species has been considered the same as *Calyptræa (Sigapatella) scutum* of Lesson, but it seems doubtful whether that supposition is correct. There are several features mentioned in Lesson's description which are not observable in the shell before us. In the first place the size given by Lesson (11 lines = 27 mm.) is never reached by *S. tenuis*. It is described as 'à tours de la spire plus marqués et plus grands' than in *Sigapatella maculata*. As a matter of fact the whorls are traceable with much difficulty in *tenuis*. The epidermis is said to be 'blond doré,' the columella 'courte, un peu dilatée à sa base,' the septum 'échancrée en devant,' and the umbilicus 'presque nul.'

"Now, in *S. tenuis* the periostracum is so thin that it is generally worn off, the columella is hardly dilated at the base, the septum is curved, not notched, in front, and there certainly is no trace of an umbilical chink. Lesson twice refers to the *pearly* interior, but this is a character which does not occur in the *Calyptræidæ*, and his words 'nacrée très lisse' and 'nacré brillant' probably are merely descriptive of a highly glossy and perhaps lightly iridescent surface.

"It is of course possible that a mistake has occurred, and that the specimens he described came not from New Zealand, but were obtained elsewhere during the same voyage." (E. A. Smith, "Terra Nova" Exped., Zool., vol. ii, No. 4, p. 83, pl. i, figs. 20–22.)

Cominella adspersa (Bruguière).

1913. *Cominella maculata* Martyn: Suter, Man. N.Z. Moll., p. 385, pl. 45, fig. 7; not of Linné.

It is pointed out by Mr. E. A. Smith that Martyn's name is preoccupied by Linné, and therefore Bruguière's name has to be adopted. (E. A. Smith, "Terra Nova" Exped., Zool., vol. ii, No. 4, p. 85.)

Ancilla novæ-zelandiæ (Sowerby).

1913. *Ancilla bicolor* Gray: Suter, Man. N.Z. Moll., p. 453, pl. 46, fig. 20.

"*Ancilla tricolor*, Sowerby, *nec* Gray, and *A. nana* Watson are synonyms of this species. By a slip of the pen or misprint Mr. Suter has given the name *bicolor* instead *tricolor*." (E. A. Smith, "Terra Nova" Exped., Zool., vol. ii, No. 4, p. 87.)

I remember perfectly well that a long time back I sent a specimen of this shell to the British Museum for identification, and received it back with a label I read as *A. bicolor* Gray, but it may of course have been *tricolor*. I was informed that the species was described in Jukes' Voy. "Fly,"* vol. ii, 1847 (a work I have never seen), and it had in my opinion priority over Sowerby's name. I am most grateful to Mr. E. A. Smith for having corrected this mistake.

Arca (Barbatia) novæ-zealandiæ E. A. Smith.

1873. *Barbatia decussata* Sowerby : Martens, Crit. List Moll. N.Z., Errata and Addenda, p. 3.

1913. *Arca (Barbatia) decussata* Sowerby : Suter, Man. N.Z. Moll. p. 848, pl. 56, fig. 2.

1915. *Arca (Barbatia) novæ-zealandiæ* E. A. Smith, British Antarctic ("Terra Nova") Expedition, 1910, Zoology, vol. ii, No. 4, p. 88, pl. ii, figs. 1, 2.

"This species, hitherto confused with *A. decussata*, may be recognized by the minute crenulation on the anterior and posterior inner margins of the valves, and also by both the exterior and interior being more or less stained with a reddish tint. Neither of these features is met with in the true *decussata*, which is always pure-white within and without, and its lateral margins are broader, flattened, and invariably smooth. Although very similar externally, it may be observed that the radiating sculpture upon the posterior dorsal area is finer than in *decussata*, and more distinctly defined by an obtuse, rounded umbonal ridge. The posterior adductor impression in *A. decussata* is large and round, whereas in *A. novæ-zealandiæ* it is obliquely truncate behind.

"Length, 67 mm.; height, 36 mm.; diameter, 24 mm.

"The three characters above referred to—(1) the crenulation of the lateral margins; (2) colour; (3) fine posterior dorsal sculpture—should, I think, be sufficient to separate this species from *A. decussata* of Sowerby." (E. A. Smith.)

Venericardia purpurata (Deshayes).

1818. *Venericardia australis* Lamarck(?), Anim. s. Vert., vol. v, p. 610.

1854. *Cardita purpurata* Deshayes, Proc. Zool. Soc., 1852, p. 100, pl. xvii, figs. 12, 13.

1854. *Cardita quoyi* Deshayes, *l.c.*, p. 103.

1913. *Venericardia australis* Lamarck : Suter, Man. N.Z. Moll., p. 905, pl. 58, fig. 16.

"I have not adopted Lamarck's name for this common New Zealand shell, although it has been employed in all works on that fauna. We have no proof that the specimen (4–5 mm. in diameter) described by Lamarck is in fact the young of this species. It appears to have been considered as such by Quoy and Gaimard, but these authors do not state that they had seen Lamarck's type said to be from 'Nouvelle Hollande.' Moreover, Deshayes distinctly says that the Quoyan species is different, and has given it the name *Cardita quoyi*. The shells he had before him (now in the British Museum), said to be Australian, belong undoubtedly to the same species as the New Zealand shells in question." (E. A. Smith, "Terra Nova" Exped., Zool., vol. ii, No. 4, p. 90.)

Trophon recurvus (Philippi).

1846. *Fusus recurvus* Philippi, Abbild, u. Beschreib., vol. ii, p. 119; *Fusus*, pl. iii, fig. 6.

1864. *Trophon paivæ* Crosse, J. de Conch., vol. xii, p. 278, pl. xi, fig. 7.

1876. *Trophon australis* T.-Woods, Proc. Roy. Soc. Tasmania, 1875, p. 136.

1880. *Urosalpinx paivæ* Crosse : Tryon, Man. Conch. (1), vol. ii, p. 155.

1880. *Trophon paivæ* Crosse : Hutton, Man. N.Z. Moll., p. 49; non Crosse (= *T. corticatus* Hutt.).

1888. *Peristernia paivæ* Crosse : Tate, Trans. Roy. Soc. South Aust., vol. x, p. 154.

1903. *Kalydon paivæ* Crosse : Hedley, Mem. Aust. Mus., vol. iv, p. 380 (in part).

1913. *Trophon recurvus* Philippi : Hedley, P.L.S. N.S.W., vol. xxxiii, p. 329.

1913. *Trophon paivæ* Crosse : Suter, Man. N.Z. Moll., p. 415 (in part), pl. 45, fig. 22.

Trophon hanleyi Angas.

1867. *Trophon hanleyi* Angas, Proc. Zool. Soc., p. 110, pl. xiii, fig. 1.
1877. *Trophon assisi* T.-Woods, Proc. Roy. Soc. Tasmania, 1875, p. 132.
1879. *Trophon squamosissima* T.-Woods, *l.c.*, 1878, p. 33.
1886. *Fusus hanleyi* Angas : Watson, Challenger Rep., vol. xv, p. 194.
1903. *Kalydon paivæ* Crosse : Hedley, Mem. Aust. Mus., vol. iv, p. 380 (in part).
1913. *Trophon paivæ* Crosse : Suter, Man. N.Z. Moll., p. 415 (in part).

In his "Notes in Museums abroad" (P.L.S., N.S.W., vol. xxxviii, p. 329), Mr. Charles Hedley pointed out that Tryon had misled Australian collectors by uniting *T. paivæ* Crosse and *T. hanleyi* Angas; further, that the two are distinct species, and that *T. paivæ* is identical with the earlier *Fusus recurvus* Philippi.

After examining typical specimens of the two species, for which I have to thank Mr. Hedley, I found that the following characters distinguish them :—

	T. recurvus.	*T. hanleyi.*
Adult shell of 7 whorls..	Height, 26 mm.	Height, 31 mm.
Shoulder of whorls ..	Smooth, sometimes 1 cord above carina. Narrower, less steep	With 3 to 5 cinguli. Broader, much steeper.
Protoconch	2½ papillate whorls	2½ pupoid whorls.
Whorls	Rather slowly descending, carina of spire-whorls above or at middle of the whorls	More rapidly descending, carina of spire-whorls nearly always below middle of the whorls.
Canal	Equal to the height of the penultimate whorl	Mostly equal to the height of the penultimate and antepenulimate whorls together.

The proportion of diameter to height is the same in both species.

T. hanleyi occurs in the Pliocene and Miocene of New Zealand, but I have not yet come across a fossil specimen of *T. recurvus.*

Turritella (Archimediella) huttoni Cossmann.

1912. *Turritella huttoni* Cossmann, Pal. Comp., vol. ix, p. 113; footnote.
1914. *Turritella bicincta* Hutton : Suter, Palæont. Bull. No. 2, pt. i, p. 15, pl. i, fig. 6; not of Sowerby.
1916. *Turritella huttoni* Cossmann, Revue Critique Paléozoologie, vol. xx, p. 9.

Hutton's name being preoccupied, that proposed by Cossmann should be accepted.

Turritella (Archimediella) ornata Hutton.

1915. *Epitonium (Acirsa) ornatum* (Hutton): Suter, Palæont. Bull. No. 3, pt. ii, p. 13, pl. i, fig. 9.

As pointed out, the type is very fragmentary, and I was misled into classing this species under *Epitonium.* Through the kindness of Professor P. Marshall I have been enabled to examine a number of specimens he collected at Hampden, and I am now certain that it is a *Turritella,* as determined by Hutton, and it belongs to the subgenus *Archimediella* Sacco, 1875. A nearly allied species is the Recent *T. australis* Lamk. from Australia and Tasmania.

Marginella (Eratoidea) conica Harris.

1887. *Marginella australis* Hinds : Hutton, P.L.S. N.S.W. (2), vol. i, p. 211; not of Hinds.
1897. *Marginella (Glabella) conica* Harris, Cat. Tert. Moll. Brit. Mus., pt. i, p. 88, pl. iv, figs. *7a–b.*

Captain Hutton was undoubtedly mistaken when he identified a fossil *Marginella* from Awamoa and Mount Royal, Otago, as the Recent *M. australis* Hinds. The latter has somewhat the general aspect of our fossil shell, but the outer lip is smooth inside, whereas in *M. conica* it is very distinctly crenate. The specimen described by Harris is from Awamoa (Parimoa), and I have specimens from that locality which are undoubtedly Harris's species.

M. australis Hinds has to be expunged from our list.

Genus Leucosyrinx Dall.

1889. *Leucosyrinx* Dall, Bull. Mus. Comp. Zool. Harvard College, vol. xviii, p. 75.

Shell white or pale without colour pattern, thin; the anal notch behind the periphery or at the suture; sculpture delicate, of spiral keels or threads, and often oblique riblets on the shoulder of the whorls; peripheral keel, if present, not recurved.

Type: *Pleurotomella verrillii* Dall.

Dall classes *Leucosyrinx* as a subgenus of *Pleurotoma*, and Cossmann as a synonym of *Pleurotoma* Lamk. = *Turris* Bolten. In *Turris* the anal sinus is upon the carina, but in *Leucosyrinx* it is between keel and suture, as in *Surcula* and a few other genera. It therefore seems to me best to remove *Leucosyrinx* from *Turris*, and treat it as a genus. The New Zealand fossils at present known are—*Leucosyrinx alta* (Harris), *Leucosyrinx alta transenna* (Suter).

Borsonia (Cordieria) cincta (Hutton).

1915. *Mangilia (Clathurella) cincta* (Hutton): Suter, Palæont. Bull. No. 3, pt. ii, p. 38, pl. viii, fig. 13.

Borsonia (Cordieria) rudis (Hutton).

1915. *Mangilia (Clathurella) rudis* (Hutton): Suter, Palæont. Bull. No. 3, pt. ii, p. 39, pl. viii, fig. 14.

Having re-examined specimens of the above two species I find that the two plaits on the columella, the absence of crenellations, and the smooth inside of the outer lip are much more in accordance with *Cordieria* than with *Clathurella*.

Conus ornatus and C. trailli Hutton.

Most fortunately, I had to examine a number of the above species collected at Pukeuri, north of Oamaru, by Professor J. Park. There were specimens with small nodules on the keel; others had just traces of them; and a few apparently no nodules at all, but a good lens revealed traces of them, the nodules having no doubt been worn off. The two species established by Hutton are in all other characters alike, and I do not now hesitate to consider them as one species only. The specific name *ornatus* has priority, and I am of opinion that it is best classed under *Hemiconus*. *Conus traill* Hutton thus becomes a synonym of *Hemiconus ornatus* (Hutton).

Mytilus (Aulacomya) huttoni Cossmann.

1885. *Mytilus striatus* Hutton, Trans. N.Z. Inst., vol. xvii, 1884, p. 332; not of Montagu, Goldfuss, Philippi.

1916. *Mytilus huttoni* Cossmann, Revue Critique Paléozoologie, vol. xx, p. 11.

Venericardia lutea (Hutton).

1913. *Venericardia zelandica* (Deshayes): Suter, Man. N. Zeal. Moll. p. 907.

If the rule "Once a synonym always a synonym" is adopted, Hutton's name *V. lutea* should be used.

Chione spissa (Deshayes).

1913. *Chione crassa* Q. & G.: Suter, Man. N. Zeal. Moll., p. 991; not of Gmelin.
1915. *Chione spissa* (Deshayes): E. A. Smith, "Terra Nova" Exped., Zool., vol. ii, No. 4, p. 90.

The name Quoy and Gaimard gave to this shell being preoccupied by Gmelin, Deshayes' name has to be used.

Epitonium (Cirsotrema) lyratum (Zittel).

1864. *Scalaria lyrata* Zittel, Voy. "Novara," Palæ., p. 41, pl. ix, fig. 8.
1864. *Scalaria browni* Zittel, *ibidem*, p. 42, pl. ix, fig. 9.
1873. *Scalaria browni et lyrata* Zittel: Hutton, Cat. Tert. Moll., p. 9.
1885. *Scalaria browni et lyrata* Zittel: Hutton, Quart. Journ. Geol. Soc., vol. xli, p. 550.
1887. *Scalaria lyrata et browni* Zittel: Hutton, P.L.S., N.S.W. (2), vol. i, p. 220.
1897. *Cirsotrema lyrata et browni* Zittel: Harris, Cat. Tert. Moll. Brit. Mus., pt. i, p. 268.
1902. *Scalaria rugulosa* Sow.: Ortmann, Princ. Exped. Patagonia, p. 175 (including *S. lyrata et browni* Zittel as synonyms).
1907. *Scalaria rugulosa lyrata* Zittel: Ihering, Anales Museo Nac. Buenos Aires, vol. xiv, p. 141.
1915. *Epitonium rugulosum lyratum* (Zitt.): Suter, Hand-list N. Zeal. Tert. Moll., p. 10.

Having now examined a fair number of specimens I fully agree with Ortmann that *Scalaria lyrata* and *S. browni* Zittel are one and the same species, the latter representing the young form. Cossmann now classes *Scalaria rugulosa* Sow. under *Boreoscala* Kobelt, 1907 = *Arctoscala* Dall, 1909 (Essais Paléoconch. Comp., livr. 9, 1912, p. 55), which, though much resembling *Cirsotrema*, is quite distinct. *Scalaria lyrata* Zittel can therefore not be a subspecies or variety of *S. rugulosa* Sow., as suggested by Ihering, as it is a true *Cirsotrema*.

Epitonium (Confusiscala) nympha (Hutton).

1915. *Epitonium nympha* (Hutton): Suter, Palæontological Bulletin No. 3, p. 13.

Amongst the Tertiary shells collected last year by Professor J. Park at Kakanui, north-east Otago, in volcanic breccia underlying the Kakanui limestone, there was one specimen of *Epitonium nympha* (Hutt.) more perfect than the lectotype and syntype from the Pliocene of Petane, though the aperture does not show the finished peristome, but this is well shown in the figure accompanying Hutton's Pliocene Mollusca. It is the first and only specimen from our Miocene I have come across.

Studying the New Zealand Tertiary *Epitoniidæ* since receipt of Cossmann's excellent "Essais de Paléoconchologie Comparée," livr. 9, I found that the above species undoubtedly belongs to *Confusiscala* de Boury, 1910 (*l.c.*, p. 73). The fine spiral striation, present also upon the disc, and reticulated by dense fine incremental lines, is distinctly visible under a good lens. The aperture also shows clearly the little canal against the basal keel.

The stratigraphical distribution of *Confusiscala* as given by Cossmann extends from the Neocomian to the Danian, but no occurrence of this genus or subgenus (as I take it) in the Tertiary is mentioned. It is interesting to find a Cretaceous form turning up in the Miocene, and even the Pliocene, but we have a good many other examples of Cretaceous shells being found associated with distinctly Miocene molluscs. The survival, however, into Pliocene times is no doubt unique.

I compared the shell several times with Cossmann's very comprehensive diagnosis, and always found the agreement to be perfect. The measurement of the specimen is: Height, 19 mm.; diameter, 6 mm.; there are 11 whorls.

NOTE ON THE NEW ZEALAND TERTIARY SHELLS ASSIGNED TO THE GENUS *EGLISIA*.

1915. *Eglisia planostoma* (Hutton), Palæontological Bulletin No. 3, pt. ii, p. 13.
1915. *Eglisia striolata* Hutton, *idem.*, p. 14, pl. viii, fig. 4.

A very valuable paper by Mr. E. A. Smith on the genera *Eglisia*, *Callostracum*, *Mesalia*, &c., induced me to re-examine our two species supposed to belong to the genus *Eglisia* Gray, 1847. I have now come to the conclusion that they should be classed under *Mesalia* Gray (Proc. Zool. Soc., 1847, p. 155), family *Turritellidæ*, for the following reason: In *Eglisia* the peristome is continuous, and the base of the body-whorl is marked off by a keel, and bears very fine spiral sculpture different in character from that on the rest of the shell—features which are wanting in the two species. The chief characters of *Mesalia*, present in both, are: Body-whorl rounded at the periphery, aperture sinuate anteriorly, forming a very slight canal, columella somewhat twisted, and the outer lip with a shallow posterior sinus, which is shown by the incremental lines.

Fossil species of the genus *Mesalia* are known from the Eocene of the Paris Basin and Egypt, and Recent species are recorded from West Africa, the Atlantic coasts of France and Spain, Madeira, the Canaries, the Mediterranean, and Western Australia.

NOTE ON *EOSTREA* IHERING.

1913. *Eostrea* Ihering: Suter, Man. N. Zeal. Moll., p. 890.

In 1907 Ihering proposed this subgenus for species of *Ostrea* having the margins of the valves crenate inside. Now, Cossmann points out (Revue Critique Paléozoologie, vol. xx, 1916, p. 12) that *Eostrea* is a synonyum of *Ostrea* s. str.; and I found that he is right, as *O. edulis* L., the type of the genus, has crenate margins distinctly shown in the figure given by Forbes and Hanley, "British Mollusca." To keep up the very useful distinction between species with crenate and smooth margins I propose for the latter the sectional name *Anodontostrea*. The classification of the New Zealand fossil species is as follows:—

Ostrea s. str.

O. corrugata Hutton.
O. gudexi Suter.
O. mackayi Suter.
O. subdentata Hutton.
O. wuellestorfi Zittel.

Ostrea (Anodontostrea).

O. angasi Sowerby.
O. arenicola Tate.
O. hyotis (L.).
O. incurva Hutton.
O. ingens Zittel.
O. manubriata Tate.
O. nelsoniana Zittel.
O. suteri Ihering.
O. tatei Suter.

NOTE ON *ANCILLA PSEUD-AUSTRALIS* VAR. TATE.

1889. *Ancillaria pseud-australis* var. Tate, Trans. Roy. Soc. S. Austr., vol. xi, p. 148, pl. vi, fig. 13.

"This unique specimen from a well-sinking in the Murray Desert is provisionally referred to *A. pseud-australis* as an obtuse variety resembling *A. obtusa* from Cape of Good Hope. Detached spires similar to that of this variety, attaining to a diameter of 31 mm., occur in the River Murray Cliffs, but the perfect shell is yet unknown." (Tate.)

1899. *Ancilla hebera* Hutton: Tate, *loc. cit.*, vol. xxiii, p. 108.

"The fossil referred to as *A. pseud-australis* var. I now consider to be an extremely large senile form of *A. hebera* (three senile examples of varying size from Murray Desert"). (Tate.)

This form is not uncommon in the New Zealand Miocene, and I have hitherto used the name first proposed by Tate. A specimen from the Miocene of Parson's Creek, close to Oamaru, collected by Professor J. Park, and in the collection of the New Zealand Geological Survey, has the spire and its thick callus well preserved, and it shows quite distinctly *spiral ridges* and *microscopic granulation*, which are characteristic of *A. papillata* (Tate), (Trans. Roy. Soc. S. Austr., vol. xi, 1889, p. 146, pl. vii, fig. 4). This form, which, together with the typical shell, is not rare in the Miocene of North Otago and of Canterbury, is therefore doubtless the gerontic form of *A. papillata* (Tate), and *A. pseud-australis* var. (Tate) has to be expunged from the list of New Zealand Tertiary fossils.

NOTES ON SOME TERTIARY *VOLUTIDÆ*.

Cossmann has published a very valuable article on the *Volutidæ* (Essais Pal. comp., vol. 8, 1909, pp. 205–218) which I have seen only quite recently, Professor P. Marshall having kindly lent me vols. 8–10 of Cossmann's Essais Pal. comp. I now propose to make a few changes in the names hitherto adopted by me.

Athleta Conrad, 1853. Genotype: *Voluta rarispina* Lamk.

Formerly treated by Cossmann as a subgenus of *Volutilithes* Swainson, is now raised to the rank of a genus with *Volutocorbis* Dall, *Plejona* Bolten = *Volutospina* Newton and *Neoathleta* Bellardi as synonyms. The New Zealand forms are:—

Athleta huttoni (Suter).

1914. *Volutospina (Athleta) huttoni* nom. mut.: Suter, Palæont. Bull. No. 2, pt. i, p. 26.

Athleta huttoni pseudorarispina (Suter).

1915. *Volutospina (Athleta) huttoni pseudorarispina* Suter: Palæont. Bull. No. 3, pt. ii, p. 31.

Athleta (?) gracilicostata (Zittel).

1864. *Voluta gracilicostata* Zittel, Voy. Novara, Palæ., p. 38, Taf. xiii, fig. 6.

I have not seen a specimen, and the generic position is still somewhat doubtful to me.

Athleta necopinata Suter.
This Bulletin.

Cymbiola (Miomelon) corrugata (Hutton).

1914. *Lapparia corrugata* (Hutton) *et* var. *B.*: Suter, Palæont. Bull. No. 2, pt. i, p. 27; pl. ii, figs. 4, 3.

This is not a *Lapparia*, as Dr. Dall once informed me, but perfectly corresponds with *Miomelon* Dall, which is classed by Cossmann as a section of *Cymbiola* Swainson. *Proscaphella* Ihering, genotype *P. gracilior* Ihering, is a synonym of *Miomelon;* and *P. cossmanni* Ihering, from the Patagonian formation of Santa Cruz, is very nearly allied to our species.

Maculopeplum Dall, 1906. Genotype: *Voluta junonia* Hwass.

Cossmann points out that this species is the type of *Scaphella* Swainson, 1832, and that Dall's name cannot be accepted. We have two species—*Scaphella elegantissima* Suter, *Scaphella attenuata* (Hutton). Of the latter, however, I have not yet seen a specimen, and the type cannot be found, but there is a pencil drawing by the late Mr. Buchanan in the possession of the New Zealand Geological Survey. It is *Voluta elongata* Hutton. Cat. Tert. Moll., p. 7; not of Swainson = *V. attenuata* Hutton, Quart. Journ. Geol. Soc., vol. 41, 1885, p. 555.

ANNOTATED SYNOPSIS OF THE NEW ZEALAND TERTIARY *NATICIDÆ*.

Natica australis (Hutton).
Natica zelandica Q. & G.
Polinices ambiguus Suter.
Polinices amphialus (Watson).
Polinices callosus (Hutton).
Polinices gibbosus (Hutton).
Polinices (Neverita) huttoni Ihering.
Polinices lævis (Hutton).
Polinices (Euspira) ovatus (Hutton).
Polinices planispirus Suter.
Polinices (Neverita) sagenus Suter.

Sinum carinatum (Hutton).

1915. *Ampullina carinata* (Hutton): Suter, Palæont. Bull. No. 3, pt. ii, p. 10, pl. viii, figs. 2, *a*, *b*, *c*.

I fully agree with Cossmann that this interesting shell is better classed under *Sinum* (= *Sigaretus* Lamk.), as was done by Hutton. It is not globose, and there is no spiral limb or rib round the umbilicus.

Sinum (Eunaticina) cinctum (Hutton).

1915. *Polinices (Euspira) cinctus* (Hutton): Suter, Palæont. Bull. No. 3, pt. ii, p. 9, pl. iv, fig. 5.

Cossmann confirms Hutton's determination (*Sigaretus*). *Eunaticina* Fischer, 1885, is *Naticina* Gray, 1842; not of Guilding, 1835, which is a synonym of *Polinices*.

Sinum (Eunaticina) drewi (Murdoch).

1899. *Sigaretus (?) drewi* Murdoch, Proc. Mal. Soc. London, vol. iii, p. 320, pl. xvi, fig. 1.

There is no limb upon the umbilical tract.

Sinum (Eunaticina) elegans Suter.
Sinum fornicatum Suter.
Sinum (Eunaticina) miocœnicum (Suter).

1914. *Ampullina miocœnica* Suter, Palæont. Bull. No. 2, pt. i, p. 21, pl. ii, fig. 2.

The spiral sculpture and the absence of a spiral limb ornamenting the umbilical tract induce me to rectify my classification.

Sinum (Eunaticina) undulatum (Hutton).

1915. *Ampullina undulata* (Hutton): Suter, Palæont. Bull. No. 3, pt. ii, p. 11.

The observation upon the foregoing species also applies to this one.

Ampullina (Megatylotus) suturalis (Hutton).
Ampullina waihaoensis Suter.

INDEXES.

INDEX TO GENERA AND SPECIES.

(The synonyms are in italics.)

L.

M.

N.

O.

P.

INDEX TO LOCALITIES.

PLATE I.

Fig. 1. *Clio (Creseis) urenuiensis* Suter. Holotype. Urenui, Taranaki. 2·5 × 14 mm.

Fig. 2. *Lissospira exigua* Suter. Holotype. Oamaru. 1·1 × 1·3 mm.

Fig. 3. *Circulus politus* Suter. Holotype. Oamaru. Diam. 2·5 mm.

Fig. 4. *Cerithiopsis æquicincta* Suter. Holotype. Oamaru. 1·2 × 4 mm.

Fig. 5. *Cerithiella fidicula* Suter. Holotype. Oamaru. 1·5 × 4·5 mm.

Fig. 6. *Architectonica ngaparaensis* Suter. Holotype. Ngapara, Otago. Diam. 6 mm.

Fig. 7. *Turbonilla (Pyrgiscus) oamarutica* Suter. Holotype. Oamaru. 2·2 × 8 mm.

Fig. 8. *Alectrion (Tritia) latecostata* Suter. Holotype. Pukeuri. 4·5 × 8 mm.

Fig. 9. *Acteon præcursorius* Suter. Holotype. Oamaru. 3 × 6 mm.

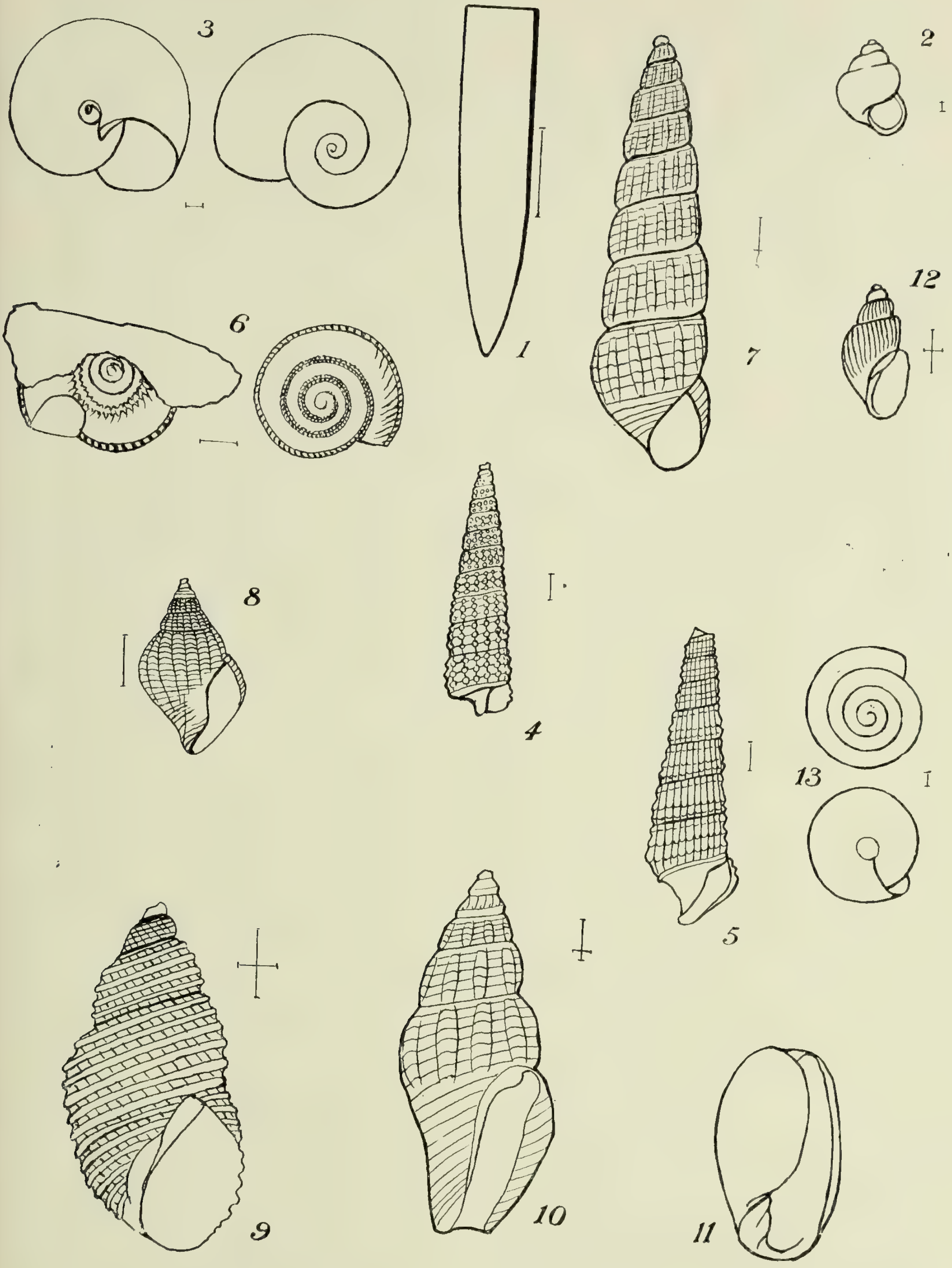
Fig. 10. *Drillia imperfecta* Suter. Holotype. Oamaru. 2·6 × 6 mm.

Fig. 11. *Cylichnella soror* Suter. Holotype. Oamaru. 2 × 3·5 mm.

Fig. 12. *Lymnoëa subscalariformis* Suter. Holotype. Awatere. 3 × 6·5 mm.

Fig. 13. *Laoma (Phrixgnathus) thomsoni* Suter. Holotype. Awatere. Diam. 1·9 mm.

PLATE I.



[H. Suter, delt.

PLATE II.

Fig. 1. *Subemarginula (Tugalia)* Suter. Holotype. Macrewhenua River. 21 × 28 mm.

Fig. 2. *Fissuridea (?) annulata* Suter. Holotype. Trelissick Basin. 6 × 16 mm.

Figs. 3, 3*a*. *Calliostoma waiparaense* Suter. Holotype, fig. 3; paratype, fig. 3*a*. Waipara. 50 × 55 mm. Natural size.

Fig. 4. *Heliacus imperfectus* Suter. Holotype. Oamaru. Diam. 9·5 mm.

Fig. 5. *Turbo (Marmorostoma) approximatus* Suter. Holotype. Wharekuri. Diam. 22 mm.

Figs. 6, 6*a*. *Astræa (Cyclocantha) bicarinata* Suter. Holotype. Trelissick Basin. Natural size. 29 × 59 mm.

Fig. 7. *Astræa (Cyclocantha) transenna* Suter. Holotype. Trelissick Basin. 19 × 42 mm.

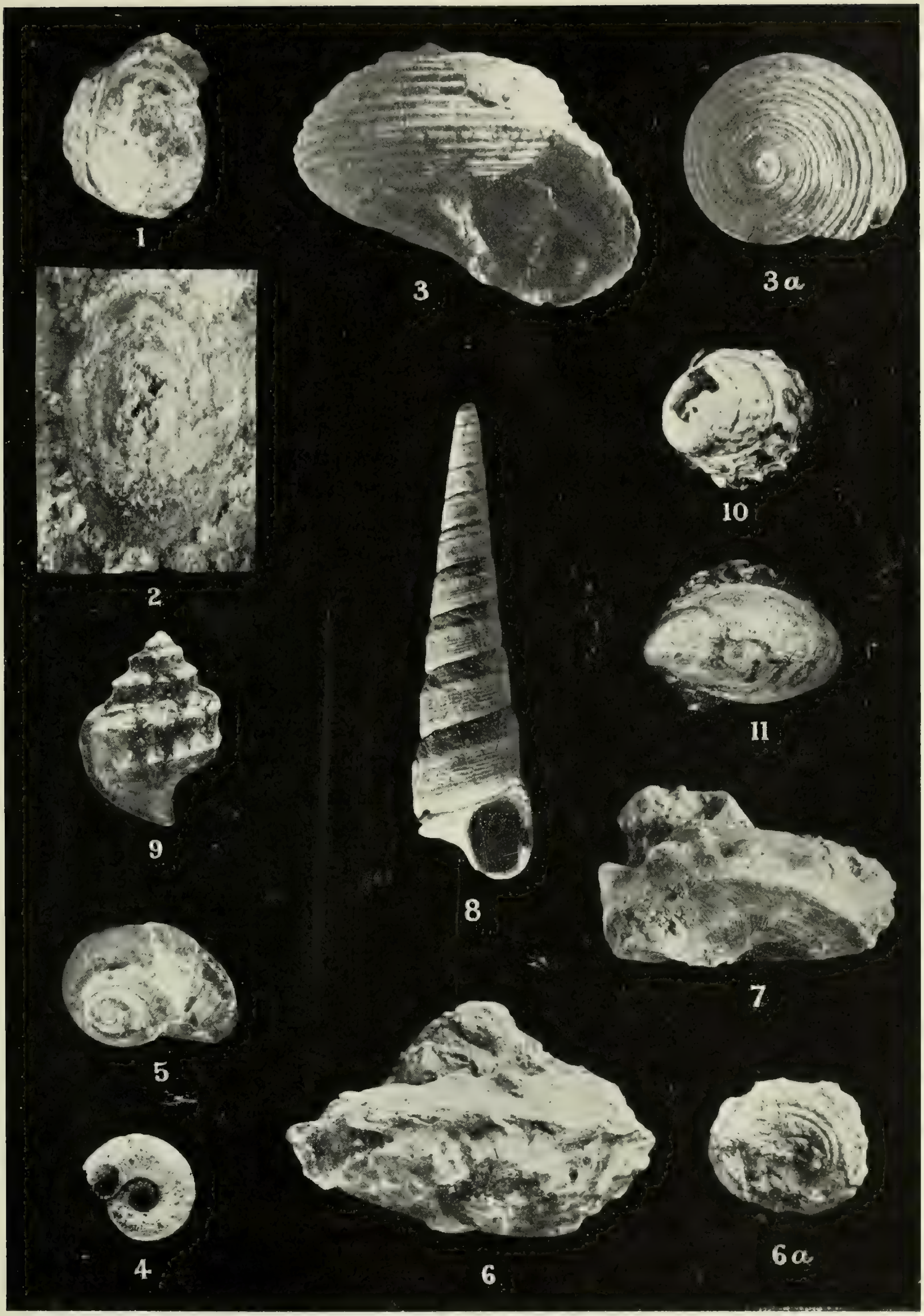
Fig. 8. *Turritella (Zaria) abscisa* Suter. Holotype. Oamaru. 20 × 77 mm.

Fig. 9. *Struthiolaria tuberculata concinna* Suter. Holotype. Waihao. 23 × 31 mm.

Fig. 10. *Calyptræa (Sigapatella) maccoyi* Suter. Holotype. Awamoa. Diam. 19 mm.

Fig. 11. *Crepidula densistria* Suter. Holotype. Awamoa. 16 × 28 mm.

PLATE II.



[*Photographed by W. Beken.*

PLATE III.

Figs. 1, 2. *Polinices planispirus* Suter. Holotype. Blue Cliffs. 45 × 54 mm.

Fig. 3. *Polinices sagenus* Suter. Holotype. Pareora. 30 × 30 mm.

Fig. 4. *Sinum (Eunaticina) elegans* Suter. Holotype. Teaneraki. 13 × 15 mm.

Fig. 5. *Sinum fornicatum* Suter. Holotype. Maerewhenua River. 11 × 18 mm.

Figs. 6, 7. *Erato neozelanica* Suter. Holotype. Oamaru. 10·5 × 19 mm.

Fig. 8. *Ficus parvus* Suter. Holotype. Oamaru. 11 × 18 mm.

Fig. 9. *Ficus transennus* Suter. Holotype. Allday Bay. 16 × 28 mm.

Fig. 10. *Turbonilla (Mormula) prisca* Suter. Holotype. Blue Cliffs. 2·8 × 9·5 mm.

Fig. 11. *Galeodes maoriana* Suter. Holotype. Kakahu. 28 × 44 mm.

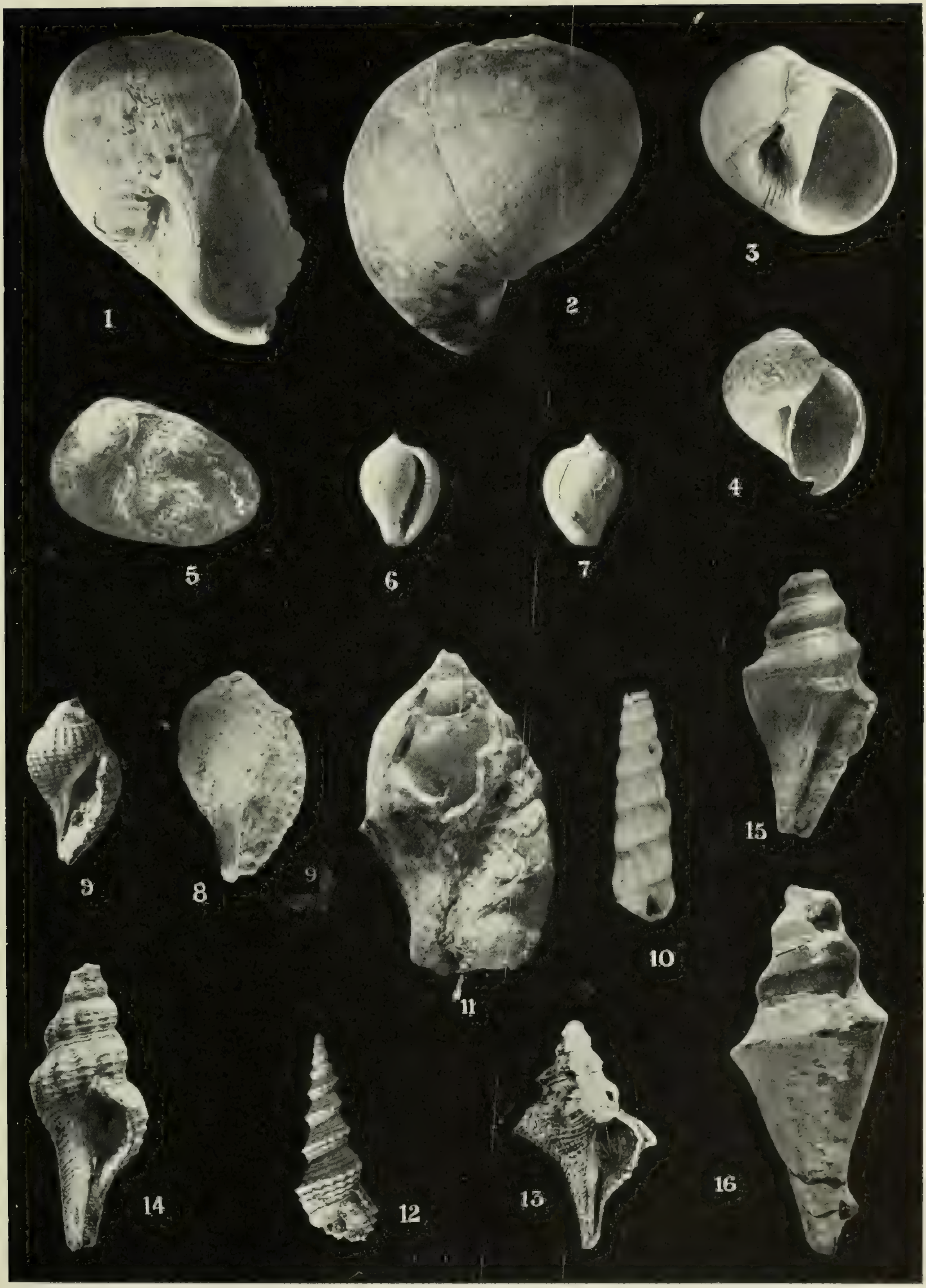
Fig. 12. *Fusinus climacotus* Suter. Holotype. Teaneraki. 6 × 17·5 mm.

Fig. 13. *Fusinus morgani* Suter. Holotype. Kaipara. 24 × 37 mm.

Fig. 14. *Fusinus solidus* Suter. Holotype. Teaneraki. 20 × 47 mm.

Figs. 15, 16. *Hemifusus (Mayeria) goniodes* Suter. Holotype and paratype. Waihao. 24 × 58 mm

PLATE III.



[*Photographed by W. Beken.*

Plate IV.

Figs. 1, 2. *Euthriofusus spinosus* Suter. Holotype. Waihao. 36 × 65 mm.

Fig. 3. *Exilia crassicostata* Suter. Holotype. Teaneraki. 5 × 15 mm.

Fig. 4. *Exilia waihaoensis* Suter. Holotype. Waihao. 6 × 20 mm.

Fig. 5. *Tritonidea acuticingulata* Suter. Holotype. Oamaru. 7 × 13 mm.

Fig. 6. *Tritonidea compacta* Suter. Holotype. Oamaru. 10 × 20 mm.

Fig. 7. *Tritonidea elatior* Suter. Holotype. Oamaru. 9 × 21 mm.

Fig. 8. *Vexillum fenestratum* Suter. Holotype. Pukeuri. 3·2 × 8 mm.

Fig. 9. *Vexillum ligatum* Suter. Holotype. Wharekuri. 4 × 9 mm.

Fig. 10. *Vexillum (Costellaria) rutidolomum* Suter. Holotype. Blue Cliffs. 14 × 30 mm.

Fig. 11. *Siphonalia compacta* Suter. Holotype. Trelissick Basin. 20 × 30 mm.

Fig. 12. *Siphonalia elegans* Suter. Holotype. Oaro Creek, Amuri. 15 × 30 mm.

Fig. 13. *Siphonalia excelsa* Suter. Holotype. Oamaru. 13 × 31 mm.

Fig. 14. *Siphonalia nodosa acuticostata* Suter. Holotype. Waihao. 14 × 26 mm.

Fig. 15. *Surcula serotina* Suter. Paratype. Waihao. 7·5 × 18 mm.

Fig. 16. *Euthria stirophora* Suter. Holotype. Oamaru. 6 × 11·5 mm.

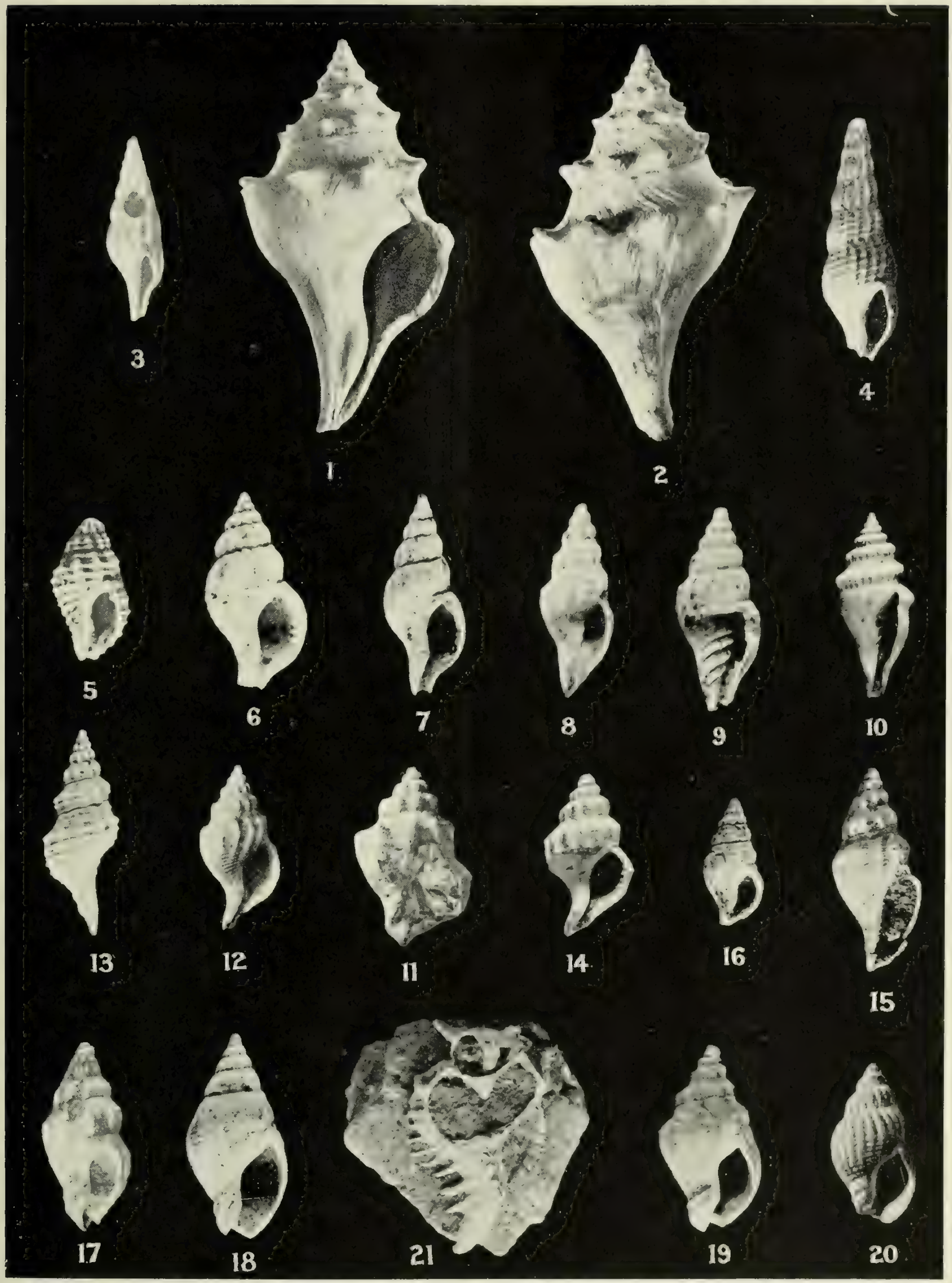
Fig. 17. *Cominella exsculpta* Suter. Holotype. Mount Harris. 7 × 16 mm.

Fig. 18. *Cominella intermedia* Suter. Holotype. Oamaru. 15 × 30·5 mm.

Fig. 19. *Cominella pulchra* Suter. Holotype. Blue Cliffs. 9 × 16·5 mm.

Fig. 20. *Cominella purchasi* Suter. Holotype. Waipara. 15 × 27 mm.

Fig. 21. *Murex (Poirieria) zelandicus komiticus* Suter. Holotype. Kaipara. Natural size.



9—New Tertiary Mollusca. [Photographed by W. Beken.

Plate V.

Fig. 1. *Trophon (Kalydon) lepidus* Suter. Holotype. Oamaru. 6 × 9·5 mm

Fig. 2. *Trophon (Kalydon) lepidus* Suter. Paratype. Oamaru. 8 × 16 mm.

Fig. 3. *Trophon (Kalydon) minutissimus* Suter. Holotype. Pareroa. 1·8 × 3·8 mm.

Fig. 4. *Fulgoraria (Alcithoe) arabica turrita* Suter. Holotype. Blue Cliffs. 39 × 110 mm.

Figs. 5, 6. *Fulgoraria (Alcithoe) biconica* Suter. Holotype. Waihao. 38 × 62 mm.

Fig. 7. *Athleta necopinata* Suter. Holotype. Waihao. 14 × 30 mm.

Fig. 8. *Lapparia hebes* (Hutton). Holotype. Oamaru. 12 × 23 mm. Pencil drawing by Buchanan.

Fig. 9. *Scaphella elegantissima* Suter. Holotype. Weka Pass. 15 × 47 mm.

Fig. 10. *Ancilla waikopiroensis* Suter. Holotype. Waikopiro. 11 × 24 mm.

Fig. 11. *Harpa (Eocithara) neozelanica* Suter. Holotype. Waihao. 45 × 57 mm.

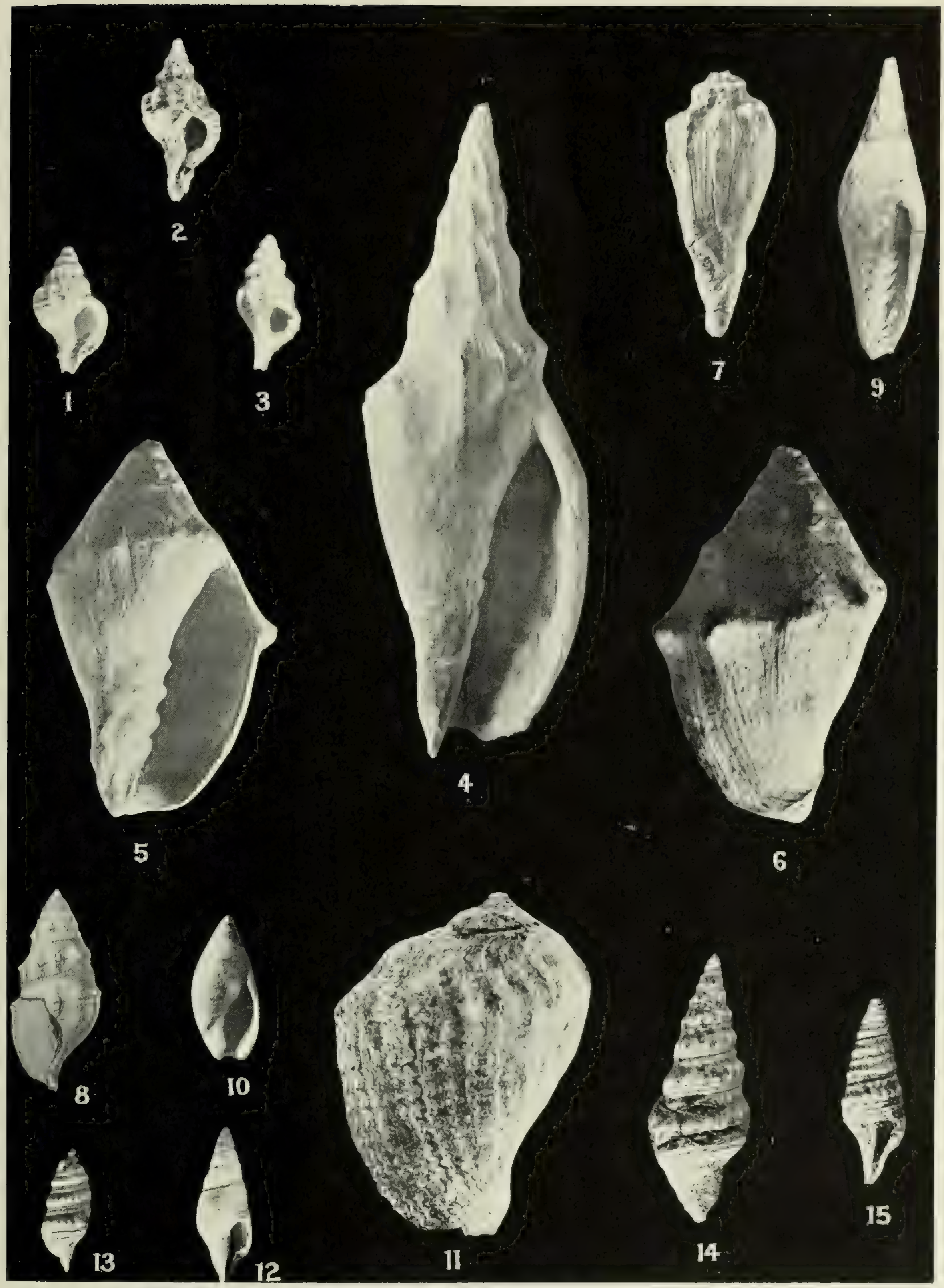
Fig. 12. *Clavatula (Perrona) mackayi* Suter. Holotype. Waihao. 4·5 × 12 mm.

Fig. 13. *Turris bimarginatus* Suter. Holotype. Teaneraki. 4 × 10 mm.

Fig. 14. *Turris complicatus* Suter. Holotype. Waihao. 8 × 22 mm.

Fig. 15. *Turris duplex* Suter. Holotype. Waihao. 5·5 × 14 mm.

PLATE V.



[Photographed by W. Beken.

Plate VI.

Fig. 1. *Turris neglectus* Suter. Holotype. Teaneraki. 6 × 14 mm.

Fig. 2. *Turris uttleyi* Suter. Holotype. Otiake River. 12 × 36 mm.

Fig. 3. *Turris uttleyi* Suter. Paratype. Waihao. 8 × 18 mm.

Fig. 4. *Drillia callimorpha* Suter. Holotype. Oamaru. 4 × 11·5 mm.

Fig. 5. *Drillia (Crassispira) costifer* Suter. Holotype. Pukeuri. 3·4 × 9·5 mm.

Fig. 6. *Surcula antegypsata* Suter. Holotype. Waihao. 14 × 30 mm.

Fig. 7. *Surcula laciniata* Suter. Holotype. Waihao. 12 × 38 mm.

Fig. 8. *Surcula mordax* Suter. Holotype. Waihao. 6 × 15 mm.

Figs. 9, 10. *Surcula oamarutica* Suter. Holotype. Oamaru. 21 × 56 mm.

Fig. 11. *Surcula obliquecostata* Suter. Holotype. Pareora. 3·1 × 9·3 mm.

Fig. 12. *Surcula serotina* Suter. Holotype. Waihao. 14 × 36 mm.

Fig. 13. *Surcula sertula* Suter. Holotype. Waihao. 11 × 33 mm.

Fig. 14. *Bathytoma antecostata* Suter. Holotype. Oamaru. 7 × 18 mm.

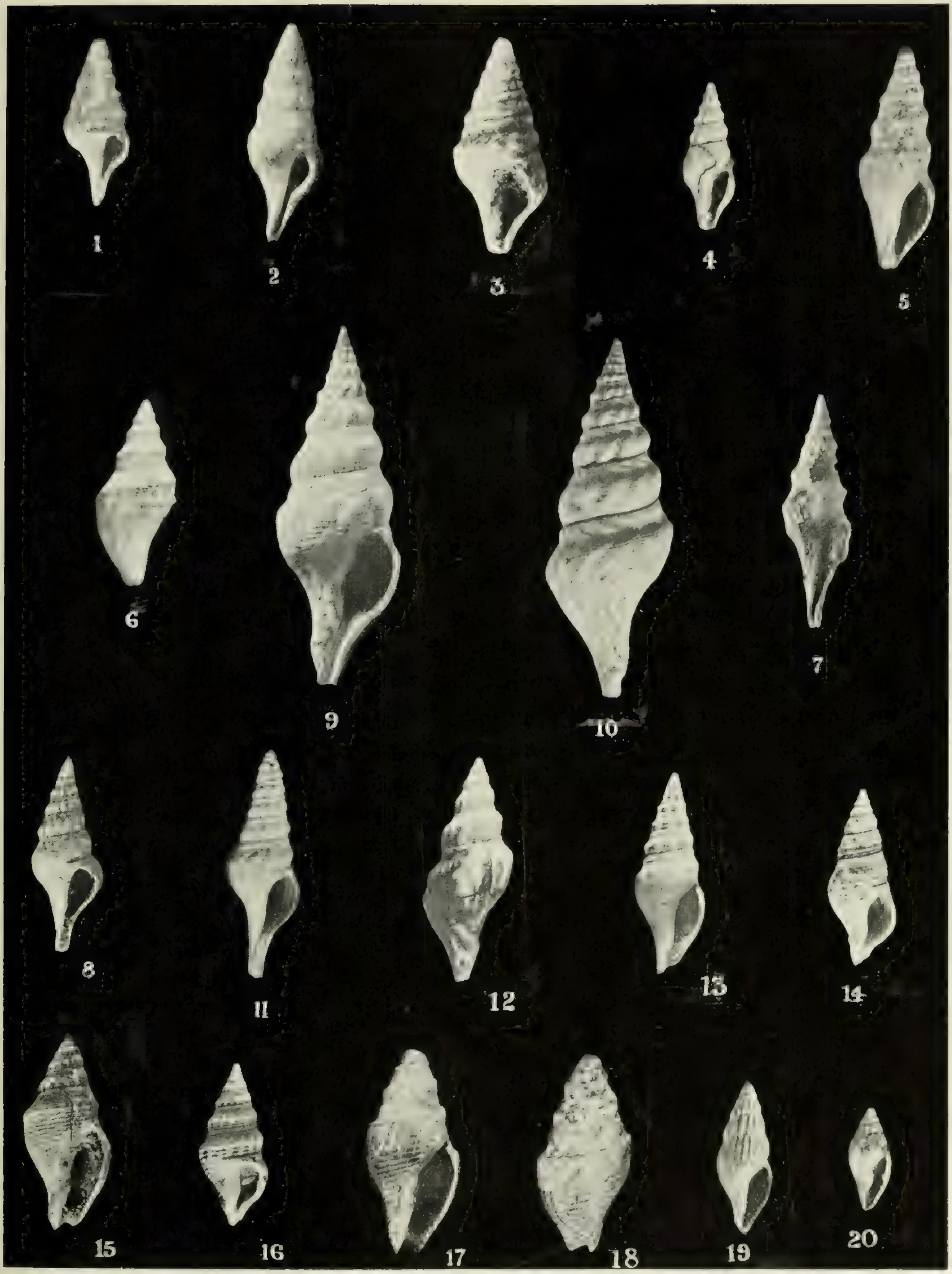
Fig. 15. *Bathytoma eximia* Suter. Holotype. Kyeburn. 11 × 22 mm.

Fig. 16. *Bathytoma perlata* Suter. Holotype. Oamaru. 6·5 × 14·5 mm.

Figs. 17, 18. *Bathytoma sulcata excavata* Suter. Holotype. Kaipara. 16 × 35 mm.

Fig. 19. *Mangilia gracilenta* Suter. Holotype. Pareora. 2·2 × 6 mm.

Fig. 20. *Borsonia (Mitromorpha) brachyspira* Suter. Holotype. Oamaru. 3 × 8 mm.



[*Photographed by W. Beken.*

Plate VII.

Fig. 1. *Bela (Buchozia) canaliculata* Suter. Holotype. Oamaru. 5 × 12 mm.

Fig. 2. *Ptychatractus tenuiliratus* Suter. Holotype. Oamaru. 4 × 9 mm.

Fig. 3. *Bela (Buchozia) infelix* Suter. Paratype. Oamaru. 3·2 × 7 mm.

Fig. 4. *Daphnella (Raphitoma) neozelanica* Suter. Holotype. Teaneraki. 7 × 14 mm.

Fig. 5. *Terebra pareoraensis* Suter. Holotype. Pareora. 5·5 × 21 5 mm.

Fig. 6. *Nucula sagittata* Suter. Holotype. Waipara. 10 × 13 mm.

Fig. 7. *Arca (s. str.) subvelata* Suter. Holotype. Oamaru. 11 × 36 mm.

Fig. 8. *Glycymeris subglobosa* Suter. Holotype. Kakahu. 50 × 52 mm.

Figs. 9, 10. *Limopsis catenata* Suter. Holotype. Oamaru. 15 × 17 mm.

Fig. 11. *Limopsis morgani* Suter. Holotype. Cape Foulwind. 27 × 35 mm.

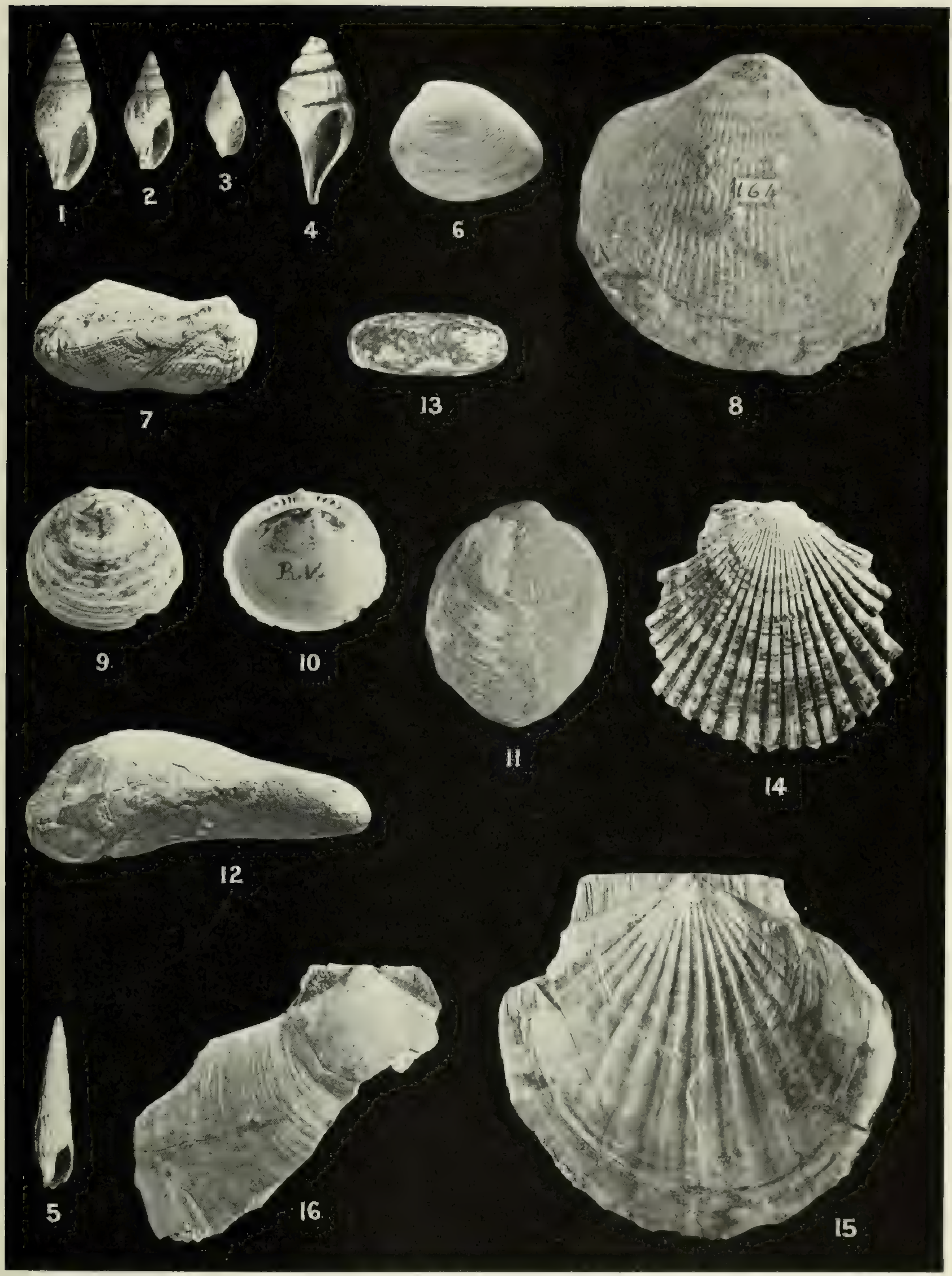
Fig. 12. *Modiolus dolichus* Suter. Holotype. Weka Pass. 21 × 57 mm.

Fig. 13. *Lithophaga nelsoniana* Suter. Holotype. Nelson. 10 × 23 mm.

Fig. 14. *Pecten (Æquipecten) devinctus* Suter. Holotype. Waihao. 37 × 38 mm.

Figs. 15, 16. *Pecten (Pseudamusium) waihaoensis* Suter. Holotype. Left and right valve. Waihao. 58 × 63 mm.

PLATE VII.



[*Photographed by W. Beken.*

PLATE VIII.

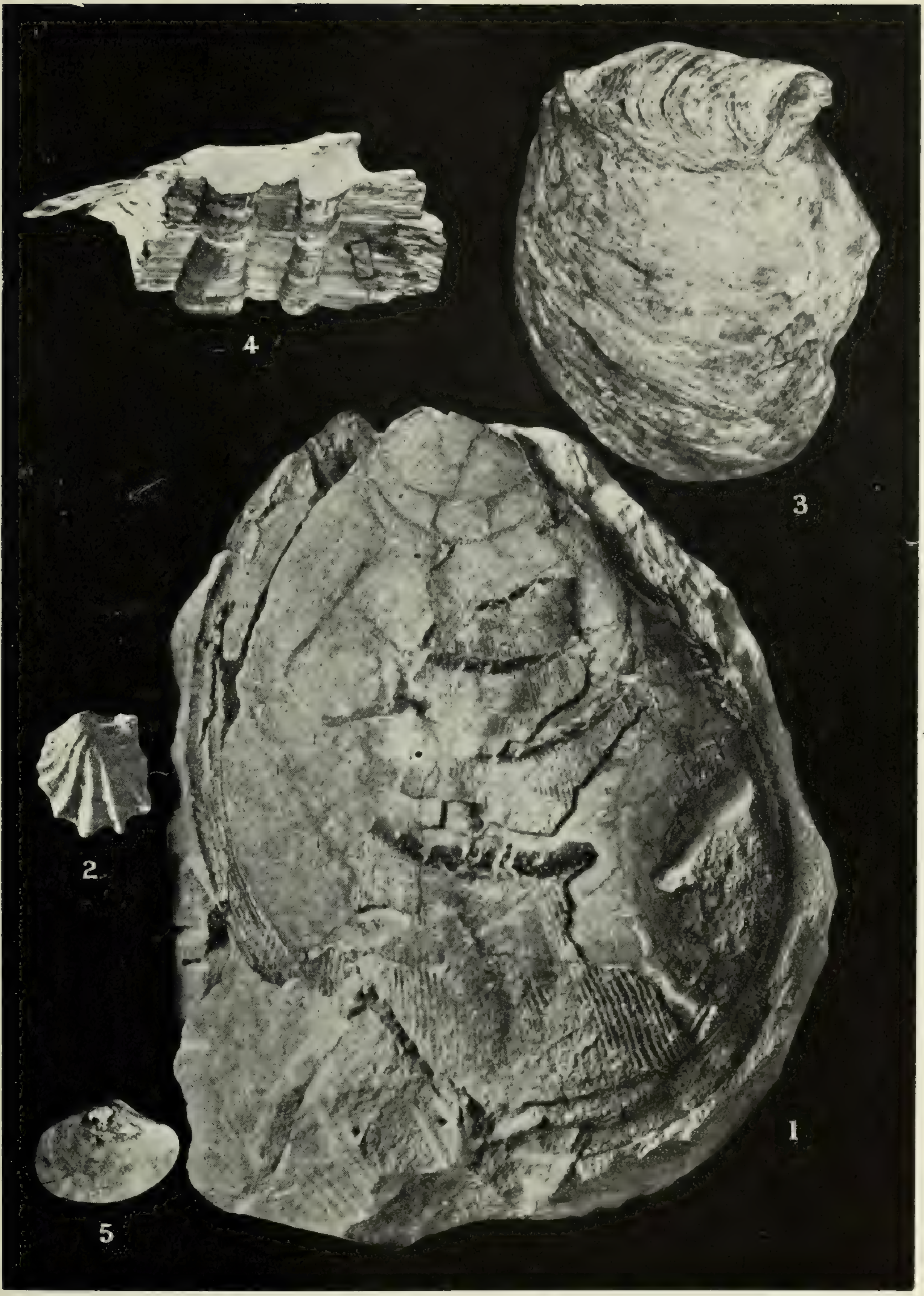
Fig. 1. *Lima (Acesta?) imitata* Suter. Holotype. Waipara. 113 × 150 mm.

Fig. 2. *Ostrea (s. str.) gudexi* Suter. Holotype. Kakahu. 20 × 23 mm.

Fig. 3. *Ostrea (s. str.) mackayi* Suter. Holotype. Waihao. 65 × 77 mm.

Fig. 4. *Melina zealandica* (Hutton) Suter. Chirotype. Shrimpton's. Natural size. Hinge.

Fig. 5. *Macrocallista pareoraensis* Suter. Holotype. Pareora. 21 × 28 mm.



10—New Tertiary Mollusca. [Photographed by W. Beken.

PLATE IX.

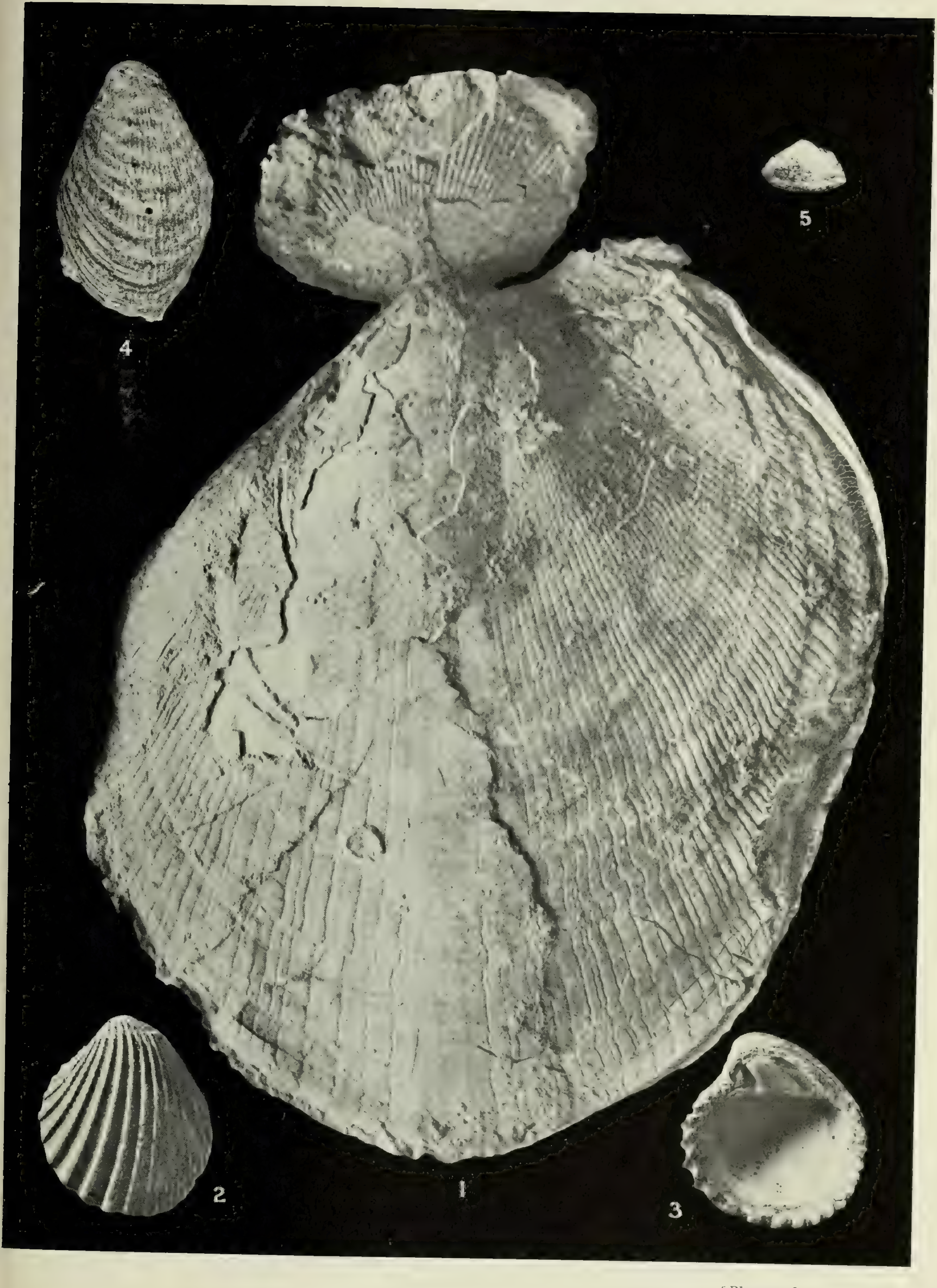
Fig. 1. *Lima (Plagiostoma) regia* Suter. Holotype. Brighton (Nelson). 175 × 200 mm., with *Pecten delicatulus* Hutton.

Figs. 2, 3. *Venericardia acanthodes* Suter. Holotype. Waihao. 21 × 24 mm.

Fig. 4. *Cardium (Fragum) dolichum* Suter. Holotype. Greymouth. 31 × 15 mm.

Fig. 5. *Corbula (Aloidis) kaiparaensis* Suter. Holotype. Kaipara. 6·5 × 10·5 mm.

PLATE IX.



[*Photographed by W. Bek...n.*

Plate X.

Figs. 1, 2. *Venericardia subintermedia* Suter. Holotype. Kaipara. 51 × 52 mm.

Figs. 3, 4. *Cytherea chariessa* Suter. Holotype. Otiake River. 22 × 25 mm.

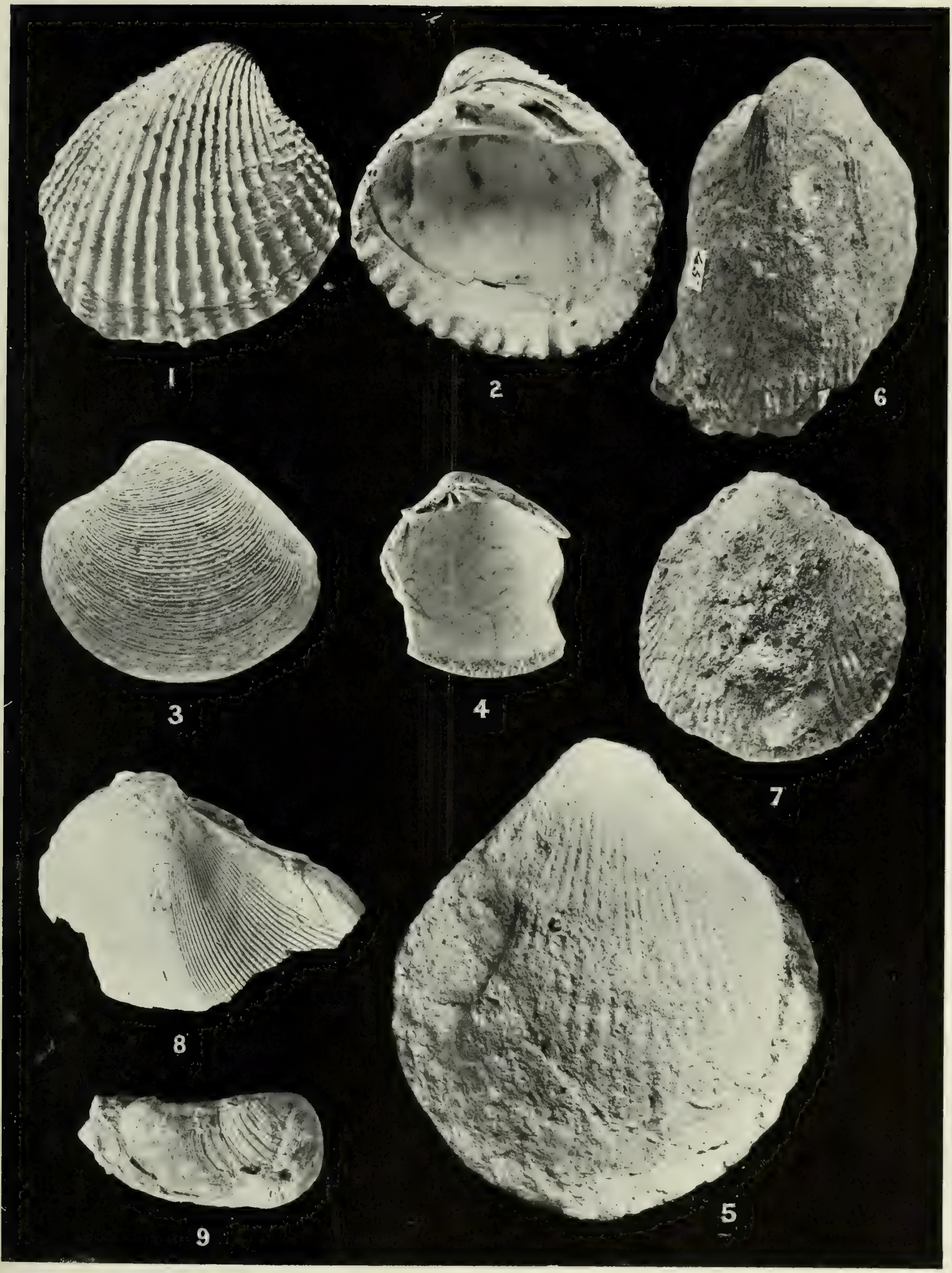
Fig. 5. *Cardium brachytonum* Suter. Holotype. Ormond. 56 × 67 mm.

Fig. 6. *Cardium (Fragum) priscum* Suter. Holotype. Brighton (Nelson). 35 × 54 mm.

Fig. 7. *Cardium subcordatum* Suter. Holotype. Trelissick Basin. 44 × 45 mm.

Fig. 8. *Protocardia (Nemocardium) alata* Suter. Holotype. Waipara. 40 × 56 mm.

Fig. 9. *Pholadidea thomsoni* Suter. Holotype. Anthony Bay. 21 × 36 mm.



11—New Tertiary Mollusca. [Photographed by W. Beken.

Plate XI.

Fig. 1. *Trochus (Anthora) avarus* Suter. Holotype. Treslissick Basin. 13 × 15 mm.

Fig. 2. *Cantharidus fenestratus* Suter. Holotype. Oamaru. 6 × 7 mm.

Fig. 3. *Calliostoma acutangulum* Suter. Holotype. Trelissick Basin. 13 × 14 mm.

Fig. 4. *Calliostoma filiferum* Suter. Holotype. Trelissick Basin. 15 × 19 mm.

Fig. 5. *Calliostoma oryctum* Suter. Holotype. Trelissick Basin. 12 × 14 mm.

Fig. 6. *Solariella prætextilis* Suter. Holotype. Trelissick Basin. 6 × 6 mm.

Fig. 7. *Solariella sulcatina* Suter. Holotype. Kakanui. 10 × 11 mm.

Fig. 8. *Astræa (Uvanilla) subfimbriata* Suter. Holotype. Kaipara. 20 × 26 mm.

Fig. 9. *Turritella (s. str.) waikopiroensis* Suter. Holotype. Waikopiro. 9 × 27 mm.

Fig. 10. *Ampullina waihaoensis* Suter. Holotype. Waihao. 16 × 16 mm.

Fig. 11. *Cypræa (Luponia) trelissickensis* Suter. Holotype. Trelissick Basin. 11 × 17 mm.

Figs. 12, 13. *Epitonium (Clathroscala) cylindrellum* Suter. Holotype, fig. 12; paratype, fig 13 Trelissick Basin. 6 × 13 mm. and 7 × 9 mm.

Fig. 14. *Epitonium (Clathroscala) elatum* Suter. Holotype. Blue Cliffs. 5 × 27·5 mm.

Fig. 15. *Epitonium (Acrilla) gracillimum* Suter. Holotype. Wharekuri. 5 × 16 mm.

Fig. 16. *Niso neozelanica* Suter. Holotype. Wharekuri. 4 × 9·3 mm.

Figs. 17, 18. *Tudicla neozelanica* Suter. Holotype. Kakahu. 22 × 29 mm.

Fig. 19. *Galeodes (Pugilina) angusta* Suter. Holotype. Kakahu. 13 × 26 mm.

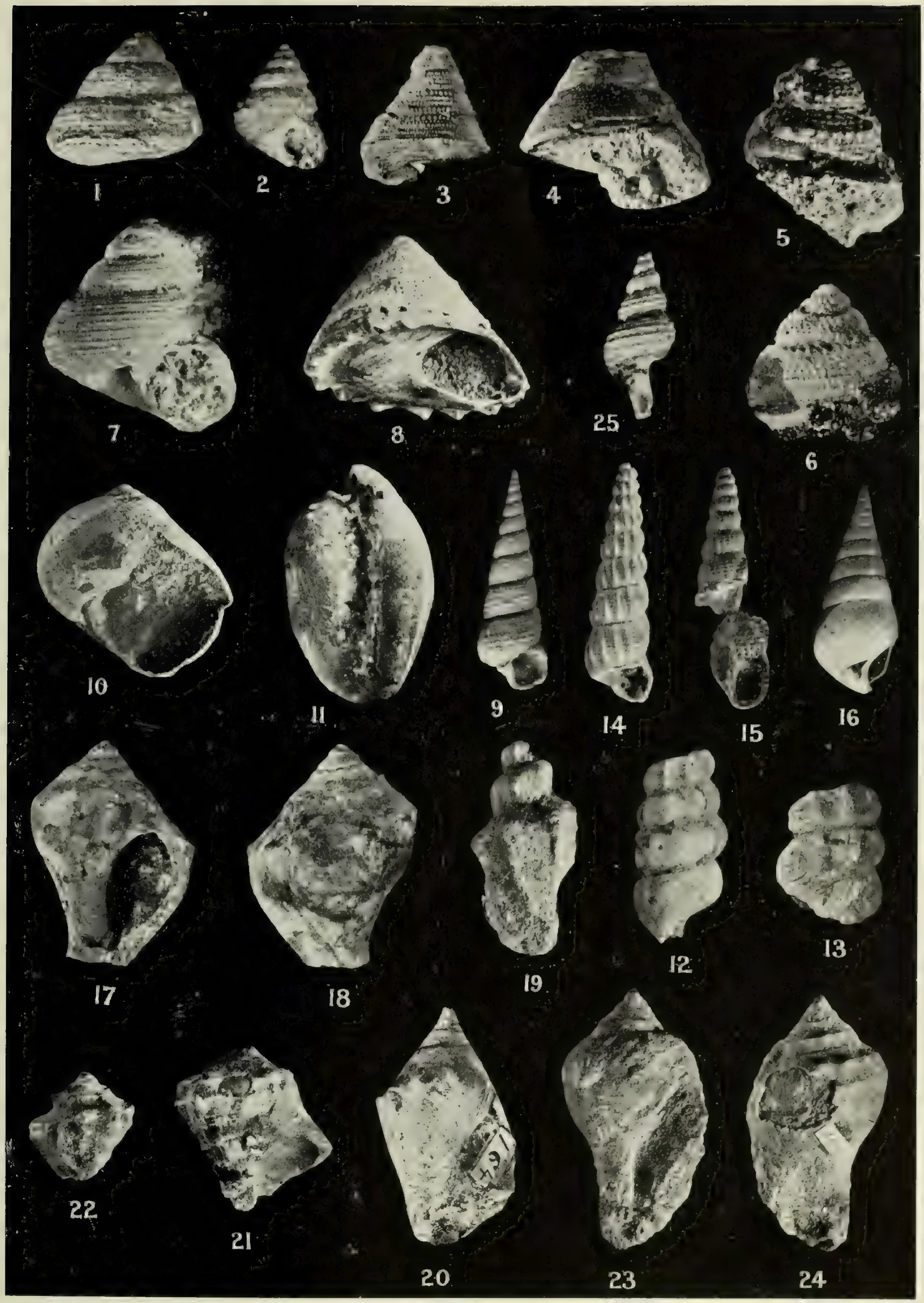
Fig. 20. *Galeodes biconica* Suter. Holotype. Kakahu. 20 × 31 mm.

Figs. 21, 22. *Galeodes (Pugilina) liræcostata* Suter. Holotype. Kakahu. 22 × 24 mm.

Figs. 23, 24. *Galeodes modesta* Suter. Holotype. Kakahu. 21 × 36 mm.

Fig. 25. *Streptosiphon (Streptopelma) reticulatum* Suter. Holotype. Waihao. 7 × 15 mm.

PLATE XI.



[*Photographed by W. Bekon.*

Plate XII.

Fig. 1. *Fusinus bicarinatus* Suter. Holotype. Trelissick Basin. 9·5 × 14 mm.

Fig. 2. *Fusinus kaiparaensis* Suter. Holotype. Kaipara. 23 × 41 mm.

Fig. 3. *Fusinus congestus* Suter. Holotype. Pareora. 7 × 14 mm.

Fig. 4. *Mitra (Cancilla) armorica* Suter. Holotype. Blue Cliffs. 8 × 20 mm.

Fig. 5. *Vexillum apicicostatum* Suter. Holotype. Waihao. 5 × 12 mm.

Fig. 6. *Euthria callimorpha* Suter. Holotype. Waitaki. 7·5 × 16 mm.

Fig. 7. *Euthria (Dennantia ?) mystica* Suter. Holotype. Kakahu. 9 × 20 mm.

Fig. 8. *Trophon (Xanthochorus) pulcherrimus* Suter. Holotype. Awatere. 6·8 × 12 mm.

Fig. 9. *Rapana neozelanica* Suter. Holotype. Waihao. 17 × 19 mm.

Fig. 10. *Rapana waihaoensis* Suter. Holotype. Waihao. 30 × 39 mm.

Fig. 11. *Lapparia hebes* (Hutton). Plesiotype. Kakahu. 22 × 40 mm.

Fig. 12. *Lapparia hebes* (Hutton). Plesiotype. Kakahu. 14 × 28 mm.

Fig. 13. *Marginella (Glabella) fraudulenta* Suter. Holotype. Pukeuri. 2·5 × 4·5 mm.

Fig. 14. *Turris regius* Suter. Holotype. Waihao. 5 × 11 mm.

Fig. 15. *Surcula climacota* Suter. Holotype. Kaipara. 8 × 22 mm.

Fig. 16. *Surcula seminuda* Suter. Holotype. Trelissick Basin. 7 × 15 mm.

Fig. 17. *Mangilia blandiata* Suter. Holotype. Otiake River. 3·5 × 8 mm.

Fig. 18. *Mangilia præcophinodes* Suter. Holotype. Oamaru. 3·5 × 8 mm.

Fig. 19. *Awateria streptophora* Suter. Holotype. Awatere. 5 × 11 mm.

Fig. 20. *Awateria streptophora evanida* Suter. Holotype. Awatere. 5 × 11 mm.

Fig. 21. *Bela (Buchozia) infelix* Suter. Holotype. Pareora. 3·2 × 7 mm.

Fig. 22. *Borsonia (Cordieria) mitromorphoides* Suter. Holotype. Wharekuri. 8 × 18 mm.

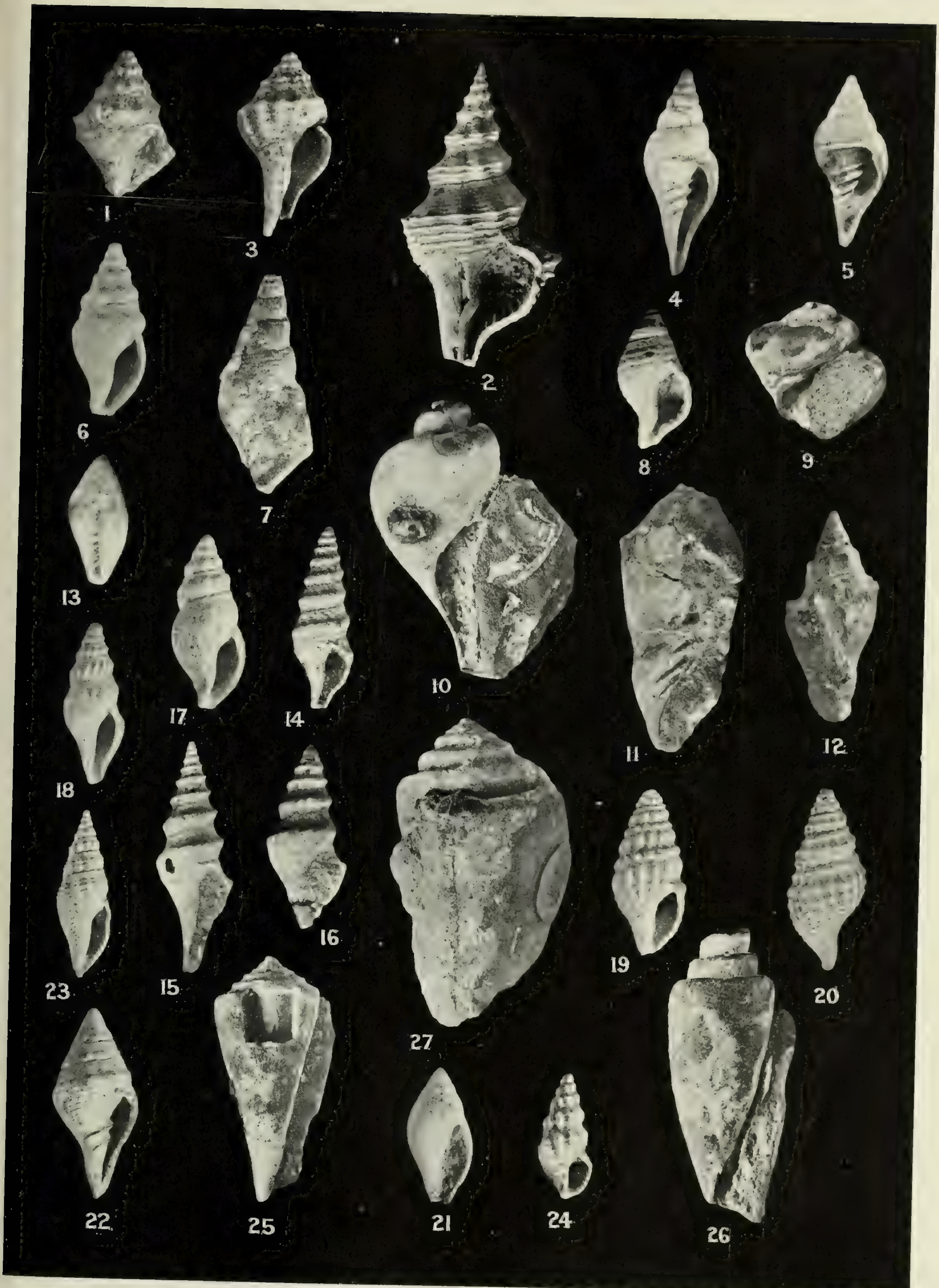
Fig. 23. *Ptychatractus nodosoliratus* Suter. Holotype. Blue Cliffs. 3·5 × 11 mm.

Fig. 24. *Ptychatractus pukeuriensis* Suter. Holotype. Pukeuri. 3 × 6·5 mm.

Fig. 25. *Conus (Leptoconus) armoricus* Suter. Holotype. Kaipara. 12 × 23 mm.

Fig. 26. *Conus (Conospira) deperditus* Suter. Holotype. Mokihinui. 13 × 30 mm.

Fig. 27. *Conus (Chelyconus) fusellinus* Suter. Holotype. Mokihinui. 25 × 37 mm.



[Photographed by W. Beken.

Plate XIII.

Fig. 1. *Ostrea (s. str.) mackayi* Suter. Holotype. Waihao. Enlarged.

Fig. 2. *Melina zealandica* (Hutton) Suter. Chirotype. Shrimpton's. Inside of valve. 90 × 115 mm.

Fig. 3. *Crassatellites cordiformis* Suter. Holotype. Broken River. 13 × 14 mm.

Fig. 4. *Venericardia pseutes* Suter. Holotype. Oamaru. 40 × 42 mm.

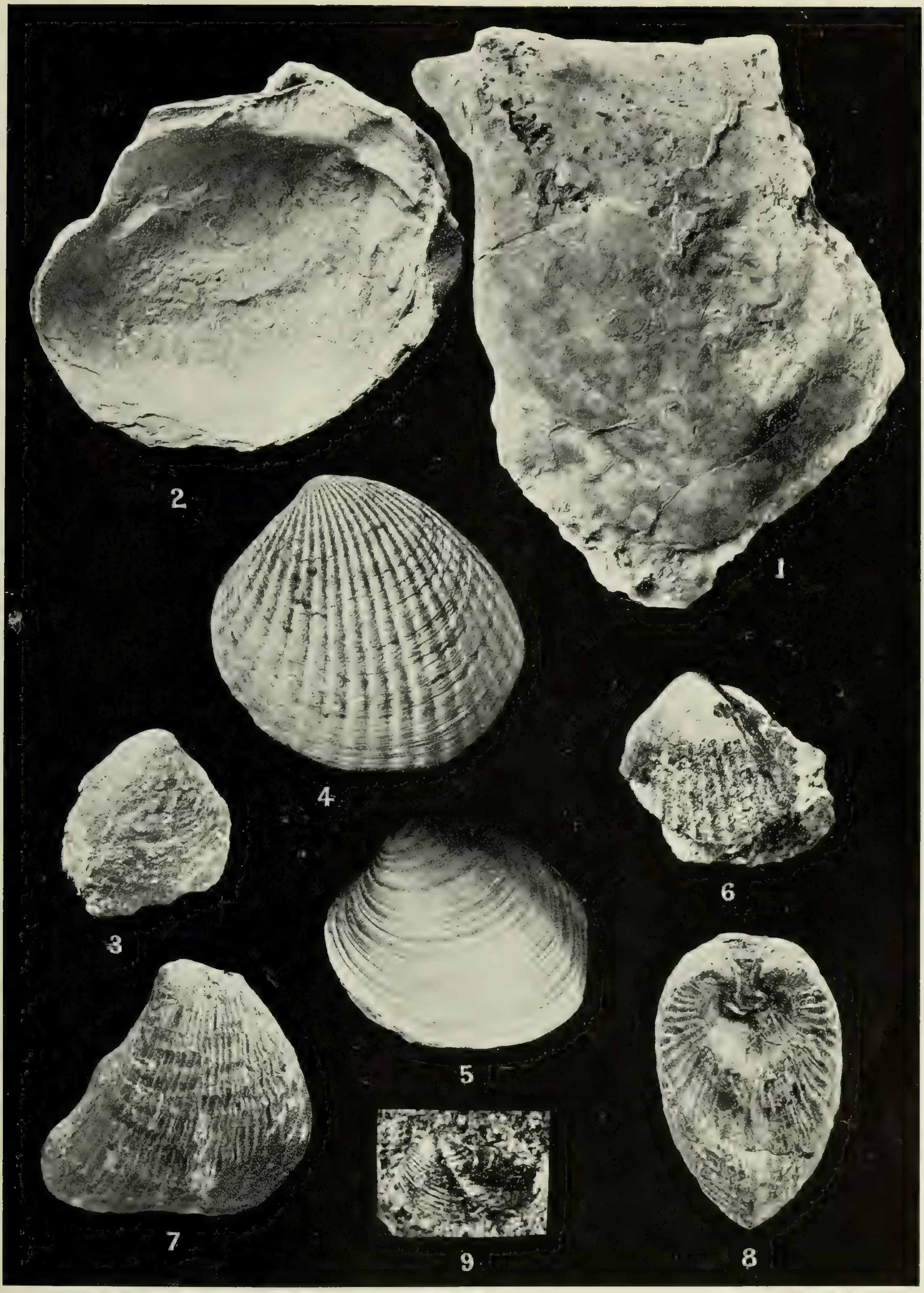
Fig. 5. *Chione chiloensis truncata* Suter. Holotype. Awamoa. 40 × 45 mm.

Fig. 6. *Cardium facetum* Suter. Holotype. Trelissick Basin. 14 × 15 mm.

Fig. 7. *Cardium (Fragum) maorinum* Suter. Holotype. Port Hills beds, Nelson. Enlarged.

Fig. 8. *Cardium (Fragum) maorinum* Suter. Holotype. Port Hills beds, Nelson.

Fig. 9. *Martesia concentrica* Suter. Holotype. Broken River. 5 × 10 mm.



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NEW ZEALAND.

Department of Mines.

NEW ZEALAND GEOLOGICAL SURVEY.
(P. G. MORGAN, Director.)

PALÆONTOLOGICAL BULLETIN No. 6.

THE EARLIER MESOZOIC FLORAS OF NEW ZEALAND.

BY

E. A. NEWELL ARBER, M.A., Sc.D., F.G.S., F.L.S.,

Trinity College, Cambridge; University Demonstrator in Palæobotany; Hon. Memb. New Zealand Institute.

ISSUED UNDER THE AUTHORITY OF THE HON. W. D. S. MACDONALD, MINISTER OF MINES.

WELLINGTON.
BY AUTHORITY: MARCUS F. MARKS, GOVERNMENT PRINTER.
1917.

LETTER OF TRANSMITTAL.

Geological Survey Office,
Wellington, 1st June, 1917.

Sir,—

I have the honour to transmit herewith a palæobotanical memoir, or monograph as it may more correctly be termed, which has been written by Dr. E. A. Newell Arber, Demonstrator in Palæobotany to the University of Cambridge, and is entitled "The Earlier Mesozoic Floras of New Zealand." The memoir, now published as Palæontological Bulletin No. 6 of the New Zealand Geological Survey, contains 80 pages of letterpress, and is illustrated by 14 plates in collotype and 12 figures reproduced as half-tones or as process blocks.

A perusal of the following pages will show that Dr. Arber, who, solely as a labour of love, undertook the work of examining and describing the plant-remains here described, has spared no trouble and no pains in order to make the results of his investigations so complete that the Mesozoic botany of New Zealand will henceforward be established on a firm footing. The memoir itself will undoubtedly become a classic, indispensable to all students of Mesophytic floras.

With the exception of the plates, which were executed by the London Stereoscopic Company, this bulletin has been prepared entirely in the Government Printing Office, Wellington. Thanks and praise are due to the Government Printer and his staff for the careful manner in which this difficult typographical material has been set up. The first proof was read by Dr. Arber, but later proofs were corrected only in New Zealand, and therefore a few small errors are doubtless present. It is hoped, however, that the corrigenda will be found few in number and of little consequence.

I have the honour to be,
Sir,
Your obedient servant,
P. G. MORGAN,
Director, New Zealand Geological Survey.

Hon. W. D. S. MacDonald,
Minister of Mines, Wellington.

CONTENTS.

LIST OF FIGURES WITH THE TEXT.

PALÆONTOLOGICAL BULLETIN No. 6.

THE EARLIER MESOZOIC FLORAS

OF

NEW ZEALAND.

CHAPTER I.

INTRODUCTION.

This memoir is concerned with an account of the earlier Mesozoic floras of New Zealand. A large number of specimens from different localities in these islands are discussed. The geological ages of the rocks in which they occur vary from Triasso-Rhætic to Neocomian. The plant-impressions belong, for the most part, to the collections of the Geological Survey of New Zealand, of which the best examples have been forwarded to me for examination and description. Others, including recent collections from the Malvern Hills and Gore districts, are now in the Sedgwick Museum, Cambridge. A further set of fossils, to which reference is also made, is in the British Museum (Natural History) as the result of an exchange effected between that institution and the New Zealand Geological Survey in 1878.

The majority of the specimens have not been previously described. In fact, as will be seen from the next section of this memoir, very little has hitherto been attempted in regard to the fossil floras of New Zealand, other than those of the Tertiary rocks.

One result of the present work has been to show that Palæozoic plants are quite unknown from New Zealand. The many rumours of the presence of *Glossopteris*-bearing rocks in these islands have proved to be without foundation.

The fossil floras discussed here appear to be chiefly of Triasso-Rhætic or Jurassic age, several examples occurring in different regions. A very interesting Neocomian flora is described, in which the Neophytic Angiospermous types are apparently still few as compared with the Mesophytic species. For the valuable description of the Angiospermous remains included here, I am greatly indebted to my friend Dr. L. Laurent, of Marsei les.

Several new genera and species are instituted. These are indicated in Chapter III, where the flora of each locality is discussed separately. A full description of these plants will be found in Chapter VI, which contains an account of all the plants examined, arranged botanically, and irrespective of their geological ages.

I would here express my obligations to the Geological Survey of New Zealand for the loan of the collections described in the present memoir. To the Director of the Survey, Mr. P. G. Morgan, F.G.S., I am indebted for his kindness in facilitating the loan of the specimens and the publication of this memoir. I wish also to record my grateful thanks to Dr. J. A. Thomson, F.G.S., formerly Palæontologist to the Survey, for similar help, and especially for much information relating to the plant localities and to the New Zealand literature bearing upon them. The New Zealand Survey has also kindly made me a grant towards the cost of the illustrations of this memoir.

I have also to acknowledge the loan of several private collections from New Zealand. The very interesting series of plant-remains collected by the late Mr. J. S. Nicol, of Mokoia Farm, near Gore, was originally lent to me a year or two before his death. These specimens were subsequently presented by his executors to the Sedgwick Museum, Cambridge, where they are much valued.

Dr. P. Marshall, F.G.S., now of Wanganui(1), and Mr. R. Speight, F.G.S., of Canterbury Museum, Christchurch, have kindly allowed me to examine specimens in their charge. Mr. Speight has also collected for me a series of plant-remains from the Malvern Hills, which he has presented to the Sedgwick Museum, Cambridge. Several of these specimens are of interest, and are figured here. I am particularly grateful to Mr. Speight for the trouble he has taken in this matter, and also for kindly forwarding the photographs of the plant-beds at Mount Potts and in the Clent Hills for reproduction here.

To Mr. D. G. Lillie, M.A., of St. John's College, Cambridge, I am indebted for information in regard to the plant localities which he visited when in New Zealand, and especially for notes on the fossil forest of Waikawa. I am also under great obligations to him for obtaining for me the loan of specimens in New Zealand. Dr. L. Cockayne, F.R.S., has also kindly sent me copies of his photographs of the fossil forest at Waikawa, which are included here.

The photographs reproduced in the plates are the work of Mr. W. Tams, and the drawings, of Mr. T. A. Brock, both of Cambridge. The sketch-maps were drawn by the late Mr. Edwin Wilson. I am indebted to all three artists for the skill and trouble which these illustrations represent.

Lastly I would endeavour to express my sincere thanks to my friends in Stockholm, Professor Nathorst and his assistant Dr. Halle, to whose exceptional knowledge of Mesozoic plants I have appealed in several cases of difficulty. Professor Nathorst has very kindly interested himself in no small degree in these matters, and to his sound advice and wide knowledge I am particularly indebted. Thanks to his kindness, I have had an opportunity of comparing many of the New Zealand specimens here described with the rich series of Mesozoic floras of Antarctica and South America, as well as those from other localities, preserved under his care in that great "Mecca" of Palæobotany at Stockholm.

(1) Dr. Marshall is now headmaster, Wanganui Collegiate School, but until the end of 1916 was Professor of Geology at Otago University College, Dunedin. Hence the references on pages 33 and 51 of this memoir to his collection at Dunedin. [P. G. M.]

CHAPTER II.

HISTORICAL.

THE past records of Mesophytic plants from New Zealand form, with very few exceptions, a long list of *nomina nuda*—genera and species stated to be new, but neither figured nor described. In a recent note(1) I have gone very fully into these pseudo-records, which it is impossible to recognize, enumerating no less than seventy-one instances. I need not therefore deal with these matters here in detail, save to record the names of Hector(2), Ettingshausen(3), and Crié(4) as the originators of these absurdities. In fact, until the end of 1912, there were only eleven valid records of pre-Cretaceous plants from New Zealand. The number of Neophytic records is considerably greater, but with these we are not concerned here.

The earliest valid determinations from New Zealand are by Unger(5), and date from 1864. He described and figured two Wealden plants from the Waikato Heads, in Auckland, a flora redescribed here. The first of these, his *Polypodium Hochstetteri* Unger(6), is a *Cladophlebis*, allied to *C. australis* (Morr.). The other, *Asplenium palæopteris* Unger(7), I have not seen; but as the specific name can hardly stand, since it has also been used as a generic term, I should propose to term it *Sphenopteris* (? *Coniopteris*) sp., and I have elsewhere(8) compared it with the Jurassic fern *Sphenopteris Murrayana* (Brongn.). Professor Seward(9) has regarded it as identical with the Wealden *Sphenopteris Fittoni* Sew.

The three other specimens from Pakawau, Massacre (or Golden) Bay, in the Province of Nelson, figured by Unger, are very obscure fragments, and these records may be neglected. One of them is a *Cladophlebis* sp.

Hector(10) in 1886 figured, but did not describe, seventeen species from three important plant-bearing localities in New Zealand, the floras of which are dealt with in the present memoir. Some of these are small fragments, identical either with one another or with plants earlier described from other parts of the world. In several cases the names were already preoccupied(11). I have already discussed each record at some length elsewhere(8), and I need only give here my conclusions in summary form. Of Hector's seventeen species only two stand as new, while six others are first records from New Zealand. These, despite the absence of descriptions, I regard as valid.

There are first of all eight records from the Clent Hills, which I have revised as follows:—

Hector's Name.		Revised Nomenclature.
Asplenites rhomboides Hect.	.. =	*Thinnfeldia* sp.; cf. *T. argentinica* (Gein.).
Pecopteris acuta Hect. ..	.. =	*Cladophlebis* sp.
Pecopteris linearis Hect.	.. =	*Cladophlebis australis* (Morr.).
Vertebraria novæ-zealandiæ Hect.	.. =	? (Wrong generic determination, very obscure).
Taxites maitai Hect. ..	.. =	*Elatocladus conferta* (O. & M.).
Pecopteris ovata Hect. ..	.. =	*Cladophlebis* sp.
Pecopteris obtusata Hect.	.. =	*Cladophlebis* sp.
Camptopteris incisa Hect.	.. =	*Dictyophyllum acutilobum* (Braun).

(1) Arber (1913[2]); see also Thomson (1913).
(2) Hector (1870), (1878[1]), (1879[1]), (1879[2]), (1886[1]).
(3) Ettingshausen (1887[1]), (1887[2]), (1890).
(4) Crié (1888); see also (1889).
(5) Unger (1864).
(6) Unger (1864), pl. ii.
(7) Unger (1864), pl. i, figs. 4–8.
(8) Arber (1913[2]), p. 125.
(9) Seward (1894), p. xxxiii.
(10) Hector (1886[1]), text-figs. 30, 30A.
(11) I have given a list of these in Arber (1913[2]), p. 126.

Next there are six records from Mataura Falls, in Southland :—

Hector's Name.		Revised Nomenclature.
Macrotæniopteris lata Hect.	.. =	*Tæniopteris crassinervis* (Feist.).
Lomarites pectenata Hect.	.. =	*Microphyllopteris pectinata* (Hect.).
Taxites manawao Hect.	.. =	*Pagiophyllum peregrinum* (L. & H.).
Pterophyllum matauriensis Hect...	=	*Ibid.*
Sphenopteris asplenoides Hect.	.. =	*Sphenopteris* sp.
Taxites kahikatea Hect...	.. =	?

Lastly we have three species from Waikawa, in Southland :—

Hector's Name.		Revised Nomenclature.
Taxites manawao Hect...	.. =	*Palissya tenuifolia* (McCoy).
Pecopteris grandis Hect.	.. =	*Cladophlebis australis* (Morr.).
Asplenites palæopteris Unger	.. =	*Sphenopteris* (? *Coniopteris*) sp.

In 1889 Crié(1) described two petrifactions from Mataura and Toitoi :—

Crié's Name.		Revised Nomenclature.
Psaronius Huttonianus Crié	.. =	*Osmundites* sp.(2).
Araucarioxylon australe Crié	.. =	*Ibid.*

In 1907 Kidston and Gwynne-Vaughan(3) described two very interesting Osmundaceous stems from "near Gore, Otago," as *Osmundites Gibbiana* K. & G.-V., and *O. Dunlopi* K. & G.-V. These are among the few petrifactions as yet known from New Zealand, and were no doubt really derived from Curio Bay, Waikawa. More recently Sinnott(4) has also discussed similar specimens.

Prior to the commencement of the present work we therefore find that there were only eleven valid records of Mesophytic plants from New Zealand, as follows :—

Cladophlebis australis (Morr.).
Dictyophyllum acutilobum (Braun).
Microphyllopteris pectinata (Hect.)
Osmundites Dunlopi K. & G.-V.
Osmundites Gibbiana K. & G.-V.
Elatocladus conferta (O. & M.).
Palissya tenuifolia (McCoy).
Pagiophyllum peregrinum (L. & H.).
Pterophyllum matauriensis Hect.
Tæniopteris crassinervis (Feist.).
Araucarioxylon australe Crié.

In a preliminary note(5), published in 1913, on the fossil plants of the Mount Potts beds I figured the following species, among others, indicated as occurring in this locality :—

Linguifolium Lillieanum sp. nov.
Baiera cf. *B. paucipartita* Nath.
Tæniopteris Daintreei McCoy.
Chiropteris lacerata sp. nov.
Thinnfeldia lancifolia (Morr.).

These plants are both described and refigured in the present memoir, in order to render the account of the New Zealand floras as complete as possible.

(1) Crié (1889).
(2) Kidston and Gwynne-Vaughan (1916), p. 479.
(3) Kidston and Gwynne-Vaughan (1907).
(4) Sinnott (1914).
(5) Arber (1913[1]).

CHAPTER III.

A REVIEW OF THE LOCALITIES, WITH A SYNOPSIS OF THE COLLECTIONS AND PREVIOUS RECORDS, AND A DISCUSSION AS TO THE GEOLOGICAL AGE OF THE BEDS.

I propose in the present chapter to consider the localities from which the fossil plants dealt with here were obtained. These will be enumerated roughly in order of their geological age, beginning with the most important of the older Triasso-Rhætic floras, and concluding with the single Neocomian plant-assemblage. In addition to details relating to the localities and the collections made from them, with an enumeration of previous records, I have also added a list of the species described here. Previous opinions in regard to the geological age of the beds are next considered, and finally in each case the conclusions which I have arrived at on this point are stated.

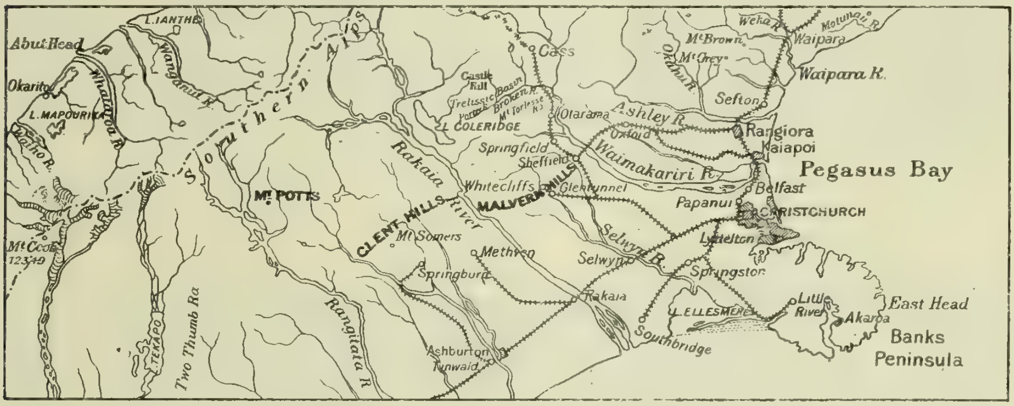

Fig. 1. Sketch-map of the Canterbury District, South Island, showing the Relative Positions of the Plant Localities at Mount Potts, and in the Clent and Malvern Hills.

A. The Rhætic Flora of Mount Potts (Canterbury).

Locality.—Mount Potts, situated in Ashburton County, Canterbury, is part of a mountain-range lying between the upper Rangitata River on the south-west (fig. 1) and the upper Rakaia River on the north-east, and drained by the upper Ashburton River on the south-east. Mount Potts itself, a snow-covered mountain 7,197 ft. in height, is almost isolated from the range by the Potts River, which flows south and west to join the Rangitata River. The fossiliferous localities (figs. 2, 3) lie on the western slopes of Mount Potts, principally in Rocky (or Fossil) Gully (the faunal locality) and in Tank Gully (the plant locality), the small streams of which flow westward to the Clyde River, a branch of the upper Rangitata.

The beds here consist of a great thickness of dark shales, alternating with thinner layers of sandstone. They form a large anticlinal fold in Fossil Gully, where they are well exposed for several miles.

The Collections.—The first fossils found in these beds were Spiriferinas and other brachiopoda (see p. 6), discovered by Haast (afterwards Sir Julius von Haast) in 1861.

Plants were first obtained from associated beds by McKay(1) in 1878. The New Zealand Geological Survey collection, however, apparently contains only a very few fragmentary specimens from this locality. The material described here was collected from Tank Gully in November, 1911, by Mr. D. G. Lillie, of Cambridge, as the result of a journey to Mount Potts, in company with Mr. R. Speight, F.G.S., of Christchurch.

Previous Records.—Hector(2), in 1878 and in subsequent years, recorded "*Glossopteris augustifolia* and *Schizoneura* sp." from these beds, but no figures or descriptions of the specimens were ever published by him.

Ettingshausen(3), in 1887, recorded seven species of the genera *Equisetum*, *Tæniopteris*, *Asplenium*, *Palissya*, *Baiera*, *Thinnfeldia*, and *Protocladus*, six of which were new, but no figures or descriptions were given of any of them, and they remain mere *nomina nuda*.

As stated in the previous chapter, in 1913(4) I figured the following plants collected by Mr. Lillie from Mount Potts. These are now in the British Museum (Natural History) :—

Linguifolium Lillieanum sp. nov.
Baiera cf. *Baiera paucipartita* Nath.
Tæniopteris Daintreei McCoy.
Chiropteris lacerata sp. nov.
Thinnfeldia lancifolia (Morr.).

For the sake of completeness, these specimens are refigured here, and a full description of them is also added. Two modifications have been made in the list of determinations, both the *Baiera* and the *Tæniopteris* being now regarded as new species, viz. :—

Baiera robusta sp. nov.
Tæniopteris Thomsoniana sp. nov.

Previous Opinions with regard to the Age of the Mount Potts Beds.—The nature of the flora of the Mount Potts beds, and the question of its geological age, have been the subjects of much controversy in New Zealand, particularly between Hector and Haast, and consequently considerable doubt has existed in Europe on these questions. The matter has been complicated by the fact that, sixteen years before the first plant-remains were discovered at Mount Potts, certain beds of mollusca, brachiopoda, and isolated saurian(?) bones were found in the same locality. Further, some fifteen miles distant, in the Clent Hills, plant-remains were also known, which Haast(5) regarded on stratigraphical evidence as occurring in beds of equivalent age to those bearing mollusca at Mount Potts, originally discovered by him in 1861.

The marine fauna from Mount Potts and the plants from the Clent Hills had been submitted to McCoy, who pronounced the former to be Lower Carboniferous or Devonian, and the latter Jurassic in age(6). Haast, however, disagreed with the age assigned to the Clent Hill flora, and explicitly states that the same beds which contain the flora in the Clent Hills overlie the molluscan beds at Mount Potts. He adds(5), "This is therefore good and, as I think, conclusive evidence that the Clent Hills and Malvern Hills plant-beds, notwithstanding they contain the remains of a plant closely allied to *Tæniopteris*, are nevertheless of great age, and, if we adopt

(1) McKay (1878[1]).
(2) Hector (1878[1]), p. iv, and McKay (1878[1]), p. 106.
(3) Ettingshausen (1887), p. 147.
(4) Arber (1913[1]).
(5) Haast (1877), p. 6.
(6) Hector (1877), p. v; Haast (1877), p. 6; and especially McCoy in Hector (1886[2]), p. xxi, footnote.

FIG. 2. THE PLANT-BEARING BEDS OF TANK GULLY, MOUNT POTTS.

[R. Speight, F.G.S., photo.

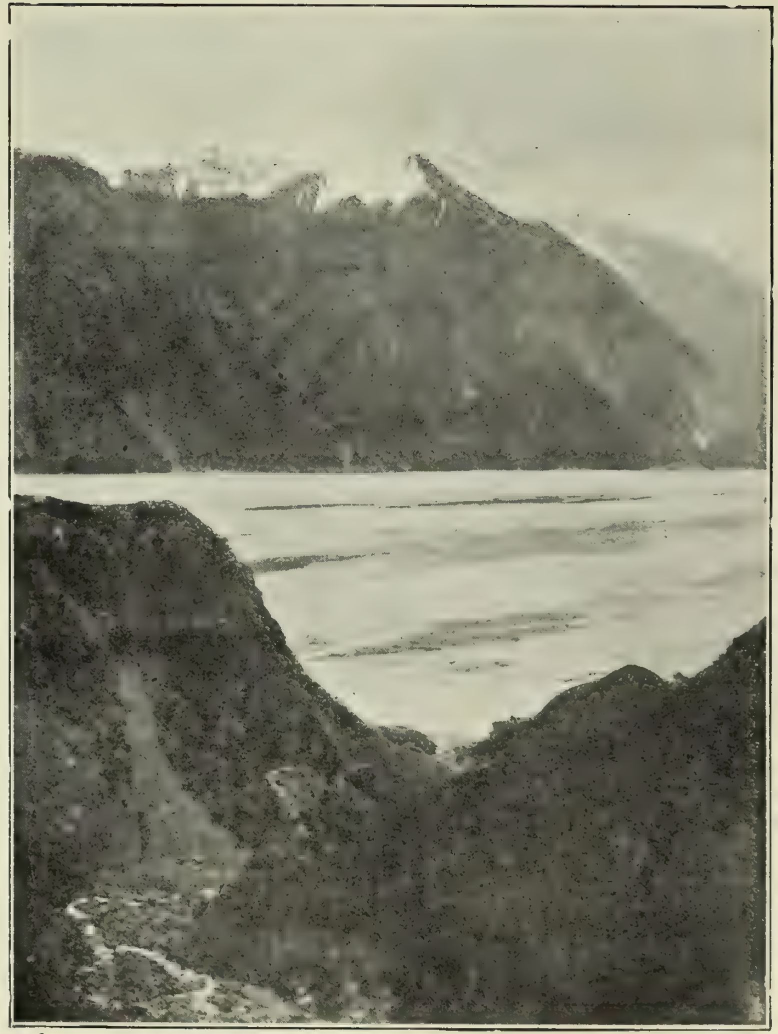

FIG. 3. TANK GULLY, MOUNT POTTS, LOOKING DOWN TO THE CLYDE RIVER.

[R. Speight, F.G.S., photo.

Professor McCoy's conclusions for the Mount Potts fossil shells, at least Carboniferous. Moreover, there is no doubt that they are of the same age as the formations which in New South Wales contain the fine coalfields."

Thus Haast clearly regarded the whole series as of Palæozoic age. This conclusion, published in 1877, began a controversy which lasted for several years, in which Hector was Haast's chief opponent. Hector(1), speaking of Haast's report, said, "I have to state that the *Pecopteris*, *Tæniopteris*, and *Camptopteris* [of the Clent Hills] mentioned by Dr. Haast are all quite different in appearance from the Australian species, but the same species have been obtained in the Waikara beds in Otago, which are certainly not Palæozoic, but of the same age as the Mataura Series. The negative evidence adduced cannot be considered of much value, and it is advisable to reserve opinions on the question of the relations which exist between these plant-beds of the Clent Hills and the Mount Potts Spirifer beds until more direct evidence can be obtained than we are at present in the possession of."

McKay's visit(2) to Mount Potts in 1878 resulted not only in the discovery of a fossil flora in the beds exposed in Tank Gully, but also in a new interpretation of the succession, which has in the main been confirmed by Park(3) more recently. McKay obtained the fossil plants from shales occurring 2,000 ft. below those containing the marine fauna(4). Hector(5) described the plants collected by McKay as "*Glossopteris augustifolia* and *Schizoneura* sp.," and stated that the beds at Mount Potts are "full of the leaves of the *Glossopteris*"(6). Hector's assertion that *Glossopteris* occurs at Mount Potts was repeated from time to time. In 1886 he gave a general review of the position of the controversy(7). In the same year he also stated that "at the base of the Kaihiku Series are the *Glossopteris* beds of Mount Potts; but these were not found in the Hokanui section, although from the thickness of the strata the relative beds must be included in it; while in the Kaihiku district *Glossopteris* occurs in the lower beds as developed in Popotunoa Gorge"(8).

It is unnecessary to follow the controversy(7) further here. The position may be summed up as follows: Haast regarded the marine fauna and plant-beds of Mount Potts as of the same age as the plant-bearing series in the Clent Hills, and that age as Carboniferous. Hector(9) asserted that the Mount Potts flora was either Carboniferous or Permian, but that the Clent Hill beds were Jurassic.

At one time in Europe it appeared probable that in Mount Potts we might have a similar succession to the lower part of the Permo-Carboniferous sequence of New South Wales, where marine horizons, containing Upper Carboniferous mollusca, alternate with estuarine beds containing *Glossopteris*. This would accord with McCoy's conclusions as to the fauna and Hector's view of the flora of Mount Potts. The obvious difficulty to this belief was the association of vertebrate bones, believed to be those of saurians, with this fauna, and this association naturally played a considerable part in the discussion in New Zealand.

I may perhaps anticipate the results of the present examination here to complete the story. There is little doubt that Haast, McCoy, and Hector were all three mistaken in their conclusions as to the age of these beds. The flora of Mount Potts proves

(1) Hector (1877), p. vi. For "Waikara" read "Waikawa." (See Table of Errata in publication cited.)
(2) McKay (1878[1]). See also Hector (1878[1]), p. iv; Hector (1878[2]), p. 533.
(3) Park (1904), p. 388.
(4) McKay (1878[1]), p. 106.
(5) Hector (1878[1]), p. iv.
(6) Hector (1878[2]), p. 533. The earliest reference to *Glossopteris* in New Zealand is by Hector in 1869, from the Hokanui Mountains—Hector (1869), p. iii.
(7) Hector (1886[2]).
(8) Hector (1886[1]), p. 77.
(9) Hector (1886[1]).

to be Rhæto-Liassic, and perhaps a little older than that of the Clent and Malvern Hills floras. Haast's main contention, however, that the two floras of Mount Potts and the Clent Hills were not separated by any great interval of time, is confirmed. But, so far, none of the plants from the Mount Potts beds have been described or figured. In 1887 the first specimens were submitted to an European palæobotanist, Ettingshausen(1). He recorded seven species from these beds, all new except the *Polypodium Hochstetteri* of Unger. None of the new types, however, were figured, much less described, and these names remain to this day discredited *nomina nuda*. Ettingshausen regarded the age of the beds as Triassic.

In 1912 I published two preliminary notes(2) having reference to this flora, in which I pointed out that the age of the flora was either Rhætic or Lower Jurassic, and that *Glossopteris* itself does not occur(3).

Conclusions as to the Age of the Beds.—The following is a list of the records from Mount Potts which are described here :—

EQUISETALES—
- *Phyllotheca minuta* sp. nov.

FERN-LIKE PLANTS
- *Linguifolium Lillieanum* Arber.
- *Chiropteris lacerata* Arber.
- *Dictyophyllum acutilobum* (Braun).
- *Cladophlebis australis* (Morr.).
- *Thinnfeldia lancifolia* (Morr.).
- *Tæniopteris Thomsoniana* sp. nov.

GINKGOALES—
- *Baiera robusta* sp. nov.

CONIFERALES—
- *Elatocladus conferta* (O. & M.).

Of the nine determinations from this locality, five are new species. Of the latter, the genus *Chiropteris* is, so far as we know, wholly Rhætic. *Phyllotheca*, in the Mesozoic rocks, is also much more abundant in the Triassic than in the Jurassic. *Linguifolium* has been previously recorded from both the Rhætic and Jurassic. *Tæniopteris Thomsoniana* and *Baiera robusta* are closely similar to Rhætic species.

As regards the other determinations, *Dictyophyllum acutilobum* and *Thinnfeldia lancifolia* are essentially Rhætic. *Cladophlebis australis* has a wide range, from the Rhætic to the Lower Cretaceous. *Elatocladus conferta* has been previously recorded only from Jurassic rocks.

Thus we see that the affinities of the Mount Potts flora strongly indicate a Rhætic rather than a Jurassic age. At the present time it is, however, impossible to distinguish between a Rhætic and Liassic flora. In this instance at least two essentially Jurassic types occur, and one must therefore admit the possibility of a Liassic age. At the same time I am, on the whole, inclined to regard the Mount Potts flora as essentially Rhætic, and base that opinion especially on the occurrence of *Chiropteris* and *Thinnfeldia lancifolia*. It certainly has very strong affinities to other floras usually termed Rhætic, and the occurrence of one or two types hitherto only known from the Jurassic is not of great moment in this connection, seeing that many plants are already known to be common to the two floras.

Age.—Rhætic.

(1) Ettingshausen (1887[1]), (1887[2]), (1878[3]), (1890).

(2) Arber (1913[1]), (1913[2]).

(3) See also pp. 1, and 20–22.

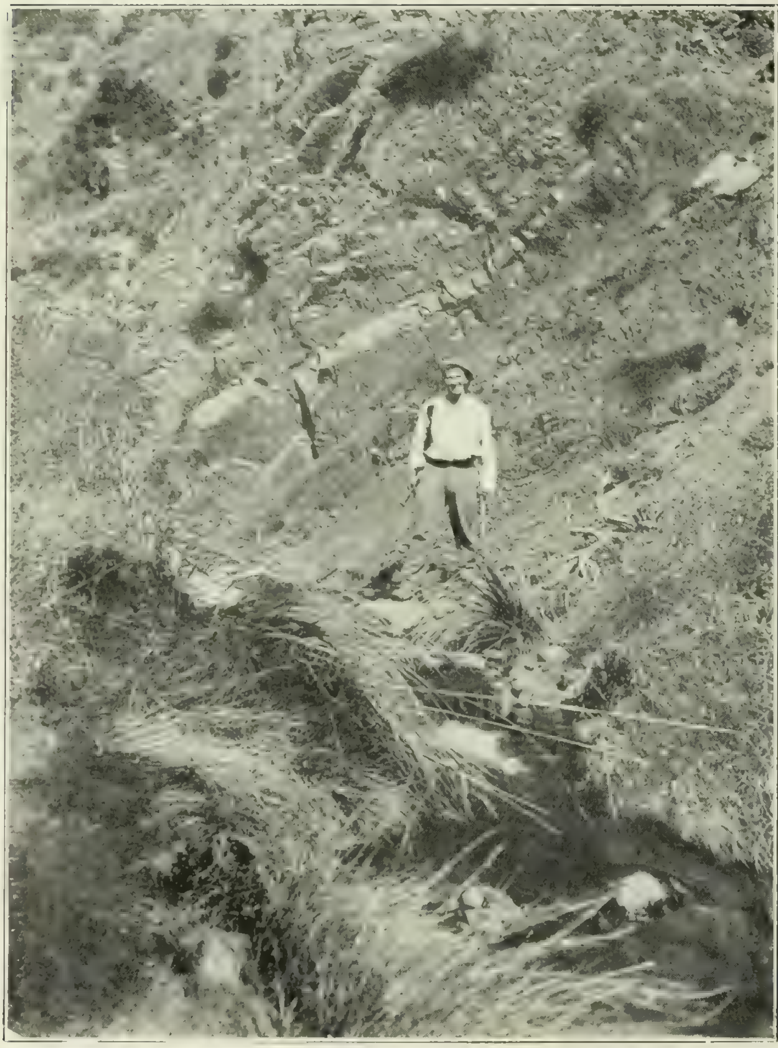

Fig. 4. The Plant-bearing Beds in the Clent Hills.

[*R. Speight, F.G.S., photo.*]

B. The Rhætic Flora of the Clent Hills (Canterbury).

Locality.—The Clent Hills lie some distance to the west of Christchurch (see map, fig. 1), but not so far to the west as Mount Potts. The beds occurring there have been described by Haast(1).

The Collections.—Fossil plants were first discovered in this locality by Haast(1), and his specimens are no doubt included in the large Survey collection from this locality. Another but smaller collection has been for many years in the British Museum (Natural History). The specimens, as a rule, however, are fragmentary, and but rarely clearly preserved.

Previous Records.—The only previous records(2) from the Clent Hills, other than mere *nomina nuda*, are eight specimens figured by Hector(3) in 1886. The first of these, *Asplenites rhomboides* Hect., is a small fragment of *Thinnfeldia* sp., perhaps *T. argentinica* (Gein.). The *Pecopteris acuta* and *P. linearis* of Hector are fragments of fronds of *Cladophlebis australis.* The *Vertebraria novæ-zealandiæ* Hect. is a wholly obscure fossil, presenting no similarity to any known species of *Vertebraria.* A small leaf-sheath of a *Phyllotheca* is, however, seen on the same specimen, and is also figured by Hector. The *Taxites maitai* of Hector is a small fragment of *Elatocladus conferta* (O. & M.). Further fragments of *Cladophlebis* are also figured under the names *Pecopteris ovata* Hect. and *Pecopteris obtusata* Hect. Hector's *Camptopteris incisa* is *Dictyophyllum acutilobum* (Braun).

Previous Opinions as to the Age of the Beds.—Haast's(4) conclusions on this point have been already quoted on pages 6–7.

Conclusions as to the Age of the Beds.—The following is a list of the determinations included here from the Clent Hills :—

Equisetales—

Phyllotheca minuta sp. nov.

Fern-like Plants—

Thinnfeldia odontopteroides (Morr.).

T. sp. cf. *T. argentinica* (Gein.).

Cladophlebis australis (Morr.).

Dictyophyllum acutilobum (Braun).

Tæniopteris Daintreei McCoy.

T. Thomsoniana sp. nov.

Coniferales—

Elatocladus conferta (O. & M.).

It is obvious that this flora is closely related to that of the Mount Potts beds, the records of which are enumerated on page 8. The species *Tæniopteris Daintreei* McCoy is an essentially Jurassic plant, which may, however, also occur in the Rhætic, while the doubtful attribution, *Thinnfeldia argentinica* (Gein.), is unknown from the Mount Potts beds(5). Otherwise all the Clent Hills fossils are identical with plants occurring at Mount Potts. At the Clent Hills, however, no trace of the genera *Linguifolium, Chiropteris,* or *Baiera* has been found. Nevertheless I conclude that the age of the beds, as at Mount Potts, is Rhætic, though the Clent Hills beds may be slightly younger in age than those of the former locality.

Age.—Rhætic.

(1) Haast (1872[2]), (1877).

(2) Haast (1877), p. 4, recorded *Pecopteris* (two or three species), *Camptopteris, Tæniopteris, Otopteris, Cyclopteris, Sphenopteris,* and other genera from this locality.

(3) Hector (1886[1]), pp. 65–66, figs. 30–30a. Also Arber (1913), p. 126.

(4) Haast (1877), p. 6.

(5) *Thinnfeldia odontopteroides* (Morr.) is also at present unknown from the Mount Potts beds.—[P. G. M.]

C. The Rhætic (?) Flora of the Hokonui Hills, Southland.

Localities.—Two plant-bearing localities occur in the Hokonui Hills(1) in Southland (see map, fig. 5) at McRae's Farm, Makarewa, and at Hedgehope respectively.

The Collections.—The specimens in the New Zealand Survey collection were obtained by Park in 1887(2).

Previous Records.—The Makarewa beds are described by Park(2) as consisting of sandstones and conglomerates, with one bed of shale. "The argillaceous shales (No. 5) contain thin seams of coal and numerous distinct fossil plants, of which a large number were collected, embracing *Pecopteris grandis*, Asplenites, Taxites, and two species of small *Tæniopteris*. The brown sandstones contain large indistinct plant-remains and fragments of silicified wood."

Conclusions as to the Age of the Beds.—The following are the records from the Hokonui Hills, Southland :—

Fern-like Plants—

Cladophlebis australis (Morr.).
Tæniopteris Daintreei McCoy.
Thinnfeldia lancifolia (Morr.).
Sphenopteris sp.

Coniferales—

Cryptomerites sp.

There is little doubt that this flora indicates either a Rhætic or an early Jurassic age, but unfortunately it is not nearly large enough to afford satisfactory evidence as to which of these two alternatives is the more correct. It may perhaps be termed, for the present, Rhætic (?).

Age.—Rhætic (?).

D. The Rhætic (?) Flora of Owaka Creek, Catlin's River, Otago.

Locality.—In Otago at Owaka Creek(3), a branch of the Catlin's River (see map, fig. 5), plants occur on several horizons, in a series of beds which have been described by McKay(4).

The Collections.—The specimens in the New Zealand Survey collection were chiefly obtained by McKay in 1873 at Old Mill, Owaka Creek. An earlier collection, formed by Hector in 1865, has also been examined.

Conclusions as to the Age of the Beds.—The following species are recorded here :—

Fern-like Plants—

Cladophlebis australis (Morr.).
Tæniopteris Daintreei McCoy.
Thinnfeldia lancifolia (Morr.).
Thinnfeldia odontopteroides (Morr.).
Thinnfeldia Feistmanteli ? (Goth.).
Sphenopteris owakaensis sp. nov.
S. otagoensis sp. nov.
Microphyllopteris sp.

Coniferales—

Brachyphyllum sp.

(1) This name is also spelt "Hokanui," as in map, fig. 5.
(2) Park (1887), pp. 145, 146.
(3) The name was formerly but incorrectly spelt "Owake."
(4) McKay (1877), pp. 59–73.

Here again the number of records, ignoring the new species, is very scanty, and the choice lies between Rhætic and Lower Jurassic. On the whole I am inclined to assign these beds provisionally to the earlier formation, on account of the abundance of the genus *Thinnfeldia*, but this conclusion may well require revision should a better collection be some day forthcoming.

Age.—Rhætic (?).

E. The Jurassic Flora of the Malvern Hills, Canterbury.

Locality.—The Malvern Hills lie some forty miles to the west of Christchurch, and contain the headwaters of the Selwyn and other rivers (see fig. 1). The sediments there developed were described by Hector(1) in 1871, and by Haast(2) in 1871 and 1872.

The Collections.—The specimens described here are in a collection specially made for this revision of the New Zealand Mesophytic floras by the kindness of Mr. R. Speight, F.G.S., who visited the Malvern Hills for this purpose. These were subsequently presented by Mr. Speight to the Sedgwick Museum, Cambridge. I have also, through Mr. Speight's good offices, had an opportunity of examining a collection from the same locality belonging to the Canterbury Museum, Christchurch.

Previous Records.—Haast(3) has recorded *Pecopteris* sp., *Tæniopteris* sp., and *Camptopteris* sp. from this locality.

Previous Opinions as to the Age of the Beds.—Haast in 1871 said the "lowest visible beds consist of conglomerates, coarse sandstones, and shales, with *Pecopteris*, *Tæniopteris*, and other remains of plants, which, according to Professor McCoy, are identical with those obtained in the coalfields of New South Wales, and are probably of Carboniferous age"(4). In 1872 Haast(5) also inclined to a Palæozoic attribution.

Conclusions as to the Age of the Beds.—The flora of the Malvern Hills is a small one, consisting of the following species:—

Fern-like Plants—

- *Linguifolium Lillieanum* Arber.
- *Cladophlebis australis* (Morr.).
- *C. denticulata* (Brongn.).
- *Tæniopteris Daintreei* McCoy.
- *Coniopteris hymenophylloides* (Brongn.).
- *Sphenopteris* sp.

Coniferales—

- *Elatocladus conferta* (O. & M.).

There is little doubt that the age is either Rhætic or Lower Jurassic. On the whole, I should be inclined to refer this flora to the latter period. Several of the above species, such as *Tæniopteris Daintreei* McCoy, the two species of *Cladophlebis*, and *Elatocladus conferta*, appear to occur both in Rhætic and Jurassic rocks in New Zealand. *Linguifolium* appears to be rare in the Malvern Hills beds. It only occurs abundantly in one other locality in New Zealand—Mount Potts—here referred to the Rhætic, though from Australia and Europe it is known in Jurassic sediments.

(1) Hector (1871).
(2) Haast (1871), p. 135; (1872[1]), p. 1.
(3) Haast (1871), p. 136; (1872[1]), pp. 6–7.
(4) Haast (1871), p. 136.
(5) Haast (1872[1]), p. 6.

In *Coniopteris hymenophylloides*, however, we have a thoroughly Jurassic type. There is also a general absence of many of the common plants met with in the Rhætic of Mount Potts and the Clent Hills. I am therefore inclined to place the Malvern Hills beds low down in the Jurassic, though, were a more extensive flora known from them, this conclusion might well require revision.

Age.—Lower Jurassic (?).

F. The Jurassic Flora of Mokoia, near Gore, Southland.

Locality.—The late Mr. J. S. Nicol's farm, Mokoia, lies four and a half miles south of Gore(1), on the left bank of the Mataura River, and about one and a quarter miles east of the river, between the towns of Gore and Mataura (see map, fig. 5).

The Collections.—About ten years ago the late Mr. J. S. Nicol began to collect such specimens as could be obtained from time to time when fresh exposures were made on the farm, and on his death in 1914 his executors presented his collection to the Sedgwick Museum, Cambridge. No plant-remains have previously been recorded from this locality. The geology of the neighbourhood of Gore and Mataura was described by McKay(2) in 1881.

Previous Opinion as to the Age of the Beds.—McKay(3) referred these beds to the Trias. Those on the east bank of the Mataura River opposite Gore he termed the Wairoa Series or Middle Trias, those on the same bank between Mataura and Gore the Otapiri Series or Upper Trias.

Conclusions as to the Age of the Beds.—The following is a list of the fossils here described from Mokoia Farm :—

Equisetales—
- *Equisetites Nicoli* sp. nov.

Fern-like Plants—
- *Dictyophyllum obtusilobum* ? (Braun).
- *Thinnfeldia* sp.
- *Coniopteris hymenophylloides* (Brongn.).
- *Sphenopteris (Ruffordia) Gœpperti* Dunk.
- *S. gorensis* sp. nov.
- *S. Currani* ? (Ten.-Woods).

Cycadophyta—
- *Nilssonia compta* ? (Phill.).
- Pinnule of a Cycadophyte.

Coniferales—
- *Elatocladus conferta* (O. & M.).
- *Stachyotaxus* ? sp.
- *Araucarites cutchensis* Feist.

I regard this flora as probably of Lower Jurassic age. *Coniopteris hymenophylloides* and *Nilssonia compta* are species abundant in the Lower Oolite (Middle Jurassic) of Britain. *Equisetites Nicoli* sp. nov. is closely similar to a species which also occurs on this horizon in Scotland. *Sphenopteris (Ruffordia) Gœpperti* ranges from the Jurassic to the Wealden, but has been recorded from the Middle Jurassic of Grahamland and England. The Jurassic affinity of the flora is thus clear. *Sphenopteris Currani* occurs on an unknown horizon of the Jurassic of Australia.

On the other hand, *Dictyophyllum obtusilobum* is only known from the Rhætic, and *Stachyotaxus* is apparently confined to this horizon, if we except certain doubtful

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(1) Though both Mokoia Farm and Gore, the nearest town, are in Southland County as now constituted, Mokoia Farm is in the old provincial district of Otago. The name Gore, as used throughout this memoir, almost invariably refers to Mokoia Farm. Southland now means the present county of that name, together with the adjoining county of Wallace, or part of it, rather than the old provincial district of Southland.—[P. G. M.]

(2) McKay (1881). (3) McKay (1881), p. 42.

forms from the Jurassic of Australia. *Elatocladus conferta* and *Araucarites cutchensis* appear to occur both in the Rhætic and Jurassic in New Zealand, but on the latter horizon only in India. The occurrence of these genera and species thus inclines me provisionally to regard the flora of the Gore beds as Lower, rather than Middle, Jurassic.

Age.—Lower Jurassic.

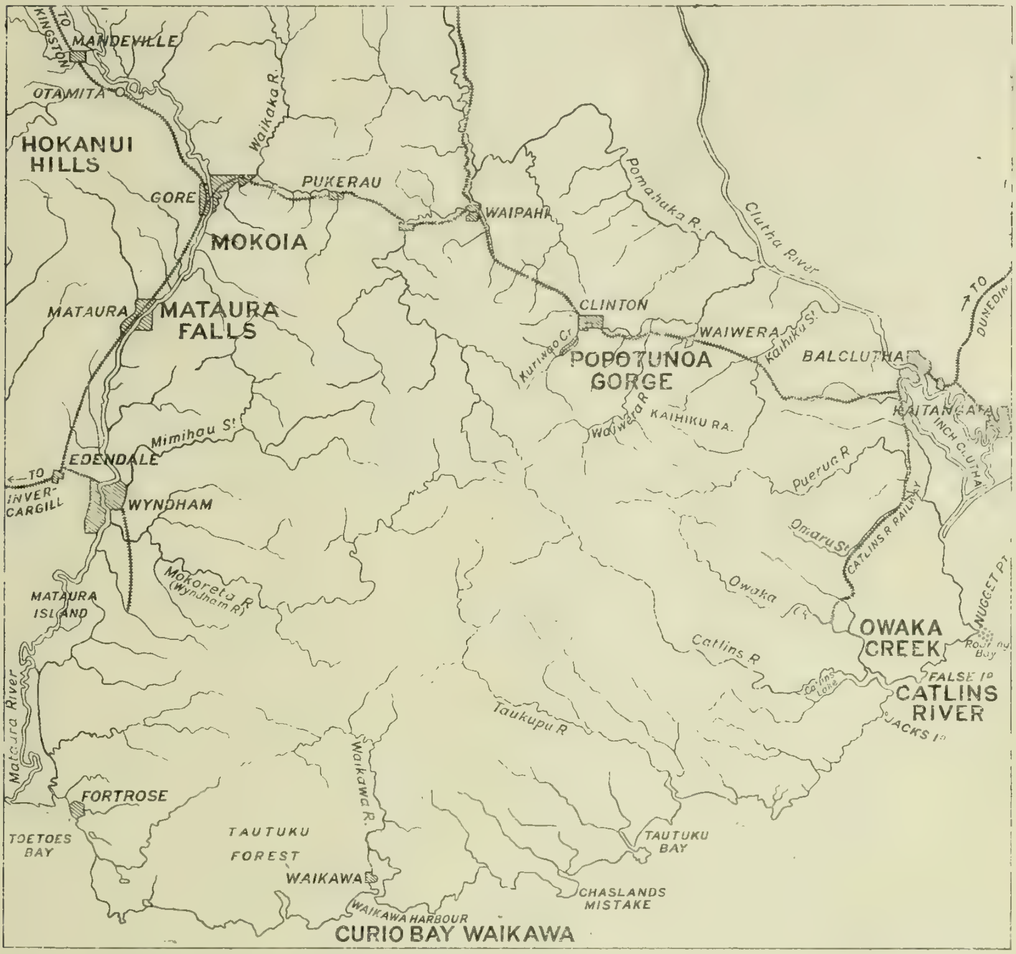

Fig. 5. Sketch-map of a Part of Southland and Otago, in South Island, showing the Fossil-plant Localities at Gore, Mataura Falls, Waikawa, Catlin's River, etc.

G. The Jurassic Flora of the Mataura Falls, Southland.

Locality.—The locality lies within the township of Mataura, on the important river of the same name, from the bed of which the specimens were collected. The Mataura plant-beds were described by McKay(1) in 1881, and by Park(2) in 1887. The best impressions come from the "tabular rocks between the main fall and the paper-mill on the eastern bank" of the Mataura. The beds consist of "alternations of a green, coarse-grained sandstone, and dark-coloured sandy beds of a more shaly character, the upper surface of these latter beds being often full of the rootlets of plants"(3).

The Collections.—The material described here belongs partly to the New Zealand Geological Survey collection and partly to a collection in the Geological Department

(1) McKay (1881).
(2) Park (1887).
(3) McKay (1881), p. 40.

of the British Museum (Natural History). The specimens appear to have all been collected either in 1863 by Buchanan, or by McKay in 1879. Mr. Lillie visited the locality in 1912, but was unable to obtain any further specimens.

Previous Records.—The occurrence of various species in this locality has been recorded by Hector, Ettingshausen, and Crié, as set forth in my previous note "On the Earlier Mesozoic Floras of New Zealand"(1). With one exception these lists consist entirely of *nomina nuda*, which need not detain us here. Full reference to these will be found in my previous paper. Hector(2), however, in 1886, figured six specimens from this locality (see also page 4), which were—

Hector's Names.		Names here adopted.
Macrotæniopteris lata O. & M. ..	=	*Tæniopteris crassinervis* (Feist.).
Lomarites pectenata Hect. ..	=	*Microphyllopteris pectinata* (Hect.).
Taxites manawao Hect. ..	=	*Pagiophyllum peregrinum* (L. & H.).
Pterophyllum matauriensis Hect.	=	*Ibid.*
Sphenopteris asplenoides Hect. ..	=	? (3).
Taxites kahikatea Hect. ..	=	?

Previous Opinion with regard to the Age of the Beds.—McKay(4) placed these beds in the Mataura Series of Upper Jurassic age.

Conclusions as to the Age of the Beds.—The fossil flora of Mataura Falls, though small, is a very interesting one. The following are the records described here :—

FERN-LIKE PLANTS—

Tæniopteris crassinervis (Feistm.).
Dictyophyllum acutilobum (Braun).
Microphyllopteris pectinata (Hect.).
Cladophlebis denticulata (Brongn.).
C. australis (Morr.).

CYCADOPHYTA—

Nilssonia elegans sp. nov.
Pterophyllum mataurìensis Hect.

CONIFERALES—

Pagiophyllum peregrinum (L. & H.).

There can be little doubt, I think, that this flora is thoroughly Jurassic, and that it belongs either to the lower or to the middle division of that system. *Tæniopteris crassinervis* (Feistm.) is a very characteristic plant in the Mataura Falls beds. In India it occurs in the Middle Jurassic of the Rajmahal Hills. *Microphyllopteris pectinata* is also allied to another species occurring in the same beds in India. *Cladophlebis denticulata* is abundant in the Middle Jurassic of England, but no doubt has a somewhat extensive vertical range. The two Cycadophytes appear to be new and somewhat isolated species, and do not help as to the horizon. On the other hand, in *Pagiophyllum peregrinum* we have a distinctly early Jurassic type, occurring in the Lias of Britain. *Dictyophyllum acutilobum* is another Rhætic and early Jurassic type. On the whole, the occurrence of these fossils leads me to favour a Lower rather than a Middle Jurassic horizon.

I should be inclined to regard the Mataura Falls beds as slightly younger than those at Mokoia, Gore, though both very probably belong to the same division of the Jurassic. The two floras are very different, and there are therefore few grounds for

(1) Arber (1913[2]).
(2) Hector (1886[1]).
(3) I have not seen any examples of this plant. The specific name, however, cannot stand, for it had already been applied to another plant by Sternberg in 1826.
(4) McKay (1881), p. 42.

comparison; but on the whole I should imagine that the Mokoia beds belong to the lowest part of the Lower Jurassic, and the Mataura Falls beds to the higher part of the same. This conclusion, however, may well be only a matter of personal opinion.

Age.—Lower Jurassic.

H. The Jurassic Flora of Waikawa, Southland.

Locality.—The fossil plants of Waikawa come from Curio Bay, some little distance along the coast to the west of the mouth of the River Waikawa, Southland(1) (see map, fig. 5). The geology of the district has been described by Park(2).

The beds of Curio Bay, Waikawa, are of particular interest as affording an example of a petrified forest of Jurassic age, in addition to furnishing many well-preserved impressions of the ordinary type. The petrified forest is exposed by the action of the sea on the shore-line, in the neighbourhood of high-water mark (see figs. 6, 7). The known examples of such fossil forests of Mesozoic age are extremely few, and this is perhaps the most remarkable of all of them.

The forest is thus described by Park(3) :—

" The sequence is as follows :—

" (1.) Coarse pebbly sandstone, in places passing into a conglomerate.

" (2.) Green sandstones, alternating with blue shaly clays with distinct plants.

" The most characteristic feature of the underlying beds (No. 2) is the large quantity of silicified timber which occurs in them. Many stumps ranging from 1 ft. to 6 ft. in height, and in some cases as much as 2 ft. in diameter at their base, are still standing in the places where they grew. On account of their more flinty and refractory nature they withstand the action of the sea much longer than the surrounding rocks; and it is not at all uncommon to see an erect trunk standing out in fine relief in the face of the steep sea-cliff, the massive root and smaller branching rootlets extending far into the underlying beds, and the trunk passing upward through various layers or beds of sandstones and shales. As already stated, the rocks here are lying almost flat, and at low water form wide shelving ledges, which are thickly strewn with the fallen or prostrate trunks and limbs of these silicified trees, many of which are over 50 ft. in length, while one was measured which exceeds 100 ft."

Mr. Lillie visited this petrified forest in November, 1912, and in a letter to me written a few weeks later he thus describes it :—

" At Curio Bay, Waikawa, there is a petrified Jurassic forest, showing the stumps of trees with their roots as they grew. The forest is undoubtedly *in situ*. The strata are very nearly horizontal, and the sea is exposing the bed which contains the forest, so that the rocky floor or strand of Curio Bay is the old forest-floor, with the stumps of trees standing up and the trunks of trees lying prostrate, just as if a Jurassic some one had been cutting timber! No trees, however, have been seen standing vertical and penetrating through several beds above, but both the fallen logs and the rooted stumps are contained within a single bed. The trunks vary from about 2 ft. in diameter to 1 in. or 2 in. Two hundred stems could easily be counted on the beach.

" Silicified wood has been obtained at intervals for some eight miles along the coast from Waikawa, and also inland near Waimahaka, so the area is a large one, and the forest is not confined to a few beds."

Figs. 6 and 7 show various parts of this fossil forest.

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(1) Waikawa, like Mokoia Farm, is in the present county of Southland, but in the old provincial district of Otago. See footnote (1) on page 12.—[P. G. M.]

(2) Park (1887).

(3) Park (1887), pp. 149–50.

From the structure of some fossil woods in the New Zealand Survey collection which are believed to have been derived from this locality it would appear that this fossil forest is composed chiefly of trees having the Araucarian type of structure. These woods are not described here, however, as the records of the locality from which they were obtained are uncertain. They appear, however, to be similar to *Araucarioxylon australe* Crié(1). There is also, I think, little or no doubt that the Osmundaceous stems described by Crié(2), and more recently by Kidston and Gwynne-Vaughan(3), which were recorded as having been obtained at Toitoi and at Gore were really derived from the neighbourhood of Curio Bay, Waikawa(4).

The Collections.—This locality is one of the richest in plant-remains known in New Zealand, so far as the Mesophytic floras are concerned. I have examined a large series of specimens, collected by Hector in 1878 and by Park in 1886, belonging to the New Zealand Geological Survey collection.

Previous Records.—With the exception of various *nomina nuda* mentioned by Hector(5) and others, the following are the only species hitherto figured from Waikawa. They were published by Hector(6) in 1886:—

Hector's Name.		Modern Name.
Taxites manawao Hect. ..	=	*Elatocladus tenuifolia* (McCoy).
Pecopteris grandis Hect. ..	=	*Cladophlebis australis* (Morr.).
Asplenites palæopteris Unger ..	=	*Coniopteris hymenophylloides* (Brongn.).

Park(7) says that *Macrotæniopteris lata*, and *Tæniopteris stipulata*, as well as *Pecopteris*, *Asplenites*, *Taxites*, *Lomarites*, and *Camptopteris* also occur.

In 1907 Kidston and Gwynne-Vaughan(3) described the petrified stems of *Osmundites Dunlopi* K. & G.-V. and *O. Gibbiana* K. & G.-V., which, as mentioned above, were no doubt derived from this locality.

Conclusions as to the Age of the Beds.—The following is a list of the records from Waikawa:—

Fern-like Plants—

Osmundites Dunlopi K. & G.-V.
O. Gibbiana K. & G.-V.
Cladophlebis australis (Morr.).
Coniopteris hymenophylloides (Brongn.).
Thinnfeldia Feistmanteli (Goth.).
Tæniopteris vittata Brongn.

Cycadophyta—

Cycadites sp.
Ptilophyllum acutifolium Morr.
P. sp.

Podozamiteæ—

Podozamites gracilis sp. nov.

Coniferales—

Elatocladus conferta (O. & M.).
E. sp.

There can be no doubt, I imagine, that this flora is of Jurassic age, but the question as to the division of the Jurassic to which it should be assigned is of a more

(1) Compare Crié (1889), p. 11, pl. 7, figs. 6, 7; pl. 8, figs. 1–4.
(2) Crié (1889), p. 11, pl. 7, figs. 1–5. (See Kidston and Gwynne-Vaughan (1916), p. 479.)
(3) Kidston and Gwynne-Vaughan (1907).
(4) Since this paper was completed I have received from Professor Sinnott a copy of his paper published in the Annals of Botany, 1914, which contains a discussion on specimens of *Osmundites* from Waikawa, and also from Kawhia, North Island.
(5) See Arber (1913[2]).
(6) Hector (1886[1]), fig. 30a, on p. 66.
(7) Park (1887), p. 150.

Fig. 6. The Fossil Forest of Waikawa, exposed on the Beach at Curio Bay, between Tidal Limits.

[*Dr. L. Cockayne, F.R.S., photo.*

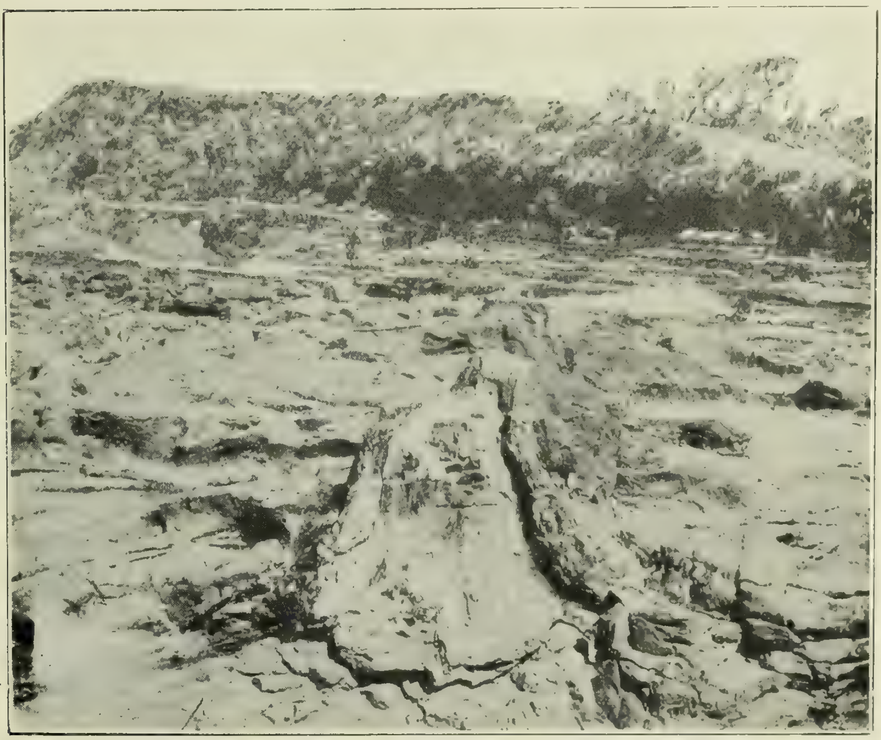

Fig. 7. The Fossil Forest of Waikawa, exposed on the Beach at Curio Bay.

[*Dr L. Cockayne, F.R.S., photo.*

difficult nature. On the whole, I am inclined to think that it is a Middle Jurassic flora. In *Tæniopteris vittata* we have a plant which, in Britain, is commonly associated with *Coniopteris hymenophylloides* in the Middle Jurassic of Yorkshire. *Podozamites* is also found in beds of similar age in various parts of the world. In the Middle Jurassic floras of India *Ptilophyllum acutifolium* and *Elatocladus conferta* both occur.

On the other hand, in *Thinnfeldia Feistmanteli* we have a fossil which probably, or perhaps certainly, occurs in beds elsewhere of somewhat older age than the Middle Jurassic. It is, however, not necessary to assume that it is restricted to the older horizons. It may have had a wide range in Jurassic time.

Our knowledge of Upper Jurassic floras is at present very limited, and it is difficult to say exactly how far that flora differed from that of the Middle Jurassic. On the whole, I have little doubt that, on the present evidence, the Waikawa flora is best regarded as of Middle Jurassic age.

Age.—Middle Jurassic.

I. The Neocomian Flora of Waikato Heads, Auckland.

Locality.—The Waikato Heads lie on the south side of the estuary of the River Waikato, in Auckland (see map, fig. 8). The plant-bearing beds here have been described by Cox(1).

The Collections.—I have seen only two small but very interesting collections from this locality. Most of the specimens in these were gathered by Hector in 1866(2). One of these collections belongs to the New Zealand Geological Survey; the other has been in the British Museum for many years past. Some plants, however, had been collected from this locality at an earlier date by members of the Novara Expedition, but I have not seen this collection.

Previous Records.—Unger(3) in 1864 figured a single specimen from this locality under the name *Polypodium Hochstetteri* sp. nov. This I regard as *Cladophlebis australis* (Morr.).

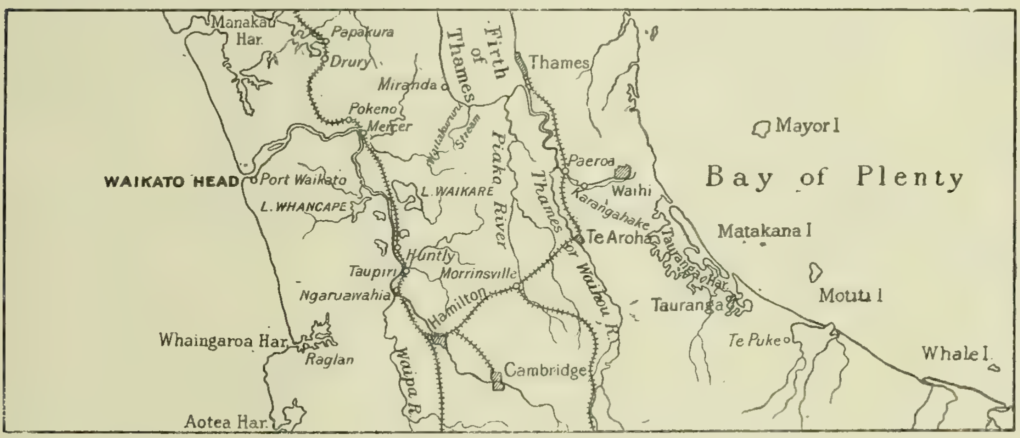

Fig. 8. Sketch-map of a Part of North Island, showing the Position of the Neocomian Plant-bearing Beds at Waikato Heads.

Previous Opinion as to the Age of the Beds.—A considerable number of formations are represented near the Waikato Heads(4). Unger(5) regarded the plant-beds as

(1) Cox (1877), p. 19.

(2) Cox (*ibid.* p. 19) stated in 1877 that he could find very few specimens, and did not think that he could add any fresh species to those already known.

(3) Unger (1864), p. 5, pl. ii, figs. 1, 2.

(4) Cox (1877), map opposite p. 16.

(5) Unger (1864), p. 5.

probably of Wealden age, and Lower Cretaceous animal-remains were also recorded by the Novara Expedition from the associated beds. On the other hand, Cox(1) apparently referred the plant-beds to the Jurassic, as part of the Mataura Series.

Conclusions as to the Age of the Beds.—The flora from Waikato Heads is a small one, consisting of the following species:—

FERN-LIKE PLANTS—
- *Tæniopteris arctica* Heer.
- *Cladophlebis australis* (Morr.).
- *C. Albertsi* ? (Dunk.).
- *C.* sp.
- *Microphyllopteris pectinata* (Hect.).
- Genus *Incertæ Sedis*—
  - *Nageiopsis longifolia* ? Font.

ANGIOSPERMÆ (DICOTYLEDONES)—
- *Artocarpidium Arberi* Laur.
- *Phyllites* sp.

There can be no doubt, I think, as to the Neocomian age of this flora. The presence of Angiospermous remains is in itself sufficient to show that these beds are younger than the Jurassic. On the other hand, the scarcity of the Angiospermous fossils and the prevalence of Mesophytic types indicate that in all probability the Waikato Heads flora is not more recent in age than the Lower Cretaceous.

This flora is particularly interesting as being perhaps one of the oldest, in a geological sense, of the known Neophytic floras. Angiosperms occur, but they are few and rare, and this group apparently was not dominant at this period in New Zealand. At any rate, at Waikato Heads it is the other types, all of which are Mesophytic, which are the dominant factors in the flora. Some of these, such as *Cladophlebis australis* and *Microphyllopteris pectinata*, occur also in the Jurassic of New Zealand. However, in the doubtful attributions to *Cladophlebis Albertsi* and *Nageiopsis longifolia*, we have fossils which are more characteristic of the Lower Cretaceous, and which are probably unknown from sediments of earlier age than the Wealden. *Tæniopteris arctica* is also a Cretaceous type. On the other hand, the absence of a large number of typically Wealden species, such as *Onychiopsis Mantelli*, which occurs in Europe and South Africa, is somewhat remarkable (see p. 25). I think, however, the presence of Angiospermous remains, in association with the Lower Cretaceous species above indicated, leaves no room for doubt that this scanty flora is of Lower Cretaceous age. It is to be particularly desired that further collections from this locality may be made before long, and that our knowledge of this very interesting early Cretaceous flora may be thereby extended.

Age.—Neocomian.

J. THE FOSSIL PLANTS OF WAIROA GORGE, WAIMEA COUNTY, NELSON.

Locality.—The beds of Wairoa Gorge, Waimea County, Nelson, were described by McKay(2) in 1878.

The Collection.—The New Zealand Geological Survey possesses a small collection from this locality, made by McKay.

Conclusions as to the Age of the Beds.—The specimens, with the single exception of the seed here figured under the name *Carpolithus McKayi*, are all too badly preserved for determination. Consequently nothing can be said as to the age of the beds, beyond the conclusion that they are no doubt Mesozoic.

Age.—Uncertain.

(1) See Cox (1877), pp. 13, 18.

(2) McKay (1878[3]), pp. 119, 150.

CHAPTER IV.

DISTRIBUTION OF SPECIES IN NEW ZEALAND, WITH REMARKS ON THE AGE OF THE FLORAS.

The following table shows the distribution in New Zealand of all the species here described :—

List of the Mesozoic Species here recorded from New Zealand.

Species.	Mount Potts.	Clent Hills.	Hokonui Hills or Catlin's River.	Malvern Hills.	Mokoia, near Gore.	Mataura.	Waikawa.	Waikato Heads.
Equisetales.								
1. *Equisetites Nicoli* sp. nov.	..	..	..	..	x	..	..	..
2. *Phyllotheca minuta* sp. nov.	x	x	..	..	..	..	..	.
Fern-like Plants.								
3. *Chiropteris lacerata* Arber	x	..	..	..	..	..	..	..
4. *Cladophlebis* cf. *C. Albertsi* (Dunk.) ..	..	..	..	..	..	..	..	x
5. *C. australis* (Morr.)..	x	x	x	x	..	x	x	x
6. *C. denticulata* (Brongn.)	..	..	..	x	..	x	..	..
7. *C.* sp.	..	..	..	..	..	..	..	x
8. *Coniopteris hymenophylloides* (Brongn.)	..	..	..	x	x	..	x	..
9. *Dictyophyllum acutilobum* (Braun) ..	x	x	..	..	..	x	..	..
10. *Dictyophyllum obtusilobum* (Braun) ..	..	..	..	..	?	..	..	..
11. *Linguifolium Lillieanum* Arber ..	x	..	..	x	..	..	..	..
12. *Microphyllopteris pectinata* (Hect.) ..	..	..	..	..	..	x	..	x
13. *M.* sp.	..	..	x	..	..	..	..	..
14. *Sphenopteris Currani* (T.-W.) ..	..	..	..	..	?	..	..	..
15. *Sphenopteris (Ruffordia) Gœpperti* Dunk.	..	..	..	..	x	..	..	..
16. *S. gorensis* sp. nov.	..	..	..	..	x	..	..	..
17. *S. otagoensis* sp. nov.	..	..	x	..	..	..	..	..
18. *S. owakaensis* sp. nov.	..	..	x	..	..	..	..	..
19. *S.* sp.	..	..	x	x	..	..	..	..
20. *Tæniopteris arctica* Heer	..	..	..	..	..	..	..	x
21. *T. crassinervis* (Feist.)	..	..	..	..	..	x	..	..
22. *T. Daintreei* McCoy	..	x	x	x	..	..	..	..
23. *T. Thomsoniana* sp. nov.	x	x	..	..	..	..	..	..
24. *T. vittata* Brongn.	..	..	..	..	..	..	x	..
25 *Thinnfeldia argentinica* (Gein.) ..	..	?	..	..	..	..	..	..
26. *T. Feistmanteli* (Goth.)	..	..	?	..	..	..	?	..
27. *T. lancifolia* (Morr.)	x	..	x	..	..	..	..	..
28 *T. odontopteroides* (Morr.)	..	x	x	..	..	..	..	..
29. *T.* sp.	..	..	..	..	x	..	..	..
Cycadophyta.								
30. *Cycadites* sp.	..	..	..	..	..	..	x	..
31. *Nilssonia compta* (Phill.)	..	..	..	..	?	..	..	..
32. *N. elegans* sp. nov.	..	..	..	..	..	x	..	..
33. *Pterophyllum matauriensis* Hect. ..	..	..	..	..	..	x	..	..
34. *Ptilophyllum acutifolium* Morr. ..	..	..	..	..	..	..	x	..
35. *P.* sp.	..	..	..	..	..	..	x	..

LIST OF THE MESOZOIC SPECIES HERE RECORDED FROM NEW ZEALAND—*continued.*

Species.	Mount Potts.	Clent Hills.	Hokonui Hills or Catlin's River.	Malvern Hills.	Mokoia, near Gore.	Mataura.	Waikawa.	Waikato Heads.
PODOZAMITEÆ.								
36. *Podozamites gracilis* sp. nov. ..	..	..	..	..	..	..	x	..
GINKGOALES.								
37. *Baiera robusta* sp. nov.	x	..	..	..	..	..	..	..
CONIFERALES.								
38. *Araucarites cutchensis* Feist. ..	?	..	..	..	x	..	..	..
39. *Brachyphyllum* sp.	..	..	x	..	..	..	..	..
40. *Cryptomerites* sp.	..	..	x	..	..	..	..	..
41. *Elatocladus conferta* (O. & M.) ..	x	x	..	x	x	..	x	..
42. *E.* sp.	..	..	..	..	..	..	x	..
43. *Nageiopsis longifolia* ? Font. ..	..	..	..	..	..	..	..	x
44. *Pagiophyllum peregrinum* (L. & H.) ..	..	..	..	..	..	x	..	..
45. *Stachyotaxus* sp.	..	..	..	..	x	..	..	..
ANGIOSPERMÆ (DICOTYLEDONES).								
46. *Artocarpidium Arberi* Laur. ..	..	..	..	..	..	..	..	x
47. *Phyllites* sp.	..	..	..	..	..	..	..	x
INCERTÆ SEDIS.								
48. *Carpolithus McKayi* sp. nov. ..	..	..	..	..	..	..	..	..
Obscure fructifications	..	..	..	..	..	..	..	x
Roots	..	..	..	..	..	x	..	..

It will be seen from the above list that the number of figured records here described from New Zealand exceeds forty-eight(1), including thirty-seven species, as compared with eleven species, which were alone recorded at the commencement of this investigation(2). Of these, at least fourteen species are new or described here for the first time, and do not appear to be known from other parts of the world—a somewhat high percentage. Two new genera, *Linguifolium* and *Microphyllopteris*, are here instituted, members of which have been previously recorded from other countries. The remaining genera are both widely distributed, and among the commonest types constituting the Mesophytic floras of all regions.

The present investigation of the earlier fossil floras of New Zealand has shown that there is, at the time of writing, no evidence of any terrestrial vegetation older than the Triasso-Rhætic. It is a remarkable fact that, despite assertions to the contrary, no trace of any Palæozoic floras has been found in these islands. Even in Permo-Carboniferous times, when the southern continent of Gondwanaland included a very large part of the Southern Hemisphere, New Zealand did not, on the known evidence, form any part of that continent, as might perhaps have been anticipated. In fact, there is no evidence to show either that New Zealand was connected with Australia or Antarctica in late Palæozoic times, or even that New Zealand then existed at all.

(1) In addition to three valid records previously described, of which no specimens are here recorded. The total number of established records of New Zealand Mesophytic plants is consequently now fifty-one species.

(2) Arber (1913²), p. 129, and page 4 of this memoir.

At present it appears that these islands did not rise above sea-level until Mesozoic times. It may be, of course, that *Glossopteris*-bearing rocks really occur in New Zealand, and that they have so far been overlooked. It is always somewhat dangerous to rely on negative evidence. On the other hand, wherever *Glossopteris*-bearing sediments occur in the Southern Hemisphere, they appear to form sheets of considerable thickness, very widely spread and not localized. The geology of New Zealand is now well known. A Geological Survey has existed in these islands for more than half a century, and it is thus very unlikely that any well-developed series of sediments with a wide distribution has been overlooked. Unless the extent and distribution of these beds is here quite exceptional, this possible source of error may be dismissed with confidence.

It is not contended that no beds of Permo-Carboniferous age occur in New Zealand. All that is asserted is that these beds, if they exist, have not yielded *Glossopteris* or any member of the *Glossopteris* flora. Personally, I should not be surprised to hear that these plants had been at length discovered in New Zealand in Palæozoic rocks, though I think it is now unlikely that such a discovery will be made. So far, however, as the present evidence is concerned, the point is that, while marine sediments of Permo-Carboniferous age may be expected to occur, there is no trace of any beds containing relics of the terrestrial flora of that period. If New Zealand did not exist as dry land at that time, marine sediments would naturally be laid down over the area, and these would be elevated at a later period when it became converted into dry land. These, however, may be very unfossiliferous. On the other hand, it seems impossible to suppose that estuarine, littoral, or fresh-water deposits occur, similar to those formed at the same period in Australia and elsewhere, but containing no traces of the terrestrial life of the period, whereas such relics are extraordinarily abundant in the corresponding rocks throughout Gondwanaland. I feel confident that if such rocks occur they will eventually yield *Glossopteris*, or some other characteristic member of that flora, and not prove to be entirely barren. However, as the matter stands at present, the history of New Zealand as a land area cannot be carried back beyond the early Mesozoic period.

In a recent paper by Professor Seward, some remarks will be found on my conclusion that there is no evidence that New Zealand ever formed part of Gondwanaland. This, on Seward's view, is " open to question." He is inclined to see in *Linguifolium* a plant, " if not generically identical with, at least very closely related to *Glossopteris*." He further adds, " there is, moreover, a very close resemblance between several New Zealand species and plants from the Rhætic floras of Tonkin, South Africa, and elsewhere, which contain representatives of *Glossopteris* or other members of the later floras of the Gondwana continent." At the same time he admits that the Mount Potts flora is " no doubt Upper Triassic or Rhætic "(1).

With the comparison between *Linguifolium* and *Glossopteris* I have dealt elsewhere (pp. 35–38), giving my reasons for rejecting this view. I merely wish to remark here that I use the term " Gondwanaland " in the usually accepted sense of the *Permo-Carboniferous* continent; and since neither Seward nor any one else has produced an *Upper Palæozoic flora* as yet from New Zealand, I conclude that New Zealand formed no part of that continent. I know of no application of the name " Gondwanaland " to a Mesozoic land area; in fact, the usefulness of this term would disappear entirely were it so used. The well-known fact that many of the genera of the *Glossopteris* flora survived in Mesozoic times, in many widely separated areas, is beside the point. Directly we reach the Mesozoic period we meet everywhere with a new flora; and whether it does or does not contain genera common to the *Glossopteris* flora, it

(1) Seward (1914), p. 39.

cannot by any stretch of terminology be termed a *Glossopteris* flora, nor can the region in which it flourished be termed Gondwanaland. *Phyllotheca*, for instance, which is an important Permo-Carboniferous genus in Gondwanaland, occurs in the Rhætic in New Zealand and elsewhere, and, on Professor Seward's own showing, as late as the Lower Cretaceous in South Africa. Yet these Mesozoic floras, in which *Phyllotheca* occurs, are not the *Glossopteris* flora, nor did they flourish on a Permo-Carboniferous continent, Gondwanaland.

On the other hand, in New Zealand we have a fairly complete series of Mesophytic floras, ranging from the Triasso-Rhætic to the Neocomian. In the provinces of Canterbury and Otago, Rhætic floras occur. Jurassic floras are met with in the provinces of Canterbury and, especially, Southland. A Neocomian flora occurs in Auckland, but no evidence of an undoubted Upper Jurassic flora has been met with so far.

Any one who is familiar with the large literature on the stratigraphical geology of New Zealand, is aware of the many contradictory and confused systems of primary classification, which have been proposed, at one time or another, for the sedimentary rocks of these islands, particularly by Hector and Hutton. Between 1878 and 1903 no less than four such schemes(1) were propounded for the Mesozoic rocks alone. Even in the most recent text-books(2) on the geology of New Zealand two quite different systems of classification of the sedimentary beds are proposed. Further, rocks which are no doubt Triasso-Rhætic in age have been called Silurian, Devonian, or even Archæan! Others of similar age have been erroneously referred to the Upper Palæozoic. Consequently, confusion worse confounded has resulted; and if this has been the case within New Zealand itself, it will be readily understood how difficult it has been in Europe to arrive at any satisfactory conclusions as to the geological age of the more important sediments of the Dominion. New Zealand, until quite recently, appears to have always lacked a competent palæontologist, trained in Europe. The palæontological side seems to have been as weak as specialism in physical geology has been strong, and consequently long-continued uncertainty has existed as to the real nature of the fossil evidence.

I do not propose to enter here into the controversies as to the age of the beds or their floras; such would serve no useful purpose. I hope, however, that the present contribution, which will no doubt prove to be only an initial step to the knowledge of the future, will do something to set at rest the doubts as to the age of the beds with which I am concerned here.

(1) Hector (1879[3]), (1880), (1881[2]); Cox (1878); Hutton (1885); Park (1904).

(2) *Cf.* Park (1910), p. 25; Marshall (1912), pp. 173, 208.

CHAPTER V.

A COMPARISON OF THE EARLIER MESOZOIC FLORAS OF NEW ZEALAND WITH THOSE OCCURRING ELSEWHERE.

I PASS now to a comparison of the earlier Mesozoic floras of New Zealand with those occurring in Mesozoic rocks in the Southern Hemisphere and elsewhere.

Commencing with the Rhætic floras of Mount Potts, the Clent Hills, and perhaps the Catlin's River, we have to deal with a vegetation which does not appear to be, as a whole, specifically identical with that of the same age occurring in Australia, South Africa, and in various localities in the Northern Hemisphere. The commonest plant in the Rhætic of New Zealand, as in the Jurassic and perhaps also the Lower Cretaceous, is that great weed of Mesozoic times, if I may so term it, *Cladophlebis australis* (Morr.). This species occurs in vast abundance in the Mesozoic rocks throughout the Southern Hemisphere, and seems, like the Bracken-fern of to-day, to have flourished in many widely separated areas with the greatest vigour and success. Next in frequency among the ferns we have several species of *Thinnfeldia* The genus is very abundant in the earlier Mesozoic rocks of Australia and Tasmania, and also occurs in beds of the same age elsewhere. In the possible occurrence of *Thinnfeldia argentinica* (Gein.) we have a South American Rhætic fossil.

Of the Coniferous remains, the widely spread species *Elatocladus conferta* (O. & M.) occurs abundantly in New Zealand in both the Rhætic and Jurassic. The distribution of this plant at the latter period extended from India to Antarctica(1). Of the rarer types, *Phyllotheca minuta* sp. nov. appears to be new, though the same genus occurred in Australia, South Africa, and even in Europe in Rhætic times. *Linguifolium* (which in New Zealand is both Rhætic and Lower Jurassic) is represented in the Mesozoic rocks of Australia, and *Chiropteris* in the Rhætic of South Africa and in Mesozoic beds in South America and Australia, but apparently in both cases by species distinct from those found in New Zealand. *Dictyophyllum acutilobum* (Braun) is widely spread in the Rhætic of Europe.

Representatives of the Ginkgoales appear to be rare in New Zealand. *Baiera robusta*, a new species, but very similar to certain Rhætic Baieras occurring in Europe, is the sole record of this group from New Zealand.

In *Tæniopteris Daintreei* we have a species more abundant in the Jurassic than the Rhætic.

The Mesophytic flora of New Zealand affords another illustration of the similarity of the Rhætic to the Lower Jurassic flora. Nearly all the genera and many of the species occurring in New Zealand are common to the two horizons. Some genera, among others *Microphyllopteris, Coniopteris, Osmundites*, and most of the representatives of the Cycadophyta and Coniferales, found in New Zealand appear to be unknown from the Rhætic.

The Jurassic flora includes *Equisetites Nicoli* sp. nov., closely allied to other species of the same genus, occurring in the Jurassic rocks of England, Scotland, and Siberia. *Cladophlebis denticulata* (Brongn.), as well as *C. australis* (Morr.), occurs. The former is also common in England and in other parts of the world, including Antarctica. *Linguifolium* occurs in the Jurassic as well as the Rhætic, and the same is true of *Dictyophyllum acutilobum* (Braun) and various species of *Thinnfeldia*. *Thinnfeldia Feistmanteli* (Goth.), however, appears to be a Jurassic rather than a Rhætic species. In *Tæniopteris crassinervis* (Feist.) and *T. vittata* Brongn. we have two thoroughly Jurassic

(1) Halle (1913[1]).

types, the former occurring in India and Australia, the latter in England and elsewhere in Europe. *Coniopteris hymenophylloides* Brongn., and *Nilssonia compta* (Phill.), are other widely distributed fossils in Jurassic sediments in various parts of the world. *Sphenopteris (Ruffordia) Gœpperti* Dunk. is more essentially a Wealden plant, though it is also known from Jurassic rocks in Europe and Antarctica.

Among the Cycadophytes, *Ptilophyllum acutifolium* occurs in the Jurassic of India and Antarctica. The genus *Podozamites*, of uncertain affinities, is represented by a new species in New Zealand.

Turning to the Coniferæ, we have *Elatocladus conferta* (O. & M.) and *Araucarites cutchensis* Feistm. occurring in Jurassic rocks in India and Grahamland. *Pagiophyllum peregrinum* (L. & H.) is a fossil first made known from the Lower Jurassic of Britain.

The Jurassic flora of New Zealand, as a whole, offers another illustration of the world-wide distribution of the plants of this period.

The following species here recorded from New Zealand are also British :

Cladophlebis denticulata (Brongn.).
Tæniopteris vittata Brongn.
Coniopteris hymenophylloides (Brongn.).
Sphenopteris (Ruffordia) Gœpperti Dunk.
Nilssonia compta (Phill.).
Pagiophyllum peregrinum (L. & H.).

Of extra-European Jurassic floras, the closest analogy is perhaps to that of the Upper Gondwanas of India, in which the following New Zealand plants also occur :—

Tæniopteris crassinervis (Feist.).
T. Daintreei McCoy.
T. vittata Brongn.
Ptilophyllum acutifolium Morr.
Elatocladus conferta (O. & M.).
Araucarites cutchensis Feist.

Among the floras of the Southern Hemisphere, the comparison with the Australian and Tasmanian Jurassic plants is more remote than might be anticipated, but this may be partly due to the fact that these southern floras are still very imperfectly known. The following species, however, are common to New Zealand and Australia :—

Cladophlebis australis (Morr.).
Thinnfeldia odontopteroides (Morr.).
T. lancifolia (Morr.).
T. Feistmanteli (Goth.).
Tæniopteris crassinervis (Feist.).
T. Daintreei McCoy.
Coniopteris hymenophylloides (Brongn.).
Sphenopteris Currani (T.-W.).
Elatocladus conferta (O. & M.).

No Jurassic plants are known from South Africa, and those recorded from South America are too few to form the basis of any comparison with the New Zealand flora.

The Jurassic flora of Grahamland(1), though as a whole specifically distinct from that of New Zealand, has, however, a certain number of types in common, particularly—

Cladophlebis denticulata (Brongn.).
Sphenopteris (Ruffordia) Gœpperti Dunk.
Coniopteris hymenophylloides (Brongn.).
Elatocladus conferta (O. & M.).
Araucarites cutchensis Feist.

(1) Halle (1913[1]).

The scanty flora of the Neocomian rocks of New Zealand naturally offers little material for comparison. Some of the plants appear to be similar to those found elsewhere in Jurassic rocks, such as *Cladophlebis australis* and *Microphyllopteris pectinata*, while others, such as *Cladophlebis Albertsi* (?), *Nageiopsis longifolia* (?) (both doubtful determinations), with *Tæniopteris arctica*, appear to be essentially Cretaceous plants occurring in England, America, and Spitzbergen respectively. The real interest in this flora lies in the comparative poverty of Angiosperms as compared with members of the truly Mesophytic genera. No doubt it is one of the earliest Angiospermous floras yet discovered.

The Neocomian flora of the Waikato Heads is also remarkable for the absence of many characteristic Wealden species, such as—

Onychiopsis Mantelli (Brongn.),
Weichselia Mantelli (Brongn.),
Otozamites Klipsteini (Dunk.),
Zamiophyllum Buchianum (Ett.),
Nilssonia Schaumburgensis (Dunk.),

some of which occur in the Uitenhage Series(1) of South Africa, a flora which, however, is somewhat unlike that occurring at Waikato Heads.

Among the broader conclusions we may, I think, hold that in Rhætic and probably also in Jurassic times New Zealand and Tasmania were united with Australia as one large connected land area. The floras of these now separated regions are nearly allied, but not identical, yet the similarity between them is probably sufficiently close to allow of this hypothesis. If this is the case the distribution of land in this quarter of the globe differed somewhat from that in Upper Palæozoic times, when, as we have seen, New Zealand formed no part of Gondwanaland.

As regards Antarctica, we have no evidence as yet of any Rhætic flora there, but in Jurassic times Grahamland may have been connected with New Zealand and also with Australia. It has been pointed out here that the floras of these three regions are similar, though as a whole perhaps specifically distinct. On the other hand, there does not appear to be similar evidence that South Africa was then united either to Antarctica or to Australia, for no trace of a land vegetation of Jurassic age is known from the former continent. Rhætic floras occur in South Africa, and are of a somewhat similar type to those of Australia. Thus the continental conditions of Permo-Carboniferous times may have been maintained as late as the Rhætic, but there is no evidence that in the direction of South Africa they were prolonged into the Jurassic period.

On the whole, so far as the present evidence leads us to any conclusions, the Mesozoic land-connections between Antarctica and the temperate regions of the Southern Hemisphere appear to have been chiefly in the direction of New Zealand and Australia. As regards South America the evidence at present is less certain. Wealden floras occur in Patagonia(2) and Peru(3), as in New Zealand and South Africa(4), but the plants so far recorded from these countries are somewhat dissimilar, and our knowledge of these floras is not sufficiently extensive to permit us to form any estimate as to how far these areas may or may not have been continuous or connected in Wealden times. From the Antarctic continent, so far as the Mesophytic floras are concerned, we have as yet no data relating to terrestrial plant-life, except in Jurassic times.

(1) Seward (1903, 1907).
(2) Halle (1913[2]).
(3) Zeiller (1914).
(4) So far as I am aware we have at present no clear evidence of a Neocomian flora from Australia.

CHAPTER VI.

SYSTEMATIC DESCRIPTIONS OF THE FOSSIL PLANTS.

Phylum EQUISETALES.

Genus EQUISETITES Sternberg, 1833.

(*Vers. Darstell. Flora Vorwelt,* Heft vii, p. 43.)

Equisetites Nicoli sp. nov. Plate III, fig. 2.

Diagnosis.—Stems fairly slender, 1 cm. or more across. Internodes smooth, 3 cm. or more in length. Leaves, between 15 and 20 in a whorl, united below for a short distance into a sheath closely clasping the stem, the upper portions free, very slender and acuminate, exceeding 2 cm. in length. Nodal diaphragms, 5–7 mm. in diameter.

Description of the Specimens.—Fragments of two leafless stems, both showing displaced nodal diaphragms, are figured, natural size, on Plate III, fig. 2. The more complete of these measures about 3·5 cm. in length and about 1 cm. in breadth. The nodal diaphragms have a diameter of 5–6 mm. The external surface of the stem appears to be smooth, or only faintly and discontinuously grooved. On the back of the same specimen other fragments of similar stems and of leaf-whorls occur, and in some cases parts of the leaf-sheath are probably in continuity with the stems.

Remarks.—The nodal discs of the New Zealand plant very closely resemble those of *Equisetites broraensis* Stopes(1), from the Jurassic of Scotland, an imperfectly known type, of which neither the stems nor the leaves have as yet been described. It would therefore be unwise for the present to refer the Gore specimen to the British species.

Equisetites Nicoli also approaches *E. lateralis* (Phil.), from the Lower Oolite of Yorkshire and Italy. They may even be identical, though at present I should be inclined to regard them as specifically distinct. There is still much mystery attaching to the Yorkshire species. Professor Seward(2) at one time regarded it as distinct from *Equisetites columnaris*, though latterly(3) he has united it with that species. I think it is quite certain that the New Zealand plant is not identical with *E. columnaris* (Brongn.). There are, however, several points of agreement with *E. lateralis.* The displaced nodal diaphragms, seen on Plate III, fig. 2, are similar to those of *E. lateralis*, though probably not identical. There are fewer "spokes in the wheel" in the New Zealand fossil.

The Rhætic *Equisetites Münsteri* Sternb., though showing some features in common, is far removed from the new Zealand fossil. The very fragmentary Australian specimen, termed by Tenison-Woods(4) *Equisetum rotiferum*, I regard as undeterminable specifically, but it shows displaced nodal diaphragms not unlike those of *Equisetites Nicoli.*

There has previously been some difference of opinion as to which genus—*Equisetites*, *Phyllotheca*, or even *Schizoneura*—such fossils should be referred to, but in this case there can be no doubt that the correct genus is *Equisetites.* In this genus the leaves are united at the base into a sheath, *closely appressed* to the stem, as in this fossil. In *Phyllotheca* there is also a basal sheath, but it is a loose, sac-like, spreading structure, not clasping the stem.

(1) Stopes (1907), p. 378, pl. xxvii, fig. 2.
(2) Seward (1898), vol. i, p. 275, text-figs. 63, 64.
(3) Seward (1900), vol. i, p. 56, text-figs. 3, 4.
(4) Tenison-Woods (1883), p. 66, pl. vi, figs. 5, 6.

The Jurassic plants of Siberia, described by Heer(1) as *Phyllotheca sibirica* Heer, are in my opinion members of the genus *Equisetites*, approaching somewhat closely the New Zealand fossils here under discussion. In both cases the free portions of the leaves are very elongate and acuminate, though the leaves as a whole do not appear to be precisely similar in form, and therefore the two plants are probably specifically distinct.

Type.—Sedgwick Museum, Cambridge.

Occurrence.—Mokoia, Gore, Southland (? Lower Jurassic).

Genus PHYLLOTHECA Brongniart, 1828.

(*Prodr. Hist. Veget. Foss.*, pp. 151, 175.)

Phyllotheca minuta sp. nov. Plate II, figs. 5, 9.

Diagnosis.—Detached whorls of leaves, cup-like in form. Leaves fleshy below, only united at the base, about 10 in a whorl, bases broad, leaves exceeding 5 mm. in length, lanceolate, tapering towards the apex, uninerved.

Descriptions of the Specimens.—In the New Zealand Survey collection from the Clent Hills a few detached leaf-sheaths occur, two of which are seen in Plate II, figs. 5 and 9, both natural size. That shown by fig. 9 was originally figured, but not described, by Hector(2). The sheath is here seen from below. The free portions of the leaves are shortly lanceolate, and about 3 mm. in length. There appear to be from seven to eight thick fleshy leaves in the whorl. A similar sheath, in which the leaves are less perfect, is shown on fig. 5 of the same plate.

Remarks.—There is little doubt, I think, that these specimens represent the foliage of a *Phyllotheca*, which, in the size of the sheaths and other characters, is unlike any species of that genus known to me. I therefore regard it as a new type, which I term *P. minuta* sp. nov. It occurs in the collections both from Mount Potts and the Clent Hills. In the former locality a variety of leafless stems, probably pith-casts of more than one type, have been found, and these also probably belong to the same genus.

Types in the New Zealand Geological Survey collection.

Occurrence.—Mount Potts (Rhætic); Clent Hills (Rhætic).

FERN-LIKE PLANTS.

Genus CHIROPTERIS Bronn, 1858(3).

(*Jahrb. für Mineral.*, Jahr. 1858, p. 143.)

Chiropteris lacerata Arber. Plate III, fig. 8.

1913. *Chiropteris lacerata* Arber, *Proc. Roy. Soc. London,* Ser. B, vol. lxxxvi, p. 346, pl. 8, fig. 6.

Diagnosis.—Leaf cuneate, exceeding 5 cm. in length and 3 cm. in breadth; apex deeply toothed, teeth fairly broad; veins fine, close, frequently anastomosing.

Description of the Specimen.—This plant appears to be rare at Mount Potts. The type specimen, which is itself imperfect, is seen enlarged on Plate III, fig. 8. It is nearly 6 cm. long. It is not quite certain that the termination of this leaf is the true apex, neither is it beyond doubt that the apparent teeth were a natural feature—they may be due to the imperfect preservation of the apical region; but, so far as one can judge from a single specimen, I think it more likely that the apex of the leaf was in nature deeply incised.

(1) Heer (1876^{2}), p. 43, pl. iv, figs. 1–7; see also (1878), p. 4, pl. i, figs. 9–15; (1880), p. 9, pl. i, figs. 5, 6.

(2) Hector (1886^{1}), p. 65, fig. 30 (4) pars.

(3) Kurr, MS. name.

Remarks.—The genus *Chiropteris* is a somewhat rare type, only known at present from Rhætic rocks in various parts of the world. *C. digitata* Bronn(1), a much larger leaf, occurs in Europe, *C. cuneata* Carr.(2) in Australia and South Africa(3), *C. copiapensis* Solms(4) in South America, and *C. Zeilleri* Seward(5) in South Africa.

The specimen from South Australia described under the name *Anthrophyopsis* (?) sp. by Etheridge(6) in 1895 is also a member of this genus, and may be distinguished as *Chiropteris Etheridgei* sp. nov.

Type in the British Museum (Natural History).

Occurrence.—Mount Potts (Rhætic).

Genus CLADOPHLEBIS Brongniart, 1849.

(*Tabl. Genr. Veget. Foss.*, p. 25).

1. Cladophlebis *cf.* C. Albertsi (Dunker). Plate IV, figs. 2, 3.

1846. *Neuropteris Albertsii* Dunker, *Monogr. Norddeutsch. Wealdenbild.*, p. 8, pl. vii, figs. 6, 6*a*.
1870. *Pecopteris Whitbiensis* Trautschold, *Nouv. Mém. Soc. Nat. Moscou*, vol. xiii, (3) p. 215, pl. xix, fig. 2.
1871. *Alethopteris Albertsii* Schenk, *Palæontogr.*, vol. xix, p. 218, pl. xxvii, fig. 4.
1882. *Pteris? Albertsi* Heer, Foss. Flora Grönlands (*Flor. Foss. Arctica*, Bd. vi, Abth. ii), p. 29, pl. xvi, figs. 5, 6; pl. xxviii, figs. 1–3; pl. xlvi, figs. 22–24.
1888. *Pteris Albertini* Velenovsky, *Abhandl. k. böhm. Gesell. Wissen. (Math.-Nat. Cl.)*, Ser. 7, Bd. ii, No. 8, p. 15, pl. iv, figs. 6–8.
1889. *Cladophlebis inclinata* Fontaine, *Monogr. U.S. Geol. Surv.*, *xv*, p. 76, pl. x, figs. 3, 4; pl. xx, fig. 8.
1889. *Cladophlebis denticulata* Fontaine, *ibid.*, p. 71, pl. iv, fig. 2; pl. vii, fig. 7.
1889. *? Cladophlebis pachyphylla* Fontaine, *ibid.*, p. 80, pl. xxv, fig. 9.
1889. *? Aspidium angustipinnatum* Fontaine, *ibid.*, p. 98, pl. xvi, figs. 1, 3, 8; pl. xvii, figs. 1, 1*a*; pl. xix, fig. 10.
1894. *Cladophlebis Albertsii* Seward, *Wealden Flora*, pt. i, p. 91, pl. viii.
1905. *? Dryopteris angustipinnata* Ward, *Monogr. xlviii, U.S. Geol. Surv.*, p. 540 &c., pl. cxiv, fig. 6.
1911. *Cladophlebis Albertsii* Berry, *Maryland Geol. Surv. Lower Cretac.*, p. 252, pl. xxxii, figs. 3, 4.

Diagnosis.—The following diagnosis was given by Seward in 1894 (see above): "Frond bipinnate, rachis flat and broad, pinnæ linear-lanceolate, alternate to opposite, pinnules falcate, contiguous, attached by the whole of the broad base, acuminate, margin entire or slightly dentate towards the apex."

Description of the Specimens.—Two examples of fronds from Waikato Heads, with small, triangular, somewhat falcate pinnules, are shown in Plate IV, figs. 2 and 3, natural size. In the larger, fig. 2, several pinnæ are seen attached to a slender axis. These vary from 1 cm. to 4 cm. in length, and the pinnules are about 7 mm. long. The nervation is obscure, but appears to be of the *Cladophlebis* type.

Remarks.—It may be doubted whether these specimens are sufficiently perfect to allow of specific determination. They appear to lie nearest to *Cladophlebis Albertsi* (Dunk.), to which perhaps they may be doubtfully referred.

Occurrence.—Waikato Heads, Auckland (Neocomian).

(1) Bronn (1858), p. 143, pl. xii, Schenk (1864), p. 86, pl. ii, fig. 4; Schimper (1869), vol. i, p. 643, pl. xliii; Schoenlein and Schenk (1865), p. 16, pl. xi, fig. 1*a*, 1*b*; Nathorst (1878[2]), p. 86, pl. xx, fig. 1.

(2) Carruthers (1872), p. 355, pl. xxvii, fig. 5.

(3) Seward (1903), p. 62, pl. ix, fig. 4.

(4) Solms (1899), p. 602, pl. xiii, figs. 1–4.

(5) Seward (1903), p. 63, text-fig. 7.

(6) Etheridge (1895), p. 141, pl. iv, figs. 2.

2. Cladophlebis australis (Morris). Plate IV, figs. 1, 5, ? 7, 8; Plate XIV.

1845. *Pecopteris australis* Morris, in Strzelecki, *Phys. Descr. N.S. Wales*, p. 248, pl. vii, figs. 1 2.
1863. *Pecopteris (Alethopteris) indica* Oldham and Morris, *Foss. Flora Gondw. Syst. (Pal. Indica)*, vol. i, pt. 1, p. 47, pl. xxvii.
1863. *Pecopteris (Asplenites) macrocarpa* Oldham and Morris, *ibid.*, p. 51, pl. xxviii, figs. 2, 3, 3*a*; pl. xxxvi, figs. 5–7.
1864. *Polypodium Hochstetteri* Unger, *Novara-Exped., Geol. Theil*, vol. i, pt. ii, Palæont., p. 5, pl. ii, figs. 1, 2.
1869. *Alethopteris australis* Schimper, *Traité Pal. Végét.*, vol. i, p. 569.
1875. *Pecopteris australis* McCoy, *Prodr. Pal. Victoria*, Dec. 2, p. 16, pl. xiv, fig. 3.
1877. *Alethopteris indica* Feistmantel, *Foss. Flora Gondw. Syst.*, vol. i, pt. ii, pp. 37–89; pl. xxxvi, figs. 4, 4*a*; pl. xlvi, figs. 3, 4.
1877. *Asplenites macrocarpus* Feistmantel, *ibid.*, pp. 39–91, pl. xxxvi, figs. 5–7; pl. xxxvii, figs. 3, 4; pl. xlviii, fig. 2.
1877. *Pecopteris (Asplenites) macrocarpa* Feistmantel, *ibid.*, vol. i, pt. iii, pp. 9–171, pl. i, figs. 1, 2.
1877. *Alethopteris (Cladophlebis) indica* Feistmantel, *ibid.*, vol. i, pt. iii, pp. 7–169, pl. i, figs. 3–5.
1878. *Alethopteris australis* Feistmantel, *Palæontogr.*, Suppl. 3, Lief. 3, p. 109, pl. xiv; figs. 1, 1*a*.
1883. *Alethopteris australis* Tenison-Woods, *Proc. Linn. Soc. N.S. Wales*, vol. viii, p. 111.
1883. *Alethopteris concinna* Tenison-Woods, *ibid.*, p. 112, pl. ix; fig. 1.
1883. *Todea australis* Renault, *Cour. Bot. Foss.*, vol. iii, p. 81, pl. xi.
1885. *Alethopteris australis* Curran, *Proc. Linn. Soc. N.S. Wales*, vol. ix, p. 251.
1886. *Pecopteris acuta* Hector, *Det. Cat. & Guide, N. Zeal. Court, Ind. & Col. Exhib.*, p. 65, fig. 30(2).
1886. *Pecopteris linearis* Hector, *ibid.*, p. 65, fig. 30(3).
1886. *Pecopteris ovata* Hector, *ibid.*, p. 65, fig. 30(6)
1886. *Pecopteris obtusata* Hector, *ibid.*, p. 66, fig. 30*a*(1).
1886. *Pecopteris grandis* Hector, *ibid.*, p. 66, fig. 30*a*(3).
1886. *Alethopteris australis* Johnston, *Geol. Tasmania*, pl. xxv, p. 153, figs. 5, 6, 8.
1888. *? Alethopteris serratifolia* Johnston, *ibid.*, pl. xxiii, fig. 1.
1890 *Alethopteris australis* Feistmantel, *Mem. Geol. Surv. N.S. Wales*, Pal. No. 3, p. 109, pl. xxvii, figs. 3, 3*a*.
1892 *Alethopteris australis* Etheridge, in Jack and Etheridge, *Geol. and Pal. Queensland*, p. 370, pl. 16, fig. 1.
1900. *Alethopteris australis* McCoy, in Stirling, *Rep. Victorian Coalfields No. 7*, p. 3, pl. ii, figs. 3, 3*a*.
1902. *Todea australis* Shirley, *Bull. 18, Geol. Surv. Queensland*, p. 10.
1904. *Cladophlebis denticulata* var. *australis*, Seward, *Rec. Geol. Surv. Victoria*, vol. i, pt. iii, p. 171 pl. xvi, figs. 25–27.

Diagnosis.—Frond bipinnate. Pinnæ oblique. Pinnules very variable in size and shape, lanceolate, straight or falcate; margin entire, not toothed; pinnules attached by the whole base to the rachis; apex acute or obtuse. Midrib well defined; lateral nerves of the characteristic *Cladophlebis* tuning-fork type, once dichotomized, or one or both branches of the primary dichotomy forking a second time. Fertile pinnæ similar to the sterile in form. Sori (?) oblique, linear, parallel to the lateral nerves.

Description of the Specimens.—On Plate XIV two pinnæ of this plant are seen, in which the pinnules and their nervation are particularly clear. A still more complete pinna is figured on Plate IV, fig. 1. The apical portion of a pinna seen on Plate IV, fig. 8, also probably belongs to this species. The above specimens are all from the Neocomian rocks of Waikato Heads, Auckland, and they appear to be indistinguishable from other examples from the Rhætic and Jurassic formations of New Zealand, such as that from the (?) Rhætic of Owaka Creek, Catlin's River, Otago, shown on fig. 5 of the same plate.

Remarks.—As is well known, this species, which in the Southern Hemisphere has a very wide vertical range, is an exceedingly difficult fossil to deal with, on account of the stereotyped nature of the frond. Were the fertile fronds known, one would expect to find that the sterile foliage of several different plants has been commonly included under the term *Cladophlebis australis* (Morr.). Yet, in dealing with the sterile foliage it appears to be quite impossible at present to recognize more than one type by any definite characters, apart from mere size. This type, *Cladophlebis australis*, is just as stereotyped as the coal-measure *Stigmaria ficoides* Sternb. The pinnules may be small or relatively large, narrow in proportion to their length, or comparatively broad, falcate or almost straight, pointed or obtuse. The nerves may fork twice, as in the type specimen, or only once; or in some pinnules one fork of the primary dichotomy of the lateral nerve may remain simple, while the other divides again. There is also every type of transition between the forms of lateral nervation above indicated. It seems to be quite impossible to recognize species founded simply on such variations. Further, as regards size, larger and smaller, longer and shorter pinnules may be expected to, and no doubt did, occur in different parts of the same leaf. Thus *Cladophlebis australis* is a very unsatisfactory, though at the same time an important and characteristic, fossil.

Further, *C. australis* appears to differ only from the British and European type, *C. denticulata* (Brongn.), in the absence of the denticulate margins characteristic of the latter species. It may well be doubted whether this character alone is of sufficient importance to warrant specific separation, especially as both species occur in the Mesophytic floras of the Southern Hemisphere, though the former is there more abundant than the latter. Professor Seward(1) has, in fact, regarded *C. australis* as a mere variety of *C. denticulata*. I am inclined, however, to keep the two species separate, at least provisionally. In cases where variations of any sort are so rare it would seem advisable to attribute some importance to a perfectly definite character, such as the presence or absence of a denticulate margin. But I am still more impressed by the fact that among the southern fossils which I have examined *C. australis* is everywhere by far the dominant type, *C. denticulata*, although occurring, being very much rarer. It therefore does not seem that the two fronds were obviously borne by the same plant. I am thus in agreement with the conclusions recently arrived at by Halle(2) in regard to the Grahamland fossils.

The specimens of *C. australis* previously figured by Hector (see synonymy) are for the most part fragments of apical portions of what were probably young fronds. They differ only in size from the larger leaves, and it appears to me to be quite impossible to separate them from *C. australis*. If once varieties are freely distinguished, then every other frond must be constituted a variety, based on very slight characters, chiefly as regards size.

The Neocomian examples, figured on Plate IV, fig. 1, and Plate XIV, have comparatively long and fairly distant pinnules. They appear to me to be, however, indistinguishable from *C. australis*. Professor Seward(3) has figured a specimen from the Uitenhage beds of Cape Colony, under the name *Cladophlebis denticulata* (Brongn.) forma *Atherstonei*, in which the pinnules are even longer, but more closely set. Similarly, from the Cretaceous of Greenland, Heer(4) has figured long-pinnuled forms under the names *Pteris longipennis* Heer and *Pteris frigida* Heer, which, except in the denticulate margin, appear to me to be identical with the specimens from Waikato

(1) Seward (1904), p. 171.
(2) Halle (1913[1]), p. 13.
(3) Seward (1903), p. 14, pl. vi, figs. 16, 17.
(4) Heer (1882), pp. 25, 28, pl. vi, fig. 5*b*; pl. x, figs. 1–13; pl. xi; pl. xii, fig. 2; pl. xiii, figs. 1, 2; pl. xvi, figs. 1, 2; pl. xviii, fig. 10*b*.

Heads, New Zealand, which are figured here. Halle(1) has also figured recently, from the Cretaceous of Patagonia, similar pinnæ as *Cladophlebis australis*. A very similar if not identical fossil occurs also in the Cretaceous of the Canadian Rocky Mountains(2).

Cladophlebis australis is almost everywhere in the Mesophytic floras of New Zealand the most abundant of all species, without exception.

Occurrence.—Mount Potts (Rhætic); Clent Hills (Rhætic); McRae's, Makarewa, Hokonui Hills (? Rhætic), Hedgehope, Hokonui Hills (? Rhætic); Owaka Creek, Catlin's River (? Rhætic); Malvern Hills (? Lower Jurassic); Mataura Falls (Lower Jurassic); Curio Bay, Waikawa (Middle Jurassic); Waikato Heads, Auckland (Neocomian).

3. Cladophlebis denticulata (Brongniart). Plate IV, fig. 6.

1828. *Pecopteris denticulata* Brongniart, *Prodr. Hist. Végét. Foss.*, p. 57.
1833–34. *Pecopteris denticulata* Brongniart, *Hist. Végét. Foss.*, p. 301, pl. xcviii, figs. 1, 2.
1833–34. *Pecopteris Phillipsii* Brongniart, *ibid.*, p. 304, pl. cix, fig. 1.
1833. *Neuropteris ligata* Lindley and Hutton, *Foss. Flora*, vol. i, pl. lxix.
1834. *Pecopteris undans* Lindley and Hutton, *ibid.*, vol. ii, pl. cxx.
1834. *Pecopteris insignis* Lindley and Hutton, *ibid.*, vol. ii, pl. cvi
1834. *Pecopteris whitbiensis* Lindley and Hutton, *ibid.*, vol ii, pl. cxxxiv.
1865. *Alethopteris insignis* Eichwald, *Leth. Ross.*, *Péd. Moy.*, p. 15, pl. ii, fig. 6.
1869. *Alethopteris denticulata* Schimper *Traité Pal. Végét.*, vol. i, p. 563.
1869. *Alethopteris insignis* Schimper, *ibid.*, p. 565.
1869. *Alethopteris Phillipsi* Schimper, *ibid.*, p. 564.
1875. *Pecopteris denticulata* Phillips, *Illustr. Geol. Yorks.*, 3rd ed., p. 206, lign. 18.
1875. *Pecopteris Phillipsii* Phillips, *ibid.*, p. 207, lign. 19.
1875. *Pecopteris insignis* Phillips, *ibid.*, p. 206, lign. 17.
1875. *Phlebopteris undans* Phillips, *ibid.*, p. 203, lign. 12.
1878. *Asplenium petruschinense* Heer, *Flor. Foss. Arctica*, vol. v, mem. ii, p. 3, pl. i, fig. 1.
1882. *Pteris frigida* Heer, *Flor. Foss. Arctica*, vol. vi, mem. ii, p. 25, pl. x, figs. 1–4; pl. xi; pl. xii, fig. 2; pl. xiii, fig. 2; pl. xvi, figs. 1, 2.
1882. *Pteris longipennis* Heer, *ibid.*, vol. vi, mem. ii, p. 28, pl. x, figs. 11, 12; pl. xiii, fig. 1.
1889. *Cladophlebis denticulata* Fontaine, *Monogr. xv, U.S. Geol. Surv.*, p. 71, pl. iv, fig. 2; pl. vii, fig. 7.
1896. Cf. *Cladophlebis Roesserti, groenlandica* Hartz, *Meddel. Grönl.*, vol. xix, p. 228, pls. vii–x.
1896. *Cladophlebis Stewartiana* Hartz, *ibid.*, p. 231, pl. xi, figs. 1, 2; pl. xii, figs. 2, 3.
1900. *Cladophlebis denticulata* Seward, *Mem. and Proc. Manchester Lit. and Phil. Soc.*, vol. xliv, No. 8, p. 18, pl. iv, fig. 9.
1900. *Cladophlebis denticulata* Seward, *Jurass. Flora*, vol. i (*Brit. Mus. Cat.*), p. 134, pl. xiv, figs. 1, 3, 4; pl. xv, figs. 4, 5; pl. xx, figs. 3, 4.
1910. *Cladophlebis denticulata* Krystofovic, *Mém. Com. Géol. St. Pétersbourg*, N.S. Livr. 56, p. 5, pl. 1, figs. 1, 1*a*.
1910. *Cladophlebis whitbiensis* Krystofovic, *ibid.*, p. 7, pl. i, figs. 5, 5*a*, 5*b*.
1911. *Cladophlebis denticulata* Thomas, *ibid.*, N.S. Livr. 71, pp. 14, 15, 63, 64, pl. ii, figs. 10–13.
1913. *Cladophlebis denticulata* Halle, *Wissen. Ergeb. Schwed. Südpolar-Exped.*, Bd. iii, Lief. 14, p. 12, pl. ii, figs. 7-9, text-fig. 3.

Diagnosis.—The following diagnosis of this species was given by Seward in 1900 (see above): "Frond bipinnate, large, with long spreading pinnæ attached to a comparatively slender rachis. Pinnules falcate, acutely pointed, usually finely dentate, attached by the whole of the base; the longest pinnules may reach a length of 3–4 cm. Venation of the typical *Cladophlebis* type; a well-marked midrib giving off secondary dichotomously forked veins at an acute angle. Towards the apex of the frond the pinnules are shorter and broader than the longer and narrower segments

(1) Halle (1913[2]), p. 25, pl. i, figs. 10–13. (2) Dawson (1886), p. 5, pl. iii, fig. 7.

in the lower and middle portion of the frond. Fertile fronds, similar in form to the sterile; the segments of the same shape, but somewhat straighter, and with an irregularly serrate margin; the sori are oblong in shape and parallel to the secondary veins."

As has already been pointed out (p. 30), *C. denticulata* differs from *C. australis* only in the pinnules having a denticulate margin.

Description of the Specimens.—A single example occurs in the Malvern Hills collection, in which the margins of the pinnules are clearly denticulate. Similar leaflets from Mataura Falls are figured on Plate IV, fig. 6. This is an enlargement of three pinnules seen in a specimen in the British Museum collection (V. 11700). They are falcate, and the margins denticulate. The lateral veins are, as a rule, twice forked.

Remarks.—This species is incidentally mentioned by Kidston and Gwynne-Vaughan(1) as occurring with *Osmundites Dunlopi* in Jurassic rocks near "Gore" (? Waikawa). It is more probable, however, that the species in question was *Cladophlebis australis.* The only other record from the Southern Hemisphere, so far as I am aware, is the undoubted one from Grahamland, which was made quite recently by Halle(2).

Occurrence.—Malvern Hills (? Lower Jurassic); Mataura Falls (Lower Jurassic).

4. Cladophlebis sp. Plate IV, fig. 7.

Description of the Specimen.—A small fragment of a pinna, in which the nervation of the leaflets is clearly marked, is figured twice enlarged on Plate IV, fig. 7. The pinnules are short and fairly broad. Unfortunately this specimen is too imperfect to permit of specific determination.

Occurrence.—Waikato Heads, Auckland (Neocomian).

Genus CONIOPTERIS Brongniart, 1849.

(*Tabl. Végét. Foss.*, p. 26.)

Coniopteris hymenophylloides (Brongniart). Plate II, figs. 1, 2, 3, 6; Plate III, figs. 3, 4, 5, and 9.

1829. *Sphenopteris hymenophylloides* Brongniart, *Hist. Végét. Foss.*, p. 189, pl. lvi, fig. 4.
1829. *Sphenopteris stipata* Phillips, *Illustr. Geol. Yorks.*, 1st ed., p . i, p. 147, pl. x, fig. 8.
1829. *Sphenopteris muscoides* Phillips, *ibid.*, p. 153, pl. x, fig. 10.
1835–36. *Pecopteris Murrayana* Brongniart, *Hist. Végét. Foss.*, p. 358, pl. cxxvi, fig. 5.
1837. *Sphenopteris arguta* Lindley and Hutton, *Fossil Flora*, vol. iii, pl. clxviii.
1837. *Tympanophora simplex* Lindley and Hutton, *ibid.*, pl. clxx A.
1837. *Tympanophora racemosa*. Lindley and Hutton, *ibid.*, pl. clxx B.
1851. *Sphenopteris nephrocarpa* Bunbury, *Quart. Journ. Geol. Soc.*, vol. vii, p. 179, pl. xii, figs. 1*a*, 1*b*.
1873. *Sphenopteris Pellati* Saporta, *Pal. Franç.*, vol. i, p. 278, pl. xxxi, fig. 1.
1875. *Sphenopteris Murrayana* (pars) Phillips, *Illustr. Geol. Yorks.*, 3rd ed., p. 212, lign. 26.
1875. *Sphenopteris affinis* Phillips, *ibid.*, p. 213, lign. 30.
1875. *Sphenopteris dissocialis* Phillips, *ibid.*, p. 214, lign. 32.
1875. *Sphenopteris hymenophylloides* Phillips, *ibid.*, p. 215, lign. 34.
1875 *Sphenopteris muscoides* Phillips, *ibid.*, p. 217, pl. x, fig. 10.
1875. *Tympanophora simplex* Phillips, *ibid.*, p. 219, lign. 43.
1875. *Tympanophora racemosa* Phillips, *ibid.*, p. 219, lign. 42.
1876. *Thyrsopteris Murrayana* Heer, *Flora Foss. Arct.*, vol. iv, pt. ii, p. 30, pl. i, fig. 4; pl. ii, figs. 1–4; pl. viii, fig. 11*b*.
1876. *Thyrsopteris Maakiana* Heer, *ibid.*, vol. iv, pt. ii, p. 31, pl. i, figs. 1–3; pl. ii, figs. 5, 6.
1878. *Thrysopteri Murrayana* Heer, *ibid.*, vol. v, pt. ii, p. i, pl. i, fig. 6.

(1) Kidston and Gwynne-Vaughan (1907), p. 759. (2) Halle (1913[1]), p. 12.

Fig. 9. Coniopteris hymenophylloides (Brongn.)
Fertile Frond from Waikawa.
In Dr. P. Marshall's Collection. $\times \frac{3}{2}$.

Fig. 10. Cycadites sp., from Waikawa.
In Dr. P. Marshall's Collection $\times \frac{3}{2}$.

Fig. 11. Podozamites gracilis sp. nova, from Waikawa.
In the New Zealand Geological Survey Collection. Natural size.

1900. *Coniopteris hymenophylloides* Seward, *Jur. Flora*, vol. i, (*Brit. Mus. Cat.*), p. 99, pl. xvi, figs. 4–6; pl. xvii, figs. 3, 6–8; pl. xx, figs. 1, 2; pl. xxi, figs. 1–4.
1904. *Coniopteris hymenophylloides* var. *australica* Seward, *Rec. Geol. Surv. Victoria*, vol. i, pt. 3, p. 163, pl. viii, fig. 6; pl. ix, figs. 7, 9; pl. x, fig. 8.
1911. *Coniopteris hymenophylloides* Thomas, *Mém. Com. Géol., St. Pétersbourg*, N.S. Livr. 71, pp. 13, 62, pl. ii, figs. 3–9; pl. viii, figs. 7–10.
1911. *Coniopteris hymenophylloides* Seward, *ibid.*, N.S. Livr. 75, pp. 10, 38, pl. i, figs. 11–15; pl. vi, figs 67, 68.
1913. *Coniopteris hymenophylloides* Halle, *Wissen. Ergeb. Schwed. Südpolar-Exped.*, vol. iii Lief. 14, p. 19, pl. iii, figs. 23, 24, $27a^2$, 27*b*?, 28–30.

Diagnosis.—The following diagnosis of this species was given by Seward in 1904 (see above): "Frond tripinnate; pinnæ linear acuminate, attached to the rachis at a wide angle; the pinnules vary considerably in size and shape, in some forms they have a few broad and rounded lobes, and in others the lamina is deeply dissected into narrow linear segments. The fertile pinnules bear the sori at the end of the veins; the lamina is usually much reduced, and in extreme cases the fertile segments agree closely with those of *Thyrsopteris elegans* Kze., or *Dicksonia Bertevana* Hook. The sori are partly enclosed in a cup-shaped indusium; the sporangia appear to have an oblique annulus of the cyatheaceous type. The two lowest pinnules of the pinna are often characterized by their unusual shape, the lower half of each pinnule consisting of long spreading and irregular *aphlebia*-like lobes. Venation and form of the frond of the *Sphenopteris* type."

Description of the Specimens.—Portions of the sterile foliage are seen on Plate II, figs. 1–3, and Plate III, fig. 5. These are of quite the normal type, and may be very closely compared with specimens of this species from the English Oolite. Some partly fertile pinnæ are seen on Plate III, fig. 4, natural size, and twice enlarged on fig. 3 of the same plate. In the latter photograph, on the left-hand side, dark oval bodies can be seen at the terminations of some of the pinnule lobes. These are no doubt the sori. The lamina of the pinnules in this specimen is slightly reduced as compared with those shown on Plate II, figs. 1–3.

A somewhat enlarged drawing of another fertile but more reduced pinnule is seen on Plate II, fig. 6.

This species also occurs at Waikawa, where, in addition to fronds with small pinnules like those figured above, others of much larger size are also found. One of these, in Professor Marshall's collection at Dunedin, is identical in size with that figured from Victoria by Seward(1) in 1904. Part of a fertile pinna also occurs on the same specimen, and this is shown by fig. 9. It bears the closest resemblance to a similar fossil, also figured by Seward(2) from the Jurassic of Victoria.

Remarks.—This plant is quite abundant in the Malvern Hill beds. The species is a variable one as regards habit, but, so far as I can see, the New Zealand specimens are indistinguishable from examples from the Jurassic rocks of Europe and Grahamland. The more reduced type of fertile pinnule recalls the specimens from the Jurassic of Victoria (Australia) described by Seward(3) as *Coniopteris hymenophylloides* var. *australica*. The chief feature of this variety is stated to be as follows: "The fertile pinnæ of the European fern are often characterized by a considerable reduction in the lamina, but in this respect there is not a little variation; in the Victorian specimens the fertile pinnæ are practically identical with the sterile, except in the occurrence of sori at the tips of the lobes"(4). In the New Zealand specimens, however, as illustrated here, there appear to be all gradations between sterile pinnules,

(1) Seward (1904[1]), pl. x, fig. 8.
(2) Seward, *ibid.*, pl. ix, fig. 7.
(3) Seward (1904[1]), p. 163, figs. 6–9.
(4) Seward, *ibid.*, p. 164

with unreduced lamina, and fertile leaflets in which the lamina is partly or very largely reduced. I am therefore inclined to refer them to the species *C. hymenophylloides* pure and simple.

Occurrence.—Malvern Hills (? Lower Jurassic); Mokoia, Gore (Lower Jurassic); Curio Bay, Waikawa (Middle Jurassic).

Genus DICTYOPHYLLUM Lindley and Hutton, 1834.

(*Foss. Flora*, vol. ii, pl. civ.)

1. Dictyophyllum acutilobum (Braun). Plate XII, figs. 2–4.

1847. *Diplodictyum acutilobum* Braun, *Flora*, N.S., vol. v, p. 83.

1862. *Camptopteris exilis* Braun, *Palæontogr.*, vol. ix, p. 54, pl. xiii, fig. 11 *a–d*.

1868. *Dictyophyllum acutilobum* Schenk, *Foss. Flora Grenzschich. Keup. & Lias Frank* p. 77, pl. xix, figs. 2–5; pl. xx, fig. 1.

1878–86. *Dictyophyllum acutilobum* Nathorst, *Floran vid Bjuf*, p. 38, pl. xi, fig. 1.

1878. *Dictyophyllum acutilobum* Nathorst, *Floran vid Höganäs och Helsingborg*, pp. 14, 44, pl. i, fig. 8.

1886. *Camptopteris incisa* Hector, *Det. Cat. & Guide, N. Zeal. Court, Ind. & Col. Exhib.*, p. 66, fig. 30*a*(8).

1906. *Dictyophyllum acutilobum* Nathorst, *K. svenska Vet.-Akad. Handl.*, vol. xli, No. 5, p. 13, pl. vi, fig. 24.

Diagnosis.—Schenk (see above) defines this species as follows: Folia petiolata pedata, segmenta digitato-pinnatifida, laciniæ oblongæ pinnatifidæ basi crenatæ, lacineæ secundariæ patentes sinu lato rotundato remotæ integræ obtusæ, inferiores breviores ovato-lanceolatæ, superiores oblongæ subfalcatæ, nervi primarii rigidi validi, secundarii per paria approximati alterni suboppositi vel oppositi, angulo recto egredientes apice in rete soluti, tertiarii angulo recto egredientes inter se ad maculas inæqualiter hexagonales conjuncti, appendices in maculas inæquales penta- vel hexagonales conjuncti, ramulis liberis, sori per paginam folii totam inferiorem sparsi rotundi, sporangia tres vel sex, globosa.

Description of the Specimens.—All the examples of this genus from New Zealand are very fragmentary, although it appears to be of common occurrence in more than one locality. The apical fragment of a segment of a frond, figured by Hector in 1886 as *Camptopteris incisa* sp. nov. from the Clent Hills, is refigured on Plate XII, fig. 3. Two larger segments from Mataura Falls are also shown on the same plate, figs. 2 and 4, the latter somewhat enlarged.

Remarks.—In the New Zealand specimens the nerves appear to be rather more prominent than in European examples.

Occurrence.—Mount Potts (Rhætic); Clent Hills (Rhætic); Mataura Falls (Lower Jurassic).

2. Dictyophyllum obtusilobum ? (Braun). Plate VIII, figs. 1 and (?) 10.

1843. *Diplodictyum obtusilobum* Braun, in Münster G., *Beitr. Petrifacten-Kunde*, Heft. vi, p. 14, pl. xiii, figs. 11, 12.

1868. *Dictyophyllum obtusilobum* Schenk, *Foss. Flora Grenzschich. Keup. & Lias Frank.*, p. 75, pl. xvi, fig. 1.

1869. *Dictophyllum obtusilobum* Schimper, *Traité Pal. Végét.*, vol. i, p. 633, pl. xli, fig. 22.

1878–86. *Dictyophyllum obtusilobum* Nathorst, *Floran vid Bjuf*, p. 37, pl. v, fig. 10; pl. vi, figs. 1–4; pl. viii, fig. 3.

Diagnosis.—This species is defined by Schenk (see above) as follows: "Folia . . . ? segmenta profunde pinnatifida oblonga, laciniæ sinu angusto rotundato remotæ integræ oblongæ æquilatæ apice rotundatæ patentissimæ, nervi primarii . . ?, secundarii excurrentes alterni per paria approximati, tertiarii angulo recto egredientes maculas inæqualiter hexagonales tri- vel quadri-seriatas formantes, appendicibus anastomosantibus in maculas parvas partiti, sori per totam paginam folii inferiorem sparsa rotunda, verosimiliter in ramulo libero insidentes, sporangia sex vel octo annulo multiarticulato instructa sporæ tetraedricæ globosæ glabræ."

Description of the Specimens.—Two segments of a frond of *Dictyophyllum* are seen on Plate VIII, fig. 1, natural size. The nervation is only faintly preserved, but both in this respect and in the shape of the segments it recalls *Dictyophyllum obtusilobum*, to which I doubtfully refer this specimen. Another fragment is illustrated by fig. 10 of the same plate, also natural size. This shows the median portion of a frond of a *Dictyophyllum*, but it is too fragmentary for specific determination, though it may also be compared with *D. obtusilobum* as regards the nervation.

Occurrence.—Mokoia, Gore (Lower Jurassic).

Genus LINGUIFOLIUM Arber, 1913.

(*Proc. Roy. Soc.*, Ser. B, vol. lxxxvi, p. 346.)

This generic name is proposed for certain Mesozoic plants, which in habit somewhat resemble *Tæniopteris* on the one hand and *Glossopteris* on the other. They differ from the former genus in the lateral veins arising at an acute angle to the midrib, and also in the nerves being somewhat arched and more frequently dichotomized. The shape of the leaf is also spathulate, and not ribbon-shaped. They differ from the latter genus in that the lateral nerves do not anastomose.

The following may be regarded as a provisional diagnosis of the genus: Leaves simple, large, usually tongue-shaped, gradually contracted at the base, margins entire. Midrib strong; lateral nerves arising at a very acute angle to the midrib, more or less arched, frequently dichotomizing, but not anastomosing.

The question will naturally arise whether it would not be better to refer the leaves, here termed *Linguifolium*, to Brongniart's genus *Phyllopteris*, as has indeed been done in regard to at least one other example previously described. At first sight it would appear that the diagnosis of *Phyllopteris* might, with some slight modification, be made to cover fossils similar to the New Zealand specimens. This is undoubtedly the case, but it is of the nature of a "fluke." Any one who is familiar with the reasons why the term *Phyllopteris* Brongn. was instituted is aware that it is a true synonym of *Sagenopteris*, that it was founded under a misapprehension, and that there is good reason to believe that the type of leaf here referred to *Linguifolium* was quite unknown to Brongniart. It seems to me extremely unwise to apply a term instituted for one genus to quite a different one, even if that term be a synonym. Further, as I have said, it is merely chance that the diagnosis of *Phyllopteris* happens also to fit *Linguifolium*, a type of frond unknown until much later. *Phyllopteris* has tended to create confusion and to prolong misunderstanding in the past, and thus for the future it is best avoided. Though Saporta has applied this term to real members of the genus *Linguifolium*, I am not inclined to follow his example, for I believe the best thing to be done in such circumstances is to abandon entirely the old term, and to start afresh with a new name, and thus at least avoid confusion.

The history of *Phyllopteris* may be stated briefly as follows: In 1830 Brongniart, in his *Histoire des Végétaux fossiles*(1), figured two plants, *Glossopteris Phillipsii* Brongn. and *G. Nilsoniana* Brongn., which he believed to be new. The second, however, is identical with a more complete specimen afterwards figured by Presl(2) as *Sagenopteris rhoifolia* Presl, and both were shown later to belong to the genus *Sagenopteris* Presl, and

(1) Brongniart (1828), vol. i, p. 225, pl. 61 *bis*, fig. 5; pl. 63, figs. 2, 3.

(2) Presl in Sternberg (1820), Heft 7, p. 164 pl. 35, fig. 1, 1838.

not to *Glossopteris* Brongn. In a later paper, however, in 1849, Brongniart(1) transferred both these plants, the one Rhætic and the other Jurassic, to a new genus *Phyllopteris*, distinct from *Glossopteris* and *Sagenopteris*, as he expressly states. Brongniart was at that time under the impression that the lateral nerves did not anastomose in these two species, a quite erroneous conclusion founded on the inaccurate representations of the nervation of these plants given in some of the earlier illustrations by Phillips and others. It has been known, however, for many years past that a reticulate lateral nervation is a constant character of *Sagenopteris*, and, further, that the two species in question are still the most typical members of that genus. Thus *Phyllopteris* is a synonym of *Sagenopteris*, founded under a misapprehension.

In 1873 Saporta(2) revived this term for quite a different plant, which is a true *Linguifolium*; hence the present confusion which I wish to avoid. Saporta has been followed by Etheridge(3) in regard to a South Australian type.

Other members of *Linguifolium* have been already figured from various parts of the world, though not referred to *Phyllopteris*. The most important of these are the fragmentary leaves from the Rhætic rocks of La Ternera, Chile, referred by Solms(4) to the genus *Lesleya*, as *L. Steinmanni* Solms. It must be confessed that the above specimens, as also those from New Zealand here under consideration, very closely resemble the Palæozoic plants referred to the genus *Lesleya* by Lesquereux(5), Grand' Eury(6), and Zeiller(7). Apart from the difference in size, which is no doubt not of generic value, the larger fronds of Europe differ from the Rhætic specimens chiefly in the lateral veins being finer, closer, more numerous, and more frequently branched. It will be a matter of opinion, no doubt, as to whether these differences, in combination with dissimilarity in geological age, are sufficient to warrant generic separation; but, despite the fact that it does not appear possible to distinguish the two types by more definite characters, I am so impressed by the difference in habit that I would refer the Rhætic specimens to a distinct genus. For this I have recently proposed(8) the name *Linguifolium* gen. nov., by which is intended to be implied simply "tongue-shaped leaf." *Linguifolium* may also be compared with *Copiapœa plicatella* Solms(9), from the Rhætic of Chile, which may perhaps be regarded as a species in which the nerves are more distant.

Among Australian specimens, the *Phyllopteris Feistmanteli* of Etheridge(10) is certainly a *Linguifolium*, closely similar to *Linguifolium Lillieanum*. The *Neuropteris punctata* of Shirley(11) may be either a member of this genus or more probably a *Danæopsis*. The basal portions of the leaves are not preserved, and it is therefore impossible to say whether in this fossil the leaves were simple or compound.

The fragmentary specimen figured by Seward(12), from the Jurassic rocks of Victoria, as *Thinnfeldia* sp., appears to be a *Linguifolium*, very close to if not identical with *L. Lillieanum*. The *Pterophyllum dubia* (*sic*) of Johnston(13) from Tasmania may be also of a similar nature.

(1) Brongniart (1849), pp. 22, 103–105.
(2) Saporta (1873), vol. i, p. 448, pl. lxiii, fig. 6.
(3) Etheridge (1892), p. 3, pl. —, figs. 1, 2.
(4) Solms (1899), p. 596, pl. xiii, figs. 5–7.
(5) Lesquereux (1879), p. P143, pl. xxv, figs. 1–3.
(6) Grand' Eury (1890), p. 305, pl. viii, fig. 5; Croq. F., p. 305.
(7) Zeiller (1890), p. 166, pl. xiii, fig. 2; Renault and Zeiller (1888), p. 285, pl. xxiii, fig. 6.
(8) Arber (1913[1]), p. 346.
(9) Solms (1899), p. 594, pl. xiii, figs. 8–11. Compare also the nervation of the Permo-Carboniferous *Blechnoxylon talbragarense* Etheridge (1899), p. 135, pl. xxiv, figs. 1, 2, 3.
(10) Etheridge (1892), p. 3, pl. —, figs. 1, 2.
(11) Shirley (1898), p. 20, pl. xiv, fig. 2.
(12) Seward (1904), p. 175, pl. xvii, fig. 29.
(13) Johnston (1887), p. 176; (1888), pl. xxvii, fig. 6. *Cf.* also Johnston (1896), p. 58, pl. —, figs. 5, 6, 7, *Strzeleckia gangamopteroides* Johns., which, however, has apparently no midrib.

The simple leaves of *Linguifolium* also have a considerable resemblance to the pinnules of *Danæopsis rajmahalensis* Feist.(1), a compound frond from the Rajmahal Hills of India. There is no evidence, however, that the New Zealand specimens formed part of a pinnate frond. The following is a list of the plants previously described which I regard as species of *Linguifolium*: *Linguifolium plumula* (Sap.)(2), *Linguifolium Steinmanni* (Solms)(3), *Linguifolium Feistmanteli* (Ether.)(4).

Professor Seward(5), in a criticism of my previous note on the Mount Potts flora, speaking of the fossils here termed *Linguifolium*, says, "while admitting the almost complete absence of anastomoses, I believe that in one or two cases there are actual cross-connections, and that the fronds are very closely related to such species as *Glossopteris indica* and *G. Browniana*." I am inclined, however, to regard such anastomoses as apparently occur as accidents of preservation, as I pointed out in a former note(6). Seward, however, appears to lay great stress on such cases of anastomoses of the veins as he can find, which he admits are rare, in the hope of proving this plant to be a *Glossopteris*. He says, "the leaves on which the genus *Linguifolium* is founded are, I believe, if not generically identical with, at least very closely related to, *Glossopteris*." In support of this view he cites some well-known cases among Permo-Carboniferous Glossopterids, in which the anastomoses are undoubtedly few or missing(7). The occurrence of such specimens is in no way remarkable. Whether the finer veinlets of the anastomoses are or are not preserved depends on the perfection of preservation exhibited by a particular specimen. No good case of an undoubted Glossopterid has yet been brought forward in which the absence or rarity of anastomoses cannot be well explained as the result of imperfect preservation of the nervation. Exactly the same thing is of the commonest occurrence among Tertiary dicotyledonous leaf-impressions. In such fossils the chief diagnostic characters are usually found in the delicate veins of the third or higher orders, yet as often as not these are not preserved, even when the coarser veins are well marked. Thus, if a specimen is found in Permo-Carboniferous beds in Gondwanaland in which the anastomoses are indistinct or absent, but which otherwise corresponds to *Glossopteris*, we may agree that it is probably only an imperfectly preserved member of that genus, which does not merit specific determination. Seward might apply this argument very fairly to *Linguifolium* did it occur in Permo-Carboniferous rocks, though if the limits of *Glossopteris* are to be so greatly enlarged it will have to include also *Blechnoxylon* among other types, which does not seem to me to be advisable. But as Seward appears to agree, *Linguifolium* occurs not in Permo-Carboniferous but in Mesozoic beds in New Zealand, and, as I have shown here, probably as late as the Jurassic period. Among Mesozoic plants there are several—such as the South American specimen referred to *Lesleya* by Solms, and the Australian fossil assigned to *Phyllopteris* by Etheridge, as I have pointed out above—which are very similar in habit to *Linguifolium*, but I do not imagine that any one would dream of including these in *Glossopteris*. Certainly such a suggestion has not yet been made. So far as I can judge, the New Zealand plant agrees far better with these Mesozoic types than with *Glossopteris*, which is entirely unknown from the Jurassic. For the present, seeing that in the great majority of cases, as Seward admits, there are no signs of anastomoses among the nerves of *Linguifolium*, it is better to compare them with genera which reached their maximum during the *same* geological age than to lay undue

(1) Feistmantel (1877), vol. i, pt. ii, p. 53, pl. xxxviii, figs. 4, 4*a*.
(2) Saporta (1873), vol. i, p. 450, pl. lxiii, fig. 6.
(3) Solms (1899), p. 596, pl. xiii, figs. 5–7.
(4) Etheridge (1892), p. 3, pl. —, figs. 1, 2.
(5) Seward (1914), p. 38.
(6) Arber (1913[1]), p. 345, footnote.
(7) Zeiller (1902), p. 11, pl. iii, fig. 3; also Seward and Leslie (1908), p. 113, pl. ix, fig. 2 and text-figs. 2, 3; Seward (1910), p. 508, fig. 342.

weight on the possible occurrence of a few anastomoses which are, quite as likely as not, artificial and not real, and thus to include them in a genus (*Glossopteris*) which reached its maximum at an *earlier* geological period. On my view it is by no means safe to assume that the two plants are "very closely related," and it is better to maintain a non-committal attitude, or even to suggest a distinct origin by placing the New Zealand fossils in a distinct genus.

Linguifolium Lillieanum Arber. Plate III, figs. 1, 7.

1913. *Linguifolium Lillieanum* Arber, *Proc. Roy. Soc. London*, ser. B, vol. lxxxvi, p. 346, pl. 7, figs. 1, 4.

Diagnosis.—Leaves spathulate, up to 9 cm. or more in length, and 1·7–3 cm. across at their greatest width. Margins entire, apex rounded, leaf gradually tapering to an elongate base; midrib well marked, persisting to the apex. Lateral veins arising at an acute angle to the midrib, arching upwards and then bending to the margin, once or twice forked, about 1 mm. apart.

Description of the Specimens.—The specimens are all fragmentary, and no complete leaf occurs. A median portion of a leaf is seen enlarged on Plate III, fig. 1. This shows the midrib and the lateral nervation. Here and there, in this specimen, it appears at first sight as if the lateral nerves anastomose. I am, however, convinced that, in this as in other cases, the appearances are deceptive. Some of them arise from the imperfect removal of the film of carbon covering the frond. The little strips of carbon which remain in some cases simulate nerves. In others the leaf did not lie quite flat on the matrix before preservation took place, and this has led to a squeezing of the lamina, the lateral nerves thus becoming approximated. At the top right-hand corner of this specimen the irregularity and the apparent union of the nerves appears to be due to both causes. At any rate, in the great majority of cases there is no anastomosis, and wherever such apparent unions are seen they may be explained in one of the two ways above indicated. The nervation is best seen in fig. 7 of Plate III, which shows two portions of rather small leaves, in which the lateral nerves are fairly clear, though the film of carbon still largely adheres to the lamina. The dichotomy of the nerves is only occasional. This photograph is somewhat enlarged.

Remarks.—I am inclined to regard *L. Lillieanum* as specifically distinct from any of the previously described members of the same genus indicated on p. 37. It, however, stands nearest to the South Australian *L. Feistmanteli* (Ether.). I have only seen one example from the Malvern Hills, and this belongs to the Canterbury Museum, Christchurch, New Zealand. The nervation is here clearly seen, and, so far as one can judge, this specimen is identical with those occurring at Mount Potts.

Type in the British Museum (Natural History).

Occurrence.—Mount Potts (Rhætic). Malvern Hills (? Lower Jurassic); in the Canterbury Museum, Christchurch, New Zealand.

Genus MICROPHYLLOPTERIS gen. nov.

Among the fern-like fronds of Mesophytic age occurring in New Zealand there are specimens which by most authors would be unhesitatingly referred to the genus *Gleichenites* Gœpp. Similar fronds are found not infrequently in Mesozoic rocks elsewhere, and have been generally regarded as the leaves of ferns closely allied to, if not identical with, the modern fern *Gleichenia*. This may be the case, but, so far as the present evidence of the earlier Mesozoic examples is concerned, it must be admitted that it rests entirely on a similarity of frond-habit (which is notoriously untrustworthy as a guide to affinity) and not on any precise knowledge of the fructification. Further, there is little doubt that the genus *Gleichenites*, even if it is to include the Mesophytic types in question, is a thoroughly bad one, incapable of being defined compactly or concisely. If we look into the origin of the term we find that it was instituted for Palæozoic plants now long ago transferred to other genera.

The genus was founded in 1836 by Gœppert(1), who briefly diagnosed it as follows: "Frons dichotoma pinnata. Fructificatio hucusque ignota." He described five species, all of Palæozoic age, one species being of Lower Carboniferous, three of Upper Carboniferous, and one of Permian age. Several of these plants had already been ascribed to other genera, and they have since been finally referred to *Eremopteris*, *Sphenopteris*, &c.

In 1860 Eichwald(2) recorded one of Gœppert's species, the well-known *Eremopteris artemisiæfolia* (Sternb.), from Russia, and a new species, which is apparently a Palæozoic species of *Sphenopteris*, from the same country.

These are the chief attributions of Palæozoic plants to the genus *Gleichenites*, and, as we have seen, none of them can stand. In more recent years other authors have applied this same name to Mesozoic plants of quite different affinity to those enumerated by Gœppert.

One of the first of these was the Upper Gondwana plant of India described by Oldham(3) in 1860 as *Pecopteris (Gleichenites) linearis*, and in 1862 by Oldham and Morris(4) as *Pecopteris (Gleichenites) gleichenoides*. Schimper(5) subsequently changed the specific name, and placed this plant in the living genus *Gleichenia* itself; but Feistmantel(6) more cautiously described it as *Gleichenites (Gleichenia) Bindrabunensis* (Schimper). This species I propose to term *Microphyllopteris gleichenoides* (Old. & Morr.). It has also been recorded by Etheridge(7) from Australia, and referred by him to yet another genus.

In 1865 de Zigno(8) described a new plant with a dichotomously branched frond, from the Jurassic of Italy, under the name *Gleichenites elegans*. Schimper(9) in 1869 also transferred this fossil to the genus *Gleichenia*. This plant I propose in future to term *Microphyllopteris elegans* (Zigno). As de Zigno pointed out, it is also possible that the very incomplete fragment of a frond from the Jurassic of Mamers, France, figured by Brongniart(10) as *Pecopteris Desnoyersii* in 1836, may be related to the Italian fossil generically, but at present the material is too imperfect to allow of any definite conclusions on this point.

The American Triassic *Neuropteris linnææfolia* of Bunbury(11), from the Richmond coalfield of Virginia, of which additional specimens have been figured by Fontaine(12) under the name *Acrostichides linnææfolius*, is no doubt another species of *Microphyllopteris*.

The obscure *Gleichenites microphyllus* of Schenk(13), from the Rhæto-Lias of Germany, may be a further representative of the genus, and another is perhaps Heer's(14) *Pecopteris gracilis*, from the Keuper of Neuewelt, near Basle, referred more recently by

(1) Gœppert (1836), p. 181.
(2) Eichwald (1860), vol. i, pp. 90, 91, pl. ii, figs. 5, 6.
(3) Oldham (1860), p. 324.
(4) Oldham and Morris (1862), p. 45, pl. xxv; pl. xxvi figs. 1, 3.
(5) Schimper (1869), vol. i, p. 670.
(6) Feistmantel (1877[1]), pp. 41–93.
(7) Etheridge (1888), p. 1307, pl. xxxviii, fig. 3.
(8) de Zigno (1856), vol. i, p. 193, pl. x.
(9) Schimper (1869), p. 670.
(10) Brongniart (1828), p. 366, pl. cxxix, fig. 1.
(11) Bunbury (1847), p. 281, pl. x.
(12) Fontaine (1883), p. 25, pl. vi, fig. 3; pl. vii, figs. 1–4; pl. viii, fig. 1; pl. ix, fig. 1.
(13) Schenk (1867), p. 86, pl. xxii, figs. 7, 8.
(14) Heer (1865), p. 54, pl. ii, fig. 1.

Leuthardt(1) to the genus *Gleichenia.* Here the sori can be seen, but the characters of the sporangia have not been determined. This is the only case, so far as I am aware, in which the sori have been observed in any pre-Cretaceous species of this type of frond.

In Lower Cretaceous rocks this type of frond is more abundant than in the Jurassic, and numerous specimens have been figured by Schenk, Heer(2), Nathorst(3), Debey and Ettingshausen(4), and others. Recently, Halle(5) has described two species from the Cretaceous of Patagonia, and Seward(6) another from the Jurassic of Scotland. Many of these have been referred to the genus *Gleichenites.*

I am well aware that, in the case of some of the Cretaceous and Tertiary fronds referred to *Gleichenites,* there are much better grounds for the belief in affinity to the living *Gleichenia* than exist in the case of the Jurassic species. My view is that if this term is used at all it is best preserved for cases where some further evidence than similarity of leaf-form has been found to exist.

As regards the Jurassic examples from New Zealand, there is the choice either of following others blindly in referring them to the genus *Gleichenites* (despite the absence of any real evidence of affinity with *Gleichenia,* and the thoroughly bad nature of the genus, as originally used for what are now thought to be Palæozoic Pteridosperms) or of applying some new non-committal name to them. The former course may simplify the synonymy, but the latter appears to me to be far more scientific. A third possibility, of emending Gœppert's generic diagnosis out of all recognition, does not seem to me justifiable. I have therefore decided to refer these plants to a new genus, *Microphyllopteris,* by which term I imply simply ferns with small leaflets.

Diagnosis.—Fronds pinnate, bipinnate, or dichotomously branched; pinnules small or very small, subcircular or ovate, closely set, broadest at the base, and attached by their whole base. Median nerve feeble, breaking up into simple or forked branches not far from the base of the pinnule.

1 Microphyllopteris pectinata (Hector). Plate VII, figs. 3–6, 8–11.

1886. *Lomarites pectenata* Hector, *Det. Cat. & Guide, N. Zeal. Court, Ind. & Col. Exhib.,* p. 66, fig. 30A(5).

Diagnosis.—Frond bipinnate ? ; pinnæ 8 cm. or more in length; rachis fairly stout, sometimes grooved, bearing subopposite or alternate small rounded pinnules, about 6 mm. long and up to 5 mm. across. Pinnules somewhat thick. Lateral nerves forking once or twice.

Description of the Specimens.—All the examples of this plant from the Mataura Falls beds (Plate VII, figs. 8 and 10) are poorly preserved, and in none of them is the nervation seen. Much better specimens, of what I take to be the same plant, occur in the Neocomian rocks of Waikato Heads, Auckland, and on these the above diagnosis is chiefly founded.

Of these, two specimens in the New Zealand Survey collection are shown in Plate VII, figs. 4 and 11, the former twice enlarged, the latter natural size. A part of fig. 11 is also seen, four times enlarged, on fig. 6 of the same plate, to show the nervation. The pinnules are subcircular, and about 4 mm. in length. The lateral nerves fork widely.

(1) Leuthardt (1903), pt. ii, p 40, pl. xviii, figs. 3, 3*a*.
(2) Heer (1874), p. 43, pl. iv–x, &c.
(3) Nathorst (1890), p. 8, pl. iv, figs. 3–5.
(4) Debey and Ettingshausen (1859), p. 6, pl. 1.
(5) Halle (1913²), pp. 22–23, pl. 1, figs. 14–18.
(6) Seward (1911), p. 664, pl. iii, figs. 48–58*a*; pl. v, figs. 87–89, 92–96; text-fig. 5.

Another similar specimen in the British Museum collection is shown on Plate VII, fig. 3 (natural size). The pinnules are here rather more oval in form.

Two further examples, both in the British Museum collection, are shown on the same plate, figs. 5 and 9, both somewhat enlarged. These show bipinnate leaves, the pinnæ being alternate. In fig. 5 four pinnæ are seen attached to the rachis, and the nervation of some of the pinnules is fairly clear. Fig. 9 is a similar but less distinct specimen. These two examples may eventually prove to belong to a distinct species, though from the similarity in the nervation of the pinnules I am inclined for the present to attribute them to *Microphyllopteris pectinata* (Hect.).

Remarks.—This plant agrees well in habit with the Indian *Microphyllopteris gleichenoides* (O. & M.), but the pinnules are at least twice as large. The nervation, however, corresponds with that of the Indian plant shown on plate xxv, fig. 1*a*, of Oldham and Morris's memoir. This is also the case as regards *M. elegans* (de Zigno), from the Jurassic of Italy, where, however, the habit is quite distinct, irregular dichotomies being a marked feature of the frond.

The Waikato Heads specimens may be closely compared with the *Gleichenites obtusata* of Heer(1), from the Cretaceous of Greenland, and with some of the other examples of the same genus from various parts of the world (see pp. 39, 40), especially from Cretaceous sediments.

Types.—New Zealand Geological Survey collection.

Occurrence.—Mataura Falls (Lower Jurassic); Waikato Heads (Neocomian).

2. Microphyllopteris sp. Plate II, fig. 10.

Description of the Specimen.—A single badly preserved pinna of this genus, occurring in the Catlin's River collection, is figured on Plate II, fig. 10, natural size. It measures 3·6 cm. in length. The form of the subcircular pinnules is seen, but the nervation is indistinct.

Remarks.—It is possible that this specimen should be more correctly referred to the genus *Thinnfeldia*, though I am inclined to regard it as an example of *Microphyllopteris*, on account of the small size of the pinnules.

Occurrence.—Owaka Creek, Catlin's River (? Rhætic).

Genus SPHENOPTERIS Brongniart, 1822.

(*Sur. Class. Végét. Foss.*, p. 233.)

1. Sphenopteris Currani ? (Tenison-Woods). Plate II, figs. 7, 8.

1883. *Alethopteris Currani* Tenison-Woods, *Proc. Linn. Soc. N.S. Wales*, vol. viii, p. 113, pl. vi, fig. 4.

Diagnosis.—Frond bipinnate; pinnæ alternate, lanceolate; pinnules alternate, oblique, ovate or ovate-lanceolate, delicate, crenate, or roundly lobed. Median nerve impersistent at apex, lateral nerves forked.

Description of the Specimens.—The single example of this plant in the Sedgwick Museum from Gore is figured on Plate II, fig. 7, natural size, and a single pinnule is shown 2½ times enlarged on fig. 8 of the same plate. The frond measures 9·7 cm. in length, and the pinnæ are about 3·5 cm. long, or less. The whole texture of the lamina is very delicate. The higher pinnæ are only lobed, the lower are divided into ovate pinnules with crenulate margins.

(1) Heer (1882), p. 37, pl. xxx, figs. 7–16.

Remarks.—This plant may be a new species, and not identical with *S. Currani* (Ten.-Woods), of which only a fragment of a pinna is known. If, however, the lower left-hand pinna seen in fig. 7 be compared with Tenison-Woods's illustration, it will be seen that there is very close agreement, and for this reason I am inclined to think that the two fossils may be identical.

Occurrence.—Mokoia, Gore (? Lower Jurassic).

2. Sphenopteris (Ruffordia) Gœpperti Dunker. Plate I, figs. 2, 4.

1833. *Sphenopteris Phillipsii* Mantell, *Geol. S.E. England*, p. 239, fig. 2.
1844. *Cheilanthites Goepperti* Dunker, *Über Norddeutsch. Sogen. Wälderthon*, &c., p. 6.
1846. *Sphenopteris Göpperti*, Dunker, *Monogr. Norddeutsch. Wealdenbild.*, p. 4, pl. 1, fig. 6 pl. ix, figs. 1–3.
1846. *S. Hartlebeni* Dunker, *ibid.*, p. 4, pl. ix, fig. 9.
1846. *S. longifolia* Dunker, *ibid.*, p. 4, pl. viii, fig. 6.
1852. *Sphenopteris Jugleri* Ettingshausen, *Abhandl. k.-k. geol. Reichs*, Bd. i, Abth. iii, No. 2, p, 15, pl. iv, fig. 5.
1869. *Sphenopteris (Davall.) Hartlebeni* Schimper, *Traité Pal. Végét.*, vol. i, p. 393, pl. xxx, figs. 2, 3.
1871. *Sphenopteris Göpperti* (pars) Schenk, *Palæontogr.*, vol. xix, p. 209, pl. xxv, figs. 2–5.
1876. *Sphenopteris Auerbachi* Trautschold, *Nouv. Mém. Soc. Nat. Moscou*, vol. xiii, p. 207, pl. xviii, fig. 5.
1878. *Sphenopteris Göpperti* Dupont, *Bull. Acad. Roy. Belgique*, ser. ii, vol. xlvi, p. 396.
1881. *Sphenopteris valdensis* (pars) Heer, *Sect. Trav. Géol. Portugal*, 4to, p. 14, pl. xv, fig. 11, ? figs. 9, 10, 12–14.
1890. *Sphenopteris* cfr. *Göpperti* Nathorst, *Denkschr. k. Akad. Wissen. Wien (Math.-Nat. Cl.)*, vol. lvii, p. 51, pl. vi, figs. 2, 3.
1890. *Sphenopteris* sp. Yokoyama, *Journ. Coll. Sci. Tokyo*, vol. iii, p. 34, pl. xiv, figs. 13, 13*a*.
1894. *Ruffordia Göpperti* Seward, *Wealden Flora*, pt. i, p. 76, pl. iii, figs. 5–6; pl. iv; pl. v; pl. vi, figs. 1, 1*a*.
1900. *Ruffordia Göpperti* Seward, *Jurassic Flora*, pt. i, p. 133.
1900. *Ruffordia Goepperti* Seward, *Mém. Mus. Roy. Hist. Nat. Belgique*, vol. i, p. 18, pl. iii, fig. 33.
1913. *Sphenopteris (Ruffordia ?) Goepperti* Halle, *Wissensch. Ergebn. Schwed. Südpolar-Exped.*, Bd. iii, Lief. 14, p. 25, pl. iii, fig. 9.
1914. *Sphenopteris (Ruffordia) Gœpperti*, Zeiller, *Rev. génér. Botan.*, vol. xxv *bis*, p. 451, pl. 20, fig. 2.

Diagnosis.—The following diagnosis of this species was given by Seward in 1894 (see above): "Frond tripinnate-quadripinnate, deltoid or rhomboidal, rachis frequently flexuous, pinnæ alternate, deltoid to ovate-lanceolate; pinnules delicate, decurrent on the rachis, ultimate segments linear acuminate or ovate-cuneate. Venation of the type *Cœnopteridis* and *Sphenopteridis*. Fructification in the form of scattered sporangia on fertile fronds or pinnæ, of which the leaf lamina is considerably reduced."

Description of the Specimens.—A small portion of a sterile frond of *Sphenopteris Gœpperti* is seen on Plate I, fig. 2. Another is shown by fig. 4 of the same plate, also natural size. The latter has rather broader segments, but, on the whole, despite the imperfection of the preservation, I am inclined to regard it as another example of *Sphenopteris Gœpperti* Dunk.

Occurrence.—Mokoia, Gore (? Lower Jurassic).

3. Sphenopteris gorensis sp. nov. Plate II, fig. 4.

Diagnosis.—Frond pinnate; rachis slender; pinnules opposite, more or less wedge-shaped, very broad in proportion to their length, contracted at the base; lamina deeply dissected into broad wedge-shaped lobes, which are themselves often broadly toothed or lobed.

Description of the Specimen.—The single example of this frond from Gore is figured on Plate II, fig. 4, natural size. The pinna measures 7·4 cm. in length. The rachis is slender and perhaps grooved. The pinnules measure about 1·5 cm. in length, but vary somewhat in breadth, being about 1 cm. across at the broadest part near the base in the lowest pinnules seen in fig. 4, but narrower in the case of the higher pinnules. They are deeply dissected into a large number of small, wedge-shaped, contiguous segments, broadest at the apex, and these segments are again often toothed or lobed.

Type.—Sedgwick Museum, Cambridge.

Occurrence.—Mokoia, Gore (? Lower Jurassic).

4. **Sphenopteris otagoensis** sp. nov. Plate 1, figs. 5, 6, 8; Plate V, fig. 7.

Diagnosis.—Frond bi- or tri-pinnate; rachis of ultimate pinnæ grooved, slender. Pinnules subopposite or alternate, between 1 cm. and 2 cm. in length, lobed, contracted at the base; lobes rather broad, rounded or rather acute at the apex. Nervation of the ordinary Sphenopterid type.

Description of the Specimen. — This plant, which resembles some Palæozoic *Sphenopterids* more closely than any Mesozoic species of the genus with which I am acquainted, is represented by several specimens. A photograph of one of these is seen on Plate V, fig. 7, twice enlarged. Drawings of two others will be found on Plate I, figs. 6 and 8, both natural size. An enlarged drawing of the nervation is seen on Plate I, fig. 5.

Remarks.—This species may be related to, or even identical with, *S. owakaensis*, though on the present material I am inclined to regard them as distinct.

Type.—New Zealand Geological Survey collection.

Locality.—Owaka Creek, Catlin's River (? Rhætic).

5. **Sphenopteris owakaensis** sp. nov. Plate V, fig. 8.

Diagnosis.—Rachis slender. Pinnules broadly ovate, 12 mm. long and 7 mm. to 8 mm. broad at the base, contracted at the base; margin lobed, about three lobes on each side; lobes rounded; terminal lobe small. Nerves supplying the lower lobes arising directly from the rachis; median nerve impersistent, giving off at an acute angle numerous, strong, erect, and branched lateral nerves which fork widely.

Description of the Specimen.—This species is founded on a single specimen consisting of 4 or 5 pinnules, part of which is seen enlarged three times on Plate V, fig. 8, to show the nervation.

Type.—New Zealand Geological Survey collection.

Occurrence.—Owaka Creek, Catlin's River (? Rhætic).

6. **Sphenopteris** sp. Plate III, fig. 6; Plate V, figs. 3, 9.

Description of the Specimens.—A very small fragment of a *Sphenopteris* frond, from the Malvern Hills, is figured on Plate III, fig. 6, twice enlarged. The lobes of the pinnules appear to be short but broad. This specimen is, of course, quite indeterminable specifically. I figure it here as being a somewhat unusual type of frond from the Mesozoic rocks.

Another species of *Sphenopteris* (Plate V, figs. 3 and 9, both twice enlarged) occurs in the Hokonui Hills. The pinnules here are oval, slightly lobed, and contracted at the base. Each has a median nerve, and the lateral nerves dichotomize twice, or even three times. Both these specimens, however, are too fragmentary for specific determination.

Occurrence.—Malvern Hills (? Lower Jurassic); McRae's, Hokonui Hills (? Rhætic).

Genus TÆNIOPTERIS Brongniart, 1828.

(*Prodr. Hist. Végét. Foss.*, p. 61.)

Some species of *Tæniopteris*, in which the leaves are large and broad, have been referred to separate genera—such as *Macrotæniopteris* Schimper, *Angiopteridium* Schimper, *Stangerites* Bornemann—by many authors, and more especially by Schimper and Feistmantel. As I pointed out, however, in 1905(1), there are no good characters which clearly distinguish these genera from *Tæniopteris*, and certainly the size and shape of the leaf alone are untrustworthy data on which to base generic distinctions. I therefore prefer to include all such fossils within the single genus *Tæniopteris*.

1. Tæniopteris arctica Heer. Plate VI, figs. 1, 6; Plate VII, figs. 5, 9.

1872. *Tæniopteris arctica* Heer, *Öfvers. k. Vet.-Akad. Förhandl.* for 1871, p. 1181.
1874. *Oleandra arctica* Heer, Kreide Flora Arct. Zone (*Flora Foss. Arctica*, vol. iii, mem. ii), p. 38, pl. xii, figs. 3–11.
1891. Cf. *Oleandra arctica* Newberry, *Amer. Journ. Sci.*, vol. xli, p. 201, pl. xiv, fig. 9.
1903. *Tæniopteris* sp. (cf. *Tæniopteris arctica*) Seward, *Ann. S. Afric. Mus.*, vol. iv, pt. 1, p. 19, pl. ii, figs. 5, 5*a*.

Diagnosis.—The following diagnosis was given by Heer in 1874 (see above): "Foliis coriaceis, petiolatis, lineari-lanceolatis, basin et apicem versus sensim attenuatis, acumimatis, integerrimis nervo medio valido, nervis secundariis horizontalibus, numerosis, dichotomis; soris rotundatis, biseriatis, nervo medio approximatis."

Description of the Specimens.—In Plate VI, fig. 1, several leaves are seen, twice enlarged. The longest frond is 5 cm. long, and about 1 cm. broad. The midrib is fairly strong, and the lateral nerves are very clear, distant, and once forked; the branches of the forks being distant. Fig. 6 of the same plate illustrates a narrower type of frond, natural size. Two other specimens, in the British Museum collection, are shown by figs. 5 and 9 of Plate VII, both somewhat enlarged.

Remarks.—Fragments of this frond also occur on the large specimen figured in Plate XIV, but are not seen in the photograph.

This species in some respects very closely resembles *T. Daintreei* McCoy in habit. It differs, however, in the nervation, the nerves being conspicuous and comparatively distant, forking either near the midrib or at any point between the midrib and margin.

The New Zealand specimens appear to me to agree very closely with the fronds from the Cretaceous of Greenland figured by Heer in 1874 (see above), especially the fig. 3 of plate xii of that memoir. They also somewhat resemble the specimen from the Uitenhage Series of Cape Colony, figured by Seward in 1903, and doubtfully referred to Heer's species.

Occurrence.—Waikato Heads, Auckland (Neocomian).

(1) Arber (1905), p. 120.

2. Tæniopteris crassinervis (Feistmantel). Plate IX, fig. 4; Plate X, figs. 1–3, 5.

1877. *Macrotæniopteris crassinervis* Feistmantel, *Foss. Flora Gondw. Syst. (Pal. Indica)*, vol. i (2), p. 102 (50), pl. xxxviii, figs. 1, 2, 2*a*, 2*b*, 3.

1883. *? Macrotæniopteris crassinervis* Fontaine, *Monogr. vi, U.S. Geol. Surv.*, p. 22, pl. v fig. 5; ? pl. vi, figs. 1, 2.

1886. *Macrotæniopteris lata* Hector, *Det. Cat. & Guide, N. Zeal. Court, Ind. & Colon. Exhib.* p. 66, fig. 30*a*(4).

1892. *Macrotæniopteris crassinervis ?* Etheridge, in Jack and Etheridge, *Geol. & Pal. Queensland*, p. 376, pl. xvi, fig. 5.

1898. *Macrotæniopteris crassinervis* Dun, *Rep. Austr. Assoc. Adv. Sci. Sydney*, vol. vii, p. 398.

Diagnosis.—Fronds with long petioles, very variable in size, from 8 cm. to 19 cm. or more in length, and 1·5 cm. to 8 cm. or more broad. Apex obtuse or obtusely pointed; base suddenly contracted, margins wavy; lamina coriaceous. Midrib stout, up to 1 cm. broad; lateral nerves very stout, ½ mm. across, about 8 to 12 in 1 cm. of length of frond, generally arising at right angles to the midrib, single or once forked.

Description of the Specimens.—The very complete specimen figured on Plate X, fig. 1, about half natural size, gives a very good idea of the mature frond of this species. It is the type of Hector's (not Oldham and Morris's) *Macrotæniopteris lata.* The apex is not quite perfect, and not more than 3 cm. of the rachis is seen at the base. The length of the lamina is 19 cm., and its greatest breadth 6·6 cm. The midrib near the base is 4 mm. across, fairly smooth, at any rate not striated. The nerves are strong (½ mm. across) and fairly distant, about 10 in each centimetre of length. The nerves are simple for the most part, with occasionally a single dichotomy, the limbs of the forks being widely separated. In the greater part of the lamina the lateral nerves arise at right angles to the midrib. At the apex they curve slightly upwards, and at the base downwards.

The specimen figured on Plate X, fig. 2, is interesting, as showing what I take to be a young immature leaf of the same species. It measures 8 cm. in length, but neither the base nor the apex is seen. It has a maximum breadth of 1·5 cm. The apparently pointed termination above is deceptive. This portion of the leaf is in part folded on itself, and in part still covered by the rocky matrix. The nerves are slightly closer than in the previous specimen.

The photograph on Plate X, fig. 3, shows the base of a frond, and the long petiole. This specimen is in the British Museum collection (V. 11679). Another specimen in the same collection (V. 11671), figured on Plate IX, fig. 4, shows the apex of a frond, and the more acute origin of the lateral nerves in this region. On Plate X, fig. 5, part of another specimen (V. 11677) in the same collection is enlarged three times to show the nervation.

There are many other examples of this plant in the New Zealand Survey collection, some of which are of very large size. The fronds may be as much as 8 cm. broad, the stout midrib 1 cm. across, and there may be only 8 or 9 veins in 1 cm. of length of the lamina.

Remarks.—A comparison of the specimens seen on Plate X, fig. 1 and fig. 2, is interesting as showing how little the supposed distinctions founded solely on the size of the frond are to be depended upon, and consequently the absence of any real difference between *Macrotæniopteris* and *Tæniopteris.* The young leaves of the former would certainly be included in the latter genus.

The *Danæites Heerii* of de Zigno(1), from the Jurassic of Italy, closely resembles *Tæniopteris crassinervis* (Feist.), but I am not convinced that the two are identical. Fontaine(2) has also identified certain Tæniopterids from the Trias of Richmond in Virginia, U.S.A., as identical with the Indian plant, but the poor illustrations which he furnishes of these specimens do not suggest that these determinations are correct.

Occurrence.—Mataura Falls (Middle Jurassic).

3. Tæniopteris Daintreei McCoy. Plate VI, fig. 5.

1850. *Tæniopteris spatulata* McClelland, *Rep. Geol. Surv. India* for 1848–49, p. 53, pl. xvi, fig. 1.
1860. *Tæniopteris Daintreei* McCoy, *Trans. Roy. Soc. Victoria,* vol. 7, p. 97.
1863. *Stangerites spathulata* Oldham and Morris, *Foss. Flora Gondw. Syst. (Pal. Indica),* vol. i, pt. i, p. 34, pl. vi, figs. 1–6.
1863. *Stangerites spathulata* var. *multinervis* Oldham and Morris, *ibid.*, p. 34, pl. vi, fig. 7.
1875. *Tæniopteris Daintreei* McCoy, *Pal. Victoria,* Dec. 2, p. 15, pl. xiv, figs. 1 2.
1877. *Angiopteridium spathulatum* Feistmantel, *Foss. Flora Gondw. Syst. (Pal. Indica),* vol. i, pt. ii, pp. 45–107, pl. iv, figs. 1–7.
1877. *Angiopteridium spathulatum* Feistmantel, *ibid.*, vol. i, pt. iii, pp. 10–172, pl. 1, figs. 6*b*, 7*b*.
1878. *Tæinopteris Daentreei* Feistmantel, *Palæontogr.*, Suppl. iii, Lief. 3, Heft 1, p. 110, pl. 14, figs. 2, 3.
1879. *Angiopteridium spathulatum* Feistmantel, *Foss. Flora Gondw. Syst. (Pal. Indica),* vol. i, pt. iv, pp. 16–206, pl. i, figs. 8–13, 17, 18; pl. ii, figs. 3, 5, 6; pl. xv, fig. 11.
1879. *Angiopteridium McClellandi* Feistmantel, *ibid.*, pp. 17–207, pl. i, figs. 14–16; pl. ii, fig. 4.
1890. *Tæniopteris Daintreei* Feistmantel, *Abhandl. k. böhm. Gesell. Wissen. (Math. Natur. Cl.),* Folge vii, Bd. 3, No. 6, p. 66, pl. 2, fig. 11.
1890. *Tæniopteris Daintreei* Feistmantel, *Mem. Geol. Surv. N.S. Wales, Pal. No. 3,* p. 114, pl. xxvii, figs. 4, 5; pl. xxviii, figs. 6, 6*a*.
1892. *Tæniopteris Daintreei* McCoy, in Stirling, *Rep. Victorian Coalfields,* 1 and 2, p. 12, pl. ii, figs. 11, 12.
1898. *Angiopteridium spathulata* Dun, *Rep. Austral. Assoc. Adv. Sci., Sydney* p. 390.
1900. *Tæniopteris Daintreei* McCoy, in Stirling, *Rep. Victorian Coalfields No. 7,* p. 3, pl. i, fig. 5*b*; pl. ii, figs. 4, 7, 7*a*; pl. ii A.
1904. *Tæniopteris Daintreei* Seward, *Rec. Geol. Surv. Victoria,* vol. i, pt. iii, p. 168, pl. xiii, figs. 19, 20–22; pl. xiv, fig. 18; ? pl. xv, figs. 23, 24.

Diagnosis.—McCoy in 1875 (see above) gave the following diagnosis of this species: Frond very long, linear, parallel-sided; substance thick; edges straight; midrib thick, very strong; veins extending at right angles from the midrib to the lateral margins, a few straight and simple, the greater number once forked at a variable distance between the midrib and lateral margin. Usual width of frond, 4 lines; about 10 or 11 lateral veins in the space of 2 lines at the margin (both of ordinary specimens 4 lines wide, and one young fragment nearly 2 in. long, but only 1½ lines wide throughout).

Description of the Specimens.—*T. Daintreei* appears to be abundant in several localities in New Zealand. The specimen figured on Plate VI, fig. 5 (natural size), is from the Malvern Hills. It is a fragment of a narrow frond, 4 cm. long and about 1 cm. across. The midrib is stout, but the lateral nervation is not very clear.

Remarks.—This and other specimens appear to me to be quite similar to those figured from the Jurassic rocks of Victoria by Seward in 1904 as *T. Daintreei.*

Occurrence.—Clent Hills (Rhætic); McRae's, Makarewa, Hokonui Hills (? Rhætic); Hedgehope, Hokonui Hills (? Rhætic); Owaka Creek, Catlin's River (? Rhætic); Malvern Hills (? Lower Jurassic).

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(1) de Zigno (1856), p. 208, pl. xxv.

(2) Fontaine (1883), p. 22, pl. v, fig. 5; pl. vi, figs. 1, 2.

4. Tæniopteris Thomsoniana sp. nov. Plate VI, fig. 4; Plate VIII, figs. 4, 7.

1913. *Tæniopteris Daintreei* Arber, *Proc. Roy. Soc. London,* ser. B, vol. lxxxvi, p. 346, pl. viii, fig. 5.

Diagnosis.—Frond rather small, spathulate, broadest at apex, 3 cm. to 7 cm. or more in length, and up to 2 cm. broad. Apex broadly rounded. Median nerve fairly strong; lateral nerves fine, fairly close, arising at right angles to the median nerve, for the most part simple, but not infrequently forked near the midrib, and occasionally between the median nerve and the margin.

Description of the Specimens.—Two leaves from the Clent Hills are figured on Plate VIII, figs. 4 and 7, both natural size. A likewise incomplete leaf from Mount Potts is figured, twice enlarged, on Plate VI, fig. 4. This has a length of over 6 cm.

Remarks.—I have previously recorded this species as *Tæniopteris Daintreei* McCoy, but I am now of the opinion that it is a distinct species, which I propose to name *T. Thomsoniana,* in honour of Dr. J. Allan Thomson, F.G.S., of New Zealand. This species is particularly characterized by the relatively small size of the leaf, the spathulate form, and the comparatively infrequent dichotomy of the lateral nerves. Of the Australian Tænipoterids, it appears to approach nearest to *T. lentriculiforme* (Ether.)(1), which it somewhat resembles as regards the lateral nervation, though in the New Zealand plant the nerves appear to dichotomize more frequently. It is, however, distinguished by the form of the frond.

Type.—British Museum (Natural History).

Occurrence.—Mount Potts (Rhætic); Clent Hills (Rhætic).

5. Tæniopteris vittata Brongniart. Plate IV, fig. 4; Plate VI, figs. 2, 3.

1822. "Blattstuch einer Scitaminea" Sternberg, *Vers. Darstell. Flora Vorwelt,* Heft iii. p. 37, pl. xxxvii, fig. 2.
1828. *Tæniopteris vittata* Brongniart, *Prodr. Hist. Végét. Foss.,* p. 62.
1831–32. *Tæniopteris vittata* Brongniart, *Hist. Végét. Foss.,* p. 263, pl. lxxxii, figs. 1–4.
1829. *Scolopendrium solitarium* Phillips, *Geol. Yorks.,* 1st ed., p. 147, pl. viii, fig. 5.
1833. *Tæniopteris vittata* Lindley and Hutton, *Foss. Flora,* vol. i, pl. lxii.
1837. *Tæniopteris vittata* Lindley and Hutton, *ibid.,* vol. iii, pl. clxxvi B.
1865. *Tæniopteris vittata* Eichwald, *Leth. Ross.,* vol. ii, p. 24, pl. ii, fig. 5.
1869. *Oleandridium vittatum* Schimper, *Traité. Pal. Végét.,* vol. i, p. 607.
1873. *Tæniopteris vittata* Saporta, *Pal. Franç.,* vol. i, p. 444, pl. lxiv, figs. 1–5.
1875. *Tæniopteris vittata* Phillips, *Geol. Yorks.,* 3rd ed., p. 205, pl. viii, fig. 5.
1876. *Oleandridium vittatum* Feistmantel, *Foss. Flora Gondw. Syst. (Pal. Indica),* vol. ii, pt. i, p. 15, pl. 1, fig. 5.
1876. Cf. *Tæniopteris mareyesiaca* Geinitz, *Palæontogr.,* Suppl. iii, Lief. ii (2), p. 9, pl. ii, figs. 1–3.
1887. Cf. *Oleandridium tenuinerve* Schenk, *Bibl. Bot.* (Uhlworm and Haenlein), Heft vi, p. 4, pl. v, fig. 20*a*.
1890. *Oleandridium vittatum* Schimper, in Zittel, *Handb. Pal.,* Abth. ii, Palæophyt., p. 133, fig. 107.
1897. *? Oleandridium vittatum* Bartholin, *Danmarks Geol. Undersög. 2 Raekke,* No. 7, p. 15, pl. —, fig. 8.
1900. *Tæniopteris vittata* Seward, *Jurass. Flora,* vol. i, p. 157, pl. xvi, fig. 1.
1910. *Tæniopteris spathulata* Krystofovic, *Mém. Com. Géol. St. Pétersbourg,* N.S., Livr. 56, p. 9, pl. ii, figs. 2, 2*a*.
1911. *Tæniopteris vittata* Thomas, *ibid.,* N.S., Livr. 71, pp. 23, 71, pl. iv. figs. 2, 3.
1911. *Tæniopteris vittata* Seward, *ibid.,* Livr. 75, pp. 16, 45, pl. iii, figs. 30, 31.

Diagnosis.—Leaf simple, broadly or narrowly linear, ribbon-shaped or elliptical, contracted somewhat at the base and apex, up to 20 cm. or more in length, and from 7 mm. to 3 cm. in width. Lateral nerves fine, close, arising at right

(1) Etheridge 1894[2]), p. 49, pl. viii.

angles to the midrib, simple or frequently forked either near the midrib or near the margin.

Description of the Specimens.—Several fragments of fronds of this species are seen, natural size, on Plate VI, figs. 2, 3. On Plate IV, fig. 4, another leaf is shown, somewhat contracted towards the base, and with a stout midrib. This, perhaps more than any of the other examples, resembles the British specimens of *Tæniopteris vittata.*

Remarks.—These specimens appear to me to be indistinguishable from those of *T. vittata* occurring in the Yorkshire Oolites. The form of the frond is perhaps a little more ribbon-shaped and less elongately elliptical than in the English fossils, though in the specimen shown on Plate IV, fig. 4, we have a type more attenuated at one extremity, like the British plants. I therefore do not attach any importance to such slight variations in the form of the frond. As regards the nervation, the New Zealand specimens appear to me to be identical with the British, in which, however, the nerves may be a little finer and closer.

Occurrence.—Curio Bay, Waikawa (Middle Jurassic).

Genus THINNFELDIA Ettingshausen, 1852.

(*Abh. k.k. Geol. Reichs.*, Bd. i, Abth. 3, No. 3, p. 2.)

Gothan(1) has recently proposed to remove three of the species from New Zealand here discussed to a new genus, *Dicroïdium*, as distinct from *Thinnfeldia.* The forking habit of the fronds of *T. odontopteroides*, *T. lancifolia*, and *T. Feistmanteli* is regarded as one point of dissimilarity, worthy of generic distinction. Others relate to certain features presented by cuticle preparations, especially the distribution of the stomata, and the presence or absence of subsidiary cells. As Antevs(2) has already pointed out, it is doubtful whether, as regards the latter points, there is any real distinction between these species and European members of the genus *Thinnfeldia.* So far as the branching of the frond is concerned, this feature does not appear to me of sufficient importance to warrant generic distinction, and I therefore prefer for the present to retain the well-established usage of referring the southern species to *Thinnfeldia*, to the members of which genus they are undoubtedly very similar in many respects.

1. Thinnfeldia sp., *cf.* T. argentinica (Geinitz). Plate I, fig. 9.

1876. *Otopteris argentinica* Geinitz, *Palæontogr.*, Suppl. iii, Lief. ii, (2) p. 6, pl. ii, figs. 5*a*, 5*b*.

Diagnosis.—Frond pinnate or (?) dichotomizing; pinnules thick, rhomboidal; nerves strong, arising independently from the rachis, and dichotomizing.

Description of the Specimen.—A fragment of a frond of *Thinnfeldia*, which is figured on Plate I, fig. 9, natural size, occurring in the New Zealand Geological Survey collection from the Clent Hills, shows several more or less rhomboidal pinnules, with strong dichotomizing nerves radiating from the base, and in most cases derived directly from the rachis. The pinnules appear to be somewhat thick and fleshy, and are contracted at the base.

Remarks.—The New Zealand specimen appears to agree fairly closely with Geinitz's species from Argentina, the chief difference being that in the latter the pinnules are distinctly rhomboidal in shape, though less so in the New Zealand fossil, where the angles are more rounded. The nervation appears, however, to be very similar in both

(1) Gothan (1912). (2) Antevs (1914).

specimens. On account of the slight difference in the shape of the pinnules, and especially in view of the fragmentary nature of the New Zealand fossil, I have been content simply to compare it with that described from Argentina.

Occurrence.—Clent Hills (Rhætic).

2. Thinnfeldia Feistmanteli ? (Gothan). Plate V, fig. 4.

1890. *Thinnfeldia odontopteroides* (pars) Feistmantel, *Mem. Geol. Surv. N.S. Wales, Pal. No. 3,* p. 101, pl. xxv.
1912. *Dicroïdium Feistmanteli* Gothan, *Abhandl. Naturhist. Gesellsch. Nürnberg,* vol. xix, p. 78, pl. xvi, fig. 1.
1913. *Dicroïdium Feistmanteli* Antevs, *K. svenska Vet.-Akad. Handl.,* vol. lii, No. 5, p. 1, pl. i, figs. 1–7.
1914. *Dicroïdium Feistmanteli* Antevs, *ibid.,* vol. li, No. 6, p. 52, pl. 1, figs. 5, 6; pl. 5, fig. 1.

Diagnosis.—Frond bipinnate above, dichotomous below; primary rachis stout; pinnæ lanceolate; pinnules large, unsymmetrically oval, approximated, confluent at the base especially towards the apex of the pinna. Nerves radiating from the base with frequent dichotomy.

Description of the Specimen.—Two pinnæ attached to a rachis are seen on Plate V, fig. 4, twice enlarged to show the nervation. The rachis is comparatively slender. The pinnæ measure 4 cm. or more in length, and the pinnules are unsymmetrically oval, and more or less united. There is no distinct midrib, the nerves all arising directly from the rachis and dichotomizing freely.

Remarks.—Gothan has recently distinguished one of the Australian specimens, assigned by Feistmantel in 1890 to *Thinnfeldia odontopteroides* (Morr.), as a new species, *Dicroïdium Feistmanteli* sp. This type is bipinnate above, and the pinnules are broader than in the ordinary forms of *T. odontopteroides.* It is difficult to decide whether it is really worthy of generic distinction or not, but, on the whole, I am inclined to accept *T. Feistmanteli* as a distinct species. In the present specimen the pinnules are thinner and less leathery than is usually the case in *T. odontopteroides,* but the rachis is much more slender than in the type specimen of *T. Feistmanteli,* and the pinnules are at the same time much smaller. I therefore regard the specific assignment of the New Zealand plant as somewhat doubtful.

Occurrence.—Owaka Creek, Catlin's River (? Rhætic); Curio Bay, Waikawa (Middle Jurassic).

3. Thinnfeldia lancifolia (Morris). Plate V, figs. 1, 2, (?) 6.

1845. *Pecopteris odontopteroides* var. *lancifolia* Morris, in Strzelecki, *Phys. Descr. N.S. Wales,* p. 249, pl. vi, fig. 4.
1888. *Thinnfeldia lancifolia* Szajnocha, *Sitzungsb. k. Akad. Wissen., Wien (Math.-Nat. Cl.),* vol. xcvii, p. 231, pl. i, figs. 4*b*, 5, 6, 7.
1909. *Thinnfeldia lancifolia* Dun, *Rec. Geol. Surv. N.S. Wales,* vol. viii, pt. iv, p. 316.
1912. *Dicroïdium lancifolia* Gothan, *Abhandl. naturhist. Gesell. Nürnberg,* vol. xix, p. 78, pl. xvi, figs. 2–4.
1913. *Thinnfeldia lancifolia* Arber, *Proc. Roy. Soc. London,* ser. B, vol. lxxxvi, p. 346, pl. viii, fig. 7.
1914. *Dicroïdium lancifolium* Antevs, *K. svenska Vet.-Akad. Handl.,* vol. li, No. 6, p. 58, pl. v, figs. 6, 7.

Diagnosis.—Habit as in *T. odontopteroides* (Morr.), (*q.v.*), but pinnules are elongate, bluntly lanceolate, decurrent, with a distinct midrib. The lateral nerves arise in part from the midrib, in part direct from the rachis, usually dichotomizing once, sometimes twice. Differs from *T. indica* Feistm. in the pinnules being neither contracted at the base nor acute at the apex.

Description of the Specimens.—Two fronds of this plant are figured on Plate V, figs. 1 and 2, the latter somewhat enlarged. Both show the actual dichotomy. The elongately lanceolate pinnules are only very slightly contracted at the base, as is well seen in both specimens. Another fragment is figured on fig. 6 of the same plate, twice enlarged.

Remarks.—This species of *Thinnfeldia* appears to be a rarer type than *T. odontopteroides*, and has been known hitherto only from Australia and South America.

Occurrence.—Mount Potts (Rhætic); McRae's, Makarewa, Hokonui Hills (? Rhætic); Owaka Creek, Catlin's River (? Rhætic).

4. **Thinnfeldia odontopteroides** (Morris). Plate I, fig. 7; Plate V, fig. 5.

1845. *Pecopteris odontopteroides* Morris, in Strzelecki, *Phys. Descrip. N.S. Wales and Van Diemen's Land*, p. 249, pl. vi, figs. 2–4.
1847. *Gleichenites odontopteroides* McCoy, *Ann. and Mag. Nat. Hist.*, vol. xx, p. 147.
1869. *Alethopteris ? odontopteroides* Schimper *Traité. Pal. Végét*, vol. i, p. 569.
1869. *Cycadopteris odontopteroides* Schimper, *ibid.*, p. 488.
1872. *Pecopteris odontopteroides* Carruthers, *Quart. Journ. Geol. Soc.*, vol. xxviii, p. 355, pl. xxvii, figs. 2, 3.
1875. *Pecopteris odontopteroides* Crépin, *Bull. Acad. Roy. Belgique*, ser. 2, vol. xxxix, p. 258, pl. —, figs. 1–5.
1876. *Thinnfeldia crassinervis* Geinitz, *Palæontogr.*, Suppl. iii, Lief. ii, p. 4, pl. 1, figs. 10–16.
1878–79. *Thinnfeldia (Pecopteris) odontopteroides* Feistmantel, *Palæontogr.*, Suppl. iii, Lief. iii, pp. 80, 169, pl. ix–xi; pl. xiii, fig. 5; pl. xiv, fig. 5; pl. xv, figs. 3–7; pl. xvi, fig. 1.
1881. *Thinnfeldia* cf. *odontopteroides* Feistmantel, *Foss. Flora Gondw. Syst. (Pal. Indica)*, vol. iii, pt. 3, p. 85, pl. xxiii A, figs. 7–9.
1885. *Thinnfeldia odontopteroides* Curran, *Proc. Linn. Soc. N.S. Wales*, vol. ix for 1884, p. 252, pl. ix, fig. 4.
1888. *Pecopteris (Thinnfeldia) odontopteroides* Johnston, *Geol. Tasmania*, pl. xxv, figs, 1, 2, 4.
1888. *Thinnfeldia odontopteroides* Szajnocha, *Sitzungsb. k. Akad. Wissen. Wien (Math.-Nat. Cl.)*, vol. xcvii, pt. 1, p. 228, pl. 1, figs. 1–3, 4*a*.
1890. *Thinnfeldia odontopteroides* Feistmantel, *Mem. Geol. Surv. N.S. Wales, Pal. No. 3*, p. 101, pl. xxiii–xxv; pl. xxvi, figs. 1, 2; pl. xxviii, fig. 8; pl. xxix, figs. 1–5.
1892. *Thinnfeldia odontopteroides* Jack and Etheridge, *Geol. & Palæont. Queensland*, p. 368, pl. xvii, fig. 1.
1898. *Thinnfeldia odontopteroides* var. *normalis*, Shirley, *Bull. 7, Geol. Surv. Queensland*, p. 21, pl. xi.
1902. *Thinnfeldia odontopteroides* Etheridge, in Brown, *Contrib. 12 & 13, Pal. South Australia*, p. 2, pl. i.
1902. *Thinnfeldia odontopteroides* Shirley, *Bull. 18, Geol. Surv. Queensland*, p. 11.
1902. *Thinnfeldia odontopteroides* Arber, *Quart. Journ. Geol. Soc.*, vol. lviii, p. 2.
1903. *Thinnfeldia odontopteroides* Seward, *Ann. S. African Mus.*, vol. iv. pt. 1, p. 52, pl. vii, figs. 1, 7, 8, 8*a*; pl. viii, figs. 7, 8; pl. ix, figs. 7, 8; pl. xi, fig. 2.
1908. *Thinnfeldia odontopteroides* Seward, *Quart. Journ. Geol. Soc.*, vol. lxiv, p. 92, pl. iv, fig. 1; pl. v, fig. 1; and text-figs. 3, 4.
1909. *Thinnfeldia odontopteroides* Dun, *Rec. Geol. Surv. N.S. Wales*, vol. viii, pt. iv, p. 315, pl. xlix, figs. 1, 2.
1912. *Dicroïdium odontopteroides* Gothan, *Abhandl. naturhist. Gesellsch. Nürnberg*, vol. xix, pt. iii, p. 78, pl. 15, fig. 4; pl. xvi, fig. 5.
1912. *Dicroïdium odontopteroides* Gothan, *ibid.*, vol. xix, pt. iv.
1914. *Dicroïdium odontopteroides* Antevs, *K. svenska Vet.-Akad. Handl.*, vol. li, No. 6, p. 55, pl. ii, figs. 2, 3; pl. iv, figs. 6, 7.

Diagnosis.—Fronds pinnate, frequently bifurcating into two equal approximated pinnæ. Rachis stout. Pinnules crowded, thick, very variable in form and in size, either broadly semicircular, deltoid, or oval, confluent at the base; nerves all arising directly from the rachis, and spreading throughout the lamina with dichotomy, or a more or less well-marked median nerve may be present, giving off forked lateral nerves at an acute angle.

Description of the Specimens.—The specimen from the Clent Hills, figured on Plate I, fig. 7, natural size, is quite the normal type of this species. The pinnules have a very broad base, and the nerves arise directly from the rachis. Several other examples occur in the collection, including forms with very short pinnules only 5 mm. long, and others with subcircular leaflets, like those from Owaka Creek shown on Plate V, fig. 5.

Remarks.—This fossil is one of the most characteristic plants of the Triassic rocks of the Southern Hemisphere, especially of Australia. It also occurs in South Africa and South America, and more rarely in India, in beds of the same age. In Europe and elsewhere other species of the same genus are commonly met with in the Rhætic and Liassic.

Occurrence.—Clent Hills (Rhætic), Owaka Creek, Catlin's River (? Rhætic).

Thinnfeldia sp. Plate II, fig. 11.

Description of the Specimen.—In Mr. Nicol's collection from Gore a specimen occurs of which a drawing is seen on Plate II, fig. 11. Several fragments of pinnæ are here shown. The left-hand example appears to me to recall *Thinnfeldia lancifolia* (Morris)(1), but most of the others appear to be lobed pinnules, showing various degrees of division. Unfortunately, all the leaves are too fragmentary to permit of specific determination.

Occurrence.—Mokoia, Gore (? Lower Jurassic).

Phylum CYCADOPHYTA.

Genus CYCADITES Sternberg, 1833.

(*Vers. Darstell. Flora Vorwelt,* Heft 5, 6, p. xxxii.)

Cycadites sp. Fig. 10.

Description of the Specimen.—A small fragment of a frond of *Cycadites* occurs in Professor Marshall's collection at Dunedin. The leaflets are narrow, and show in many cases the paired median nerves. It has not, however, been found possible to obtain preparations of the cuticle either in this or other specimens from New Zealand, since the preservation is not of the type necessary for this purpose. The fragment is too small to permit of specific determination. I refer it to *Cycadites* rather than to *Pseudocycas,* in accordance with Miss Holden's(2) conclusions on these genera.

Occurrence.—Curio Bay, Waikawa (Middle Jurassic).

Genus NILSSONIA Brongniart, 1824.

(*Am. Sci. Nat.* vol. iv, p. 10.)

1. Nilssonia compta ? (Phillips). Plate VIII, figs. 2, 3, 9.

1829. *Cycadites comptus* Phillips, *Geol. Yorks.,* 1st ed., p. 148, pl. vii, fig. 20.
1833. *Pterophyllum comptum* Lindley and Hutton, *Foss. Flora,* vol. i, pl. lxvi.
1863. *Pterophyllum princeps* Oldham and Morris, *Foss. Flora Gondwana Syst. (Pal. Indica),* vol. i pt. i, p. 23, pl. x, figs. 1–3; pl. xi, figs. 1, 2; pl. xii, fig. 1; pl. xiii, figs. 1, 2.
1863. *Pterophyllum* sp. Oldham and Morris, *ibid.,* p. 25, pl. xii, figs. 2–5.
1864. *Pterophyllum comptum* Leckenby, *Quart. Journ. Geol. Soc.,* vol. xx, p. 77, pl. ix, fig. 1.
1875. *Pterophyllum comptum* Phillips, *Geol. Yorks.,* 3rd ed., p. 227, pl. vii, fig. 20.
1883. *Nilssonia compta* Schenk, in Richthofen's *China,* vol. iv, p. 262, pl. liv, fig. 2.
1900. *Nilssonia compta* Seward, *Jurass. Flora,* vol. i, p. 223, pl. iv, fig. 5; text-figs. 39, 40.
1911. *Nilssonia compta* Thomas, *Mém. Com. Géol. St. Pétersbourg,* N.S., Livr. 71, pp. 39, 85, pl. vi, fig. 3.

Diagnosis.—The following diagnosis was given by Seward in 1900 (see above): "Frond broadly linear; varying considerably in size, and in the depth, and number

(1) *Cf.* Szajnocha (1888[1]), p. 231, pl. 1, figs. 4–6. (2) Holden (1914).

of the segments. The lamina is dissected up to the central midrib or rachis into truncate segments of unequal breadth, traversed by several parallel veins both simple and forked; the lamina is continuous over the rachis of the frond, and the segments are not laterally attached as in *Pterophyllum*."

Description of the Specimens.—A few fragments of a species of *Nilssonia* occur at Mokoia, Gore, three of which are figured on Plate VIII, figs. 2, 3, and 9, all natural size. That shown by fig. 3 measures nearly 4 cm. in length, and has a breadth of about 1 cm. The upper segment is not apical. The appearance of the frond here is due to the segments on either side of the midrib being imperfectly preserved. The segments are of unequal breadth, and truncated distally. The nervation is only faintly preserved, but most of the lateral nerves appear to be simple (*cf.* fig. 9). A short fragment similar to the last, showing the nerves more clearly, is shown by fig. 9 of the same plate. The unequal breadth of the segments is clearly seen here. A similar specimen is also seen in fig. 2.

Remarks.—It seems to me very probable that these specimens are simply small fronds of *Nilssonia compta* (Phill.), similar to those figured by Oldham and Morris(1) and by Seward(2).

Occurrence.—Mokoia, Gore (? Lower Jurassic).

2. **Nilssonia elegans** sp. nov. Plate VIII, fig. 8; Plate IX, figs. 1, 3.

Diagnosis.—Leaf up to 9–10 cm. in length, and from 2 mm. to 10 mm. broad; midrib strong, 1·5 mm. across; lamina very narrow, entire or lobed or divided to the midrib; lobes of unequal size, more or less rectangular; apex subacute or bluntly pointed.

Description of Specimens.—An undivided frond, about 9 cm. long, but only 7 mm. across at its broadest part, is seen on Plate IX, fig. 1, natural size. It apparently has an acute apex. The nervation is not seen in this specimen. Another incomplete specimen, 5 cm. long, with a more or less deeply lobed lamina, is shown twice enlarged on Plate IX, fig. 3. The nerves are here faintly seen. They are fine, parallel, and somewhat distant, and no doubt occasionally fork. The narrower leaves, which are seen scattered about on the same specimen, appear to be either young fronds of this species in which the lamina is very narrow, or the long basal portions of leaves.

A drawing of a group of three leaves is shown on Plate VIII, fig. 8. These are similar to those just described. The lobes or divisions are very irregular in size, and are truncated distally. Here again the nervation is only very faintly preserved.

Remarks.—This plant has something in common, as regards habit, with *Nilssonia polymorpha* Schenk(3), a much larger plant, quite distinct specifically, but showing equally transitions from the simple to a compound leaf. It does not agree with any of the species recently figured by Nathorst(4).

Type.—New Zealand Geological Survey collection.

Occurrence.—Mataura Falls, Southland (Middle Jurassic).

Genus PTEROPHYLLUM Brongniart, 1824.

(*Ann. Sci. Nat.*, ser. i, vol. iv, p. 211.)

Pterophyllum matauriensis Hector. Plate IX, fig. 2; Plate XII, fig. 1.

1886. *Pterophyllum matauriensis* Hector, *Det. Cat. & Guide, N. Zeal. Court, Ind. & Col. Exhib.*, p. 66, text-fig. 30*a*(7).

Diagnosis.—Pinnate fronds, up to 11 cm. in length. Rachis stout, up to 2·5 mm. across, grooved; pinnæ attached at the side of the rachis; alternate, or more rarely subopposite, 2·5 cm. to 3 cm. in length, broadest near the point of attachment, up

(1) Oldham and Morris (1863), pl. xii, figs. 2–5.
(2) Seward (1900), text-fig. 39 on p. 225.
(3) Schenk. (1867), p. 127, pl. xxix; pl. xxx, figs. 1–5; pl. xxxi, figs. 1*a*, 1*b*, 1*c*.
(4) Nathorst (1909).

to 4 mm. to 6 mm. in width at greatest breadth, more or less lanceolate, gradually tapering to an obtuse bluntly rounded apex. Veins parallel, 5 or more in each pinnule near the base, occasionally forking.

Description of the Specimens.—Two specimens from Mataura Falls are figured. Fig. 1 (natural size), Plate XII, shows the general habit, and fig. 2, Plate XVIII, is an enlarged photograph of another specimen, showing the bases of the pinnules and their nervation. Hector's figure (see above) is quite inaccurate as regards the apical characters of the leaflets, which are shown as if they were extremely acute, whereas in reality they are bluntly rounded.

Remarks.—Hector's plant is, I believe, a distinct type, not previously described. Its nearest affinities appear to be *Pterophyllum Sandbergeri* Schenk(1), from the Keuper of Raibl, Austria, and *P. Münsteri* Schenk(2), from the Rhætic of Germany. There are, of course, many other species from Rhætic or Jurassic beds in various parts of the world with which more remote comparisons might be instituted.

Type.—New Zealand Geological Survey collection.

Occurrence.—Mataura Falls, Southland (Middle Jurassic).

Genus PTILOPHYLLUM Morris, 1840.

(*Trans. Geol. Soc.*, ser. 2, vol. v, p. 327.)

1. Ptilophyllum acutifolium Morris. Plate XI, figs. 1, 2, 5.

1840. *Ptilophyllum acutifolium* Morris, *Trans. Geol. Soc.*, ser. 2, vol. v, p. 327, pl. xxi, figs. 1–3.
1841. *Ptilophyllum acutifolium* Morris, *Ann. & Mag. Nat. Hist.*, vol. vii, p. 117.
1850. *Zamia Theobaldii* McClelland, *Rep. Geol. Surv. India*, for 1848–49, p. 52, pl. xii, figs. 1, 2.
1863. *Palæozamia acutifolium* Oldham and Morris, *Foss. Flora Gondwana Syst. (Pal. Indica)*, vol. i, pt. i, p. 29, pl. xx, figs. 1, 2; pl. xxi, fig. 2.
1863. *Palæozamia acutifolium* var. *conferta* Oldham and Morris, *ibid.*, p. 29, pl. xx, fig. 3.
1867. *Palæozamia acutifolium* Blandford, *Mem. Geol. Surv. India*, vol. vi, pp. 9, 16.
1870–72. *Ptilophyllum acutifolium* Schimper, *Traité Pal. Végét.*, vol. ii, p. 166.
1872. *Palæozamia acutifolia* Wynne, *Mem. Geol. Surv. India*, vol. ix, p. 173.
1876. *Ptilophyllum acutifolium* Feistmantel, *Foss. Flora Gondwana Syst. (Pal. Indica)*, vol. ii, pt. i, p. 44, pl. v, figs. 4, 4*a*.
1877. *Ptilophyllum (Palæozamia) acutifolium* Feistmantel, *Palæontogr.*, Suppl. iii, Lief. iii, p. 11, pl. i; pl. ii; pl. iii, figs. 1, 2.
1877. *Ptilophyllum acutifolium* Feistmantel, *Foss. Flora Gondwana Syst. (Pal. Indica)*, vol. i, pt. ii, pp. 65–117, pl. xl.
1877. *Ptilophyllum acutifolium* Feistmantel, *ibid.*, vol. i, pt. iii, pp. 178–216, pl. ii, figs. 1, 2, 4.
1877. *Ptilophyllum acutifolium* Feistmantel, *ibid.*, vol. ii, pt. ii, pp. 94–114; pl. v; pl. vi, fig. 2.
1879. *Ptilophyllum acutifolium* Feistmantel, *ibid.*, vol. i, pt. iv., pp. 23–213, pl. x, figs. 1–3, 7–9; pl. xi, fig. 1; pl. xv, figs. 12, 13; pl. xvi, fig. 14.
1913. *Ptilophyllum acutifolium* Halle, *K. svenska Vet.-Akad. Handl.*, vol. li, No. 3, p. 34, pl. iii, figs. 1–12.

Diagnosis.—Leaf pinnate, elongately lanceolate, exceeding 15 cm. in length and 1·5 cm. in breadth. Pinnules 1–4 cm. in length, and 3 mm. across at the base, approximated, alternate, elongately lanceolate, broadest at the base, straight or more usually falcate, apex acuminate, base unsymmetrical, upper margin auriculate, rounded, lower margin straight. Nerves about 5, arising from the rachis, and usually forking once, subparallel, radiating from the base.

Description of the Specimens.—The specimen seen on Plate XI, fig. 5, natural size, shows several fragments of these leaves. A single leaf occurring on the back of the

(1) Schenk (1866), p. 17, pl. i, fig. 9. (2) Schenk (1867), p. 167, pl. xxxix, figs. 1–3.

same specimen is seen on the same plate (fig. 2). It measures nearly 12 cm. in length. The form of the bases of the pinnules, and the acute apices, are well seen. Part of another leaf is figured, three times enlarged, on Plate XI, fig. 1, to show the nervation.

Remarks.—This plant is abundant at Waikawa. The pinnules of the leaves are not so long as those from India figured by Oldham and Morris, but correspond more closely with their variety "*conferta*" (see above). They are also shorter than the majority of Feistmantel's specimens, though that author has also figured(1) several short-pinnuled leaves, with which the New Zealand specimens may be compared.

The resemblance to the Wealden fronds from Patagonia recently figured by Halle(2) is still more remote. No doubt great variations are met with in the fronds of this species.

Seward(3) has concluded that *Ptilophyllum acutifolium* is identical with *Williamsonia pecten* (Phill.). I am not, however, convinced as to the specific identity, though no doubt, generically, the two plants are closely allied.

Occurrence.—Curio Bay, Waikawa (Middle Jurassic).

Stem of (?) **Ptilophyllum** sp. Plate XII, fig. 5.

Description of the Specimen.—The stem structure seen on Plate XII, fig. 5, natural size, is associated with leaves of *Ptilophyllum acutifolium* at Waikawa, and may possibly be the stem of that plant. It has a highly branched axis, three branches being seen in the figure—one a comparatively long one on the left-hand side, and two short lengths of branches below on the right. These axes show, however, no definite scars or other surface features, and they are probably decorticated. Fragments of petioles, which resemble the bases of the leaves of *Ptilophyllum acutifolium*, are apparently attached to the main branches, but actual continuity between the stem and the leaves cannot be demonstrated. The evidence of association is, however, in this case fairly strong in support of the provisional view that this specimen may be the stem of *Ptilophyllum acutifolium* Morr.

Remarks.—This specimen somewhat recalls in appearance a badly preserved decorticated stem of *Williamsonia* in the Sedgwick Museum, Cambridge.

Pinnule of a Cycadophyte. Plate VII, fig. 7.

Remarks on the Specimen.—A single pinnule of a frond of a Cycadophyte, perhaps a *Pterophyllum*, occurs in the Mokoia beds near Gore. This is figured, natural size, on Plate VII, fig. 7. The pinnule is narrow, and has six parallel nerves, but unfortunately it is too fragmentary for even generic determination.

Phylum PODOZAMITEÆ.

Genus PODOZAMITES Braun, 1843.

(In Münster, *Beitr. Petrifact.*, Heft vi, p. 28.)

Podozamites gracilis sp. nov. Figs. 11, 12.

Diagnosis.—Shoots exceeding 20 cm. in length. Leaves spirally arranged, linear-lanceolate, up to 6 cm. in length, and 4 mm. to 5 mm. broad at their greatest width. Base gradually contracted, but not decurrent, apex acuminate. Nerves about 5 to 7 in number, parallel.

(1) Feistmantel (1876[1]), pl. v, fig. 4 ; (1876[2]), pl. i, figs. 2, 3 ; (1877[3]), pl. v. fig. 5 ; (1879[2]) pl. x, fig. 3 ; pl. xv, figs. 12, 13.

(2) Halle (1913[2]), p. 34, pl. iii, figs. 1–12.

(3) Seward (1900), p. 193 ; (1904[2]), p. 108.

Description of the Specimens.—There are several specimens in the New Zealand Survey collections from Waikawa, which appear to represent a new species of *Podozamites*. None of these, however, are at all perfect. A photograph of one, showing the general habit of the leafy shoot, is reproduced, natural size, as fig. 11. Fig. 12 is a drawing of another example, in which the individual leaves attached to the stem are seen more clearly.

Remarks.—This plant appears to be a very distinct species, characterized by the narrow linear leaves. In the British Jurassic type, *Podozamites lanceolatus* (L. & H.), the leaves are much broader and more lanceolate in form. In the common Rhætic species of Australia, *P. elongatus* (Morr.), the leaves are also broader and more elongated.

In 1868 Eichwald(1) figured a leaf from the Jurassic of Russia under the name *Zamites angustifolius* sp. nov. Judged by his figure, this specimen is probably more correctly assigned to *Zamites* than to *Podozamites*, to which, however both Heer and Schimper(2) have referred it. The base of the leaf is clearly decurrent, and the general habit is much more like that of a Cycadean frond than of a shoot bearing spirally arranged leaves. Heer(3) has, however, referred some further plants from Siberia to Eichwald's species, as *Podozamites angustifolius* (Eichw.). Some of these approach *Podozamites gracilis* somewhat closely, though the leaves appear to be shorter and rather different in shape.

Type.—New Zealand Geological Survey collection.

Occurrence.—Curio Bay, Waikawa (Middle Jurassic).

FIG. 12. PODOZAMITES GRACILIS SP. NOV., FROM WAIKAWA.

In the New Zealand Geological Survey Collection. Natural size.

(1) Eichwald (1863), vol. ii, p. 39, pl. 2, fig. 7.
(2) Schimper (1869), vol. ii, p. 160.
(3) Heer (1876²), pl. 45, pl. xxvi, fig. 11; (1878), p. 22, p. v, figs. 11*b*, 12.

Phylum GINKGOALES.

Genus BAIERA Braun, 1843.

(In Münster's *Beitr. Petrifact.*, Heft vi, p. 20.)

Baiera robusta sp. nov. Plate XI, figs. 3, 4.

1913. *Baiera* cf. *B. paucipartita* Arber, *Proc. Roy. Soc.*, ser. B, vol. lxxxvi, p. 346, pl. vii, figs. 1, 2, 3.

Diagnosis.—Leaves exceeding 4 cm. in length, of varying breadth, slit longitudinally for at least half their length into narrow segments of unequal breadth. Base broad, not markedly contracted, usually 6 or more parallel nerves in each segment.

Description of the Specimens. — The two specimens from Mount Potts, which I originally figured in 1913 as *Baiera* cf. *B. paucipartita*, are refigured on Plate XI, figs. 3 and 4. The former is a forked segment, shown nearly twice enlarged, but is incomplete at both extremities. The latter, which is natural size, shows the median part of a leaf split into four segments of unequal breadth.

Remarks.—There are several Rhætic species with which the New Zealand fossils may be compared. First we have the *Baiera paucipartita* of Nathorst(1), from Sweden, in which the base of the leaf is markedly contracted. This I now believe to be a distinct species, though in some respects it stands near to *B. robusta.* The *Baiera multifida* of Fontaine(2), from the Rhætic of Virginia, in the United States, and from Australia(3), appears to be a much larger leaf, judging by the very imperfect figures given of this plant. The segments of this species, however, may be compared with the New Zealand specimen. Other species which may be also compared are *Baiera tæniata* Braun(4), from the Rhætic of Germany, and *B. sub-gracilis* McCoy(5), from the Jurassic of Victoria, Australia.

Type in British Museum (Natural History).

Occurrence.—Mount Potts (Rhætic).

Phylum CONIFERALES.

Genus ARAUCARITES Presl, 1838.

(In Sternberg, "*Vers. Darstell. Flora Vorwelt,*" Heft. vii, p. 203.)

Araucarites cutchensis Feistmantel. Plate VIII, fig. 5; Plate XIII, fig. 4.

1876. *Araucarites cutchensis* Feistmantel, *Foss. Flora Gondwana Syst. (Pal Indica)*, vol. ii, pt. i, p. 62, pl. vii, fig. 7; pl. viii, figs. 2–6; pl. ix, figs. 1–3; pl. xii, fig. 10.

1877. *Araucarites cutchensis* Feistmantel, *ibid.*, vol. ii, pt. ii, pp. 16–96, pl. xiv.

1879. *Araucarites cutchensis* Feistmantel, *ibid.*, vol. i, pt. iv, pp. 27–217, pl. xiv, figs. 6–9; pl. xv, fig. 1; pl. xvi, fig. 15.

1913. *Araucarites cutchensis* Halle, *Wissen. Ergeb. Schwed. Südpolar-Exped.*, vol. iii, pt. xiv, p. 72, pl. viii, figs. 3–10, text-fig. 16.

Diagnosis.—Seed-bearing scales of the Araucarian type. Scales more or less broadly wedge-shaped, the base narrow, truncated, the apex broad, rounded, or truncated, often produced as a median narrow linear appendage. Seed single, ovoid, the broader extremity being towards the apex of the scale.

Description of the Specimens.—Two Araucarian scales occur at Gore, of which one is figured, natural size, on Plate XIII, fig. 4. In this photograph the appearance is

(1) Nathorst (1878²), p. 94, pl. xx, figs. 7–13; pl. xxi; pl. xxii, figs. 1, 2.
(2) Fontaine (1883), p. 87, pl. xlv, fig. 3; pl xlvi, figs. 1–3; pl. xlvii, figs. 1, 2.
(3) Arber, 1902), p. 4.
(4) Schenk (1867), p. 26, pl. v, figs. 1–4; pl. vi, figs. 1, 2.
(5) McCoy (1900), p. 5, pl. 1, figs. 4, 6, 7.

that of the reverse of the original(1), as will be seen by a comparison of Plate VIII, fig. 5, which is a drawing of the same scale, enlarged one and a half times. The specimen measures 2·1 cm. in length, and 1·5 cm. across at its widest part. The shape is ovate. In the centre there is an elongately elliptical hollow, that no doubt marks the place of attachment of the seed, which, however, is absent.

Remarks.—These scales agree very closely with those figured by Feistmantel(2) from the Jabalpur group of India.

Occurrence.—(?) Mount Potts, Canterbury (Rhætic); Mokoia, Gore, Southland (? Lower Jurassic).

Genus BRACHYPHYLLUM Brongniart, 1849.

(*Tabl. Genr. Végét. Foss.*, p. 69.)

Brachyphyllum sp. Plate XIII, figs. 8, 10.

Description of the Specimens.—Several examples of indifferently preserved Coniferous branches occur in the Catlin's River beds, densely clothed with short, triangular, somewhat fleshy leaves, spirally arranged. One of these twigs is shown on Plate XIII, fig. 8, natural size. Another, a branched specimen, is illustrated, twice enlarged, by fig. 10 of the same plate.

Remarks.—The preservation of these specimens is in no case good enough to warrant specific determination. They may be compared, however, with the Rhætic plants referred to this genus by Schenk(3) in Germany, and also with the English specimens(4) of like affinity from the Yorkshire Oolites. As compared with the Australian species there is some resemblance to the obscure *Brachyphyllum crassum* of Tenison-Woods(5), but less so to the *Brachyphyllum gippslandicum* of McCoy(6), which has more oval or elliptical leaves.

Occurrence.—Owaka Creek, Catlin's River, Otago (? Rhætic).

Genus CRYPTOMERITES Bunbury, 1851.

(*Quart. Journ. Geol. Soc.*, vol. vii, p. 190.)

Cryptomerites sp.

Remarks.—In the New Zealand Geological Survey collection are two very indistinct examples of Coniferous twigs from Makarewa, which resemble in habit the *Cryptomerites divaricatus* of Bunbury(7), with the type of which, at Cambridge, I have compared them. Bunbury's plant is from the Lower Oolite of the Yorkshire coast. The New Zealand specimens, however, are too badly preserved to permit of any scientific comparison. They may, however, be also compared, as regards the genus, with the India Gondwana specimen from Cutch, figured by Feistmantel(8) under Bunbury's name, and a specimen from the Jurassic of Grahamland, referred to the genus *Pagiophyllum* by Halle(9).

Occurrence.—McRae's, Makarewa, Hokonui Hills, Southland (? Rhætic).

(1) Presumably owing to the photographic plate having been inserted in the camera in the wrong position.
(2) Feistmantel (1877[3]), pp. 16–96, pl. xiv.
(3) Schenk (1867), p. 187, pl. 159, pl. 5.
(4) Seward (1900), p. 297, pl. x, fig. 1.
(5) Tenison-Woods (1883), p. xliii.
(6) McCoy (1900), p. 5, pl. ii, figs. 1, 2, 5, 5*a*; pl. iii, figs. 10–16.
(7) Bunbury (1851), p. 190, pl. xiii, fig. 4; see also Seward (1900), p. 287.
(8) Feistmantel (1876[1]), vol. ii, pt. 1, p. 59, pl. x, figs. 1, 1*a*.
(9) Halle (1913[1]), p. 74, pl. viii, fig. 11.

Genus ELATOCLADUS Halle, 1913.

(*Wissensch. Ergeb. Schwed. Südpolar-Exped.*, vol. iii, pt. xiv, p. 82.)

Dr. Halle(1) has recently proposed the term *Elatocladus* for "sterile Coniferous branches of the radial or the dorsi-ventral type, which do not show any characters which permit them to be included in one of the genera instituted for more peculiar forms." It is a common experience, when dealing with Mesozoic Conifers, to find difficulty in deciding as to which genus certain sterile shoots should be referred, the genera in question being chiefly characterized by the form of their cones. In other words, one can among these sterile shoots easily determine the species, whereas the generic attribution is a matter of greater difficulty. Dr. Halle's suggestion is that in such cases one should not attempt, in the absence of the cones, to refer the fossils to such genera as *Palissya*, *Taxites*, &c., but place them in a special genus *Elatocladus*. This suggestion is a good one, and will be adopted here.

1. Elatocladus conferta (Oldham and Morris). Plate I, figs. 1, 3; Plate VI, fig. 4; Plate VIII, fig. 6.

1863. *Cunninghamites confertus* Oldham and Morris, *Foss. Flora Gondw. System (Pal. Indica)*, vol. i, pt. i, pl. xxxii, fig. 10.
1877. *Palissya conferta* Feistmantel, *ibid.*, vol. i, pt. ii, pp. 85–137, pl. xlv, figs. 4–8; pl. xlviii, fig. 4.
1877. *Palissya conferta* Feistmantel, *ibid.*, vol. i, pt. iii, pp. 21–183, pl. v, fig. 3; pl. viii, figs. 1–6.
1879. *Palissya conferta* Feistmantel, *ibid.*, vol. i, pt. iv, pp. 216–26, pl. xiv, fig. 3; pl. xv, fig. 14.
1900. *Palissya australis* McCoy, in Stirling, *Rep. on Victorian Coalfields, No. 7*, p. 6, pl. iii, figs. 8, 9.
1913. *Palissya conferta* Arber, *Proc. Roy. Soc. London*, ser. B, vol. lxxxvi, p. 346, pl. viii, fig. 5.
1913. *Elatocladus conferta* Halle, *Wissen. Ergeb. Schwed. Südpolar-Exped.*, vol. iii, Lief. 14, p. 86, pl. viii, figs. 26–40.

Diagnosis.—Shoots freely branched, branches with dorsi-ventral symmetry, arising at a wide angle. Leaves spirally arranged, but twisted into two rows, falsely distichous, sessile, decurrent, usually making a very open angle with the axis. Lamina oblong-linear, about 6 mm. long and 1 mm. across, slightly contracted at the base, uninerved; apex obtuse.

Description of the Specimens.—*Elatocladus conferta* (O. & M.) appears to be widely distributed in New Zealand, and is a very variable type. A branched specimen from the Rhætic of Mount Potts is figured, twice enlarged, on Plate VI, fig. 4, associated with *Tæniopteris Thomsoniana*. This appears to be identical with the Indian Gondwana specimens, and also with those recently figured from Grahamland by Halle.

A drawing of similarly branched fragments from the Clent Hills is shown on Plate I, fig. 1, natural size.

Another specimen from the Jurassic of the Malvern Hills is seen, natural size, on the same plate, fig. 3. The leaves here are distinctly broader than in the previous examples. This type is, however, known elsewhere, and has been included under *E. conferta* by both Feistmantel and Halle(2). These specimens very closely resemble some described from the Jurassic rocks of India by Feistmantel(3) in 1877. A drawing of a fragment of a leafy shoot from Gore is reproduced on Plate VIII, fig. 6, natural size.

(1) Halle (1913[1]), p. 83.
(2) Halle (1913[1]), pl. viii, fig. 35.
(3) Feistmantel (1877[2]), pl. viii, figs. 1–6.

Remarks.—These specimens may be compared with *Stachyotaxus septentrionalis* (Agardh), from the Rhætic of Greenland(1) and Sweden(2).

Elatocladus conferta appears to be a widely distributed type, occurring in India, Australia, New Zealand, and Grahamland.

Occurrence.—Mount Potts, Canterbury (Rhætic); Clent Hills, Canterbury (Rhætic); Malvern Hills, Canterbury (? Lower Jurassic); Mokoia, Gore, Southland (Middle Jurassic); Curio Bay, Waikawa, Southland (Middle Jurassic).

2. Elatocladus sp. Plate XIII, fig. 9.

Description of the Specimen.—The New Zealand Geological Survey collection from Waikawa contains a single example of a species of *Elatocladus* with longer leaflets. These exceed 1·5 cm. in length, and are uninerved. This specimen is shown enlarged on Plate XIII, fig. 9. Unfortunately, it is not only fragmentary but poorly preserved, and it appears to be impossible to determine it specifically.

Remarks.—This specimen may, however, be compared with *Palissya indica* (Old. & Morr.)(3), and, so far as I can judge, it is certainly Coniferous, and not a Cycadophytean frond(4). It also somewhat resembles the Coniferous remains from the Rhætic of Sweden, described by Nathorst as *Palæotaxus rediviva* Nath.(5).

Occurrence.—Waikawa, Southland (Middle Jurassic).

Genus NAGEIOPSIS Fontaine, 1889.

(*Monogr. U.S. Geol. Surv.*, vol. xv, p. 194.)

Nageiopsis longifolia (?) Fontaine. Plate VII, figs. 1, 2.

1889. *Nageiopsis longifolia* Fontaine, *Monogr. xv U.S. Geol. Surv.*, p. 195, pl. lxxv, fig. 1; pl. lxxvi, figs. 2–6; pl. lxxvii, figs. 1, 2; pl. lxxviii, figs. 1–5; pl. lxxix, fig. 7: pl. lxxxv, figs. 1, 2, 8, 9.

1889. *Nageiopsis crassicaulis* Fontaine, *ibid.*, p. 198, pl. lxxix, figs. 2, 6; pl. lxxxii, fig. 1 pl. lxxxiv, figs. 3, 9, 11.

1905. *Nageiopsis longifolia* Ward. *Monogr. xlviii, U.S. Geol. Surv.*, p. 259, &c., pl. lxviii, figs. 9 12; pl. lxxiii, fig. 9.

1911. *Nageiopsis longifolia* Berry, *Maryland Geol. Surv., Lower Cretac.*, p. 384, pl. lxi.

Diagnosis.—The following is the diagnosis given by Berry in 1911: "Branching leafy twigs of large size, stout and thick, apparently branched in approximately one plane. Leaves linear-lanceolate, often slightly curved, somewhat equilaterally narrowed into a short slightly twisted petiole; above, gradually narrowed to the acute or subacute tip. Length, 8 cm. to 20 cm.; width, 5 mm. to 1·3 cm. The leaves are not crowded, and usually appear opposite or subopposite as if inserted on the lateral margins of the stem, although at times they seem to be attached to its upper or lower side. As previously remarked, none of the material is conclusive in regard to the phyllotaxy. Veins 9 to 12 in number, usually 10, forking only at the base and running parallel until they abut against the leaf-margin, about 0·7 mm. apart, somewhat coarser in calibre than in the other members of the genus, distinct on both sides of the lamina, and apparently not immersed. Leaf-substance not coriaceous."

(1) Hartz (1896), p. 242, pl. xiii, fig. 4*a*; pl. xix, figs. 2–4.

(2) Nathorst (1908), p. 11, pl. ii, fig. 28; pl. iii, figs. 1–9.

(3) Oldham and Morris (1863), pl. xxxiii, fig. 6.

(4) *Cf.* especially Feistmantel (1876[1]), pl. xi, fig. 5, described as *Cycadites cutchensis* Feist., and (1879), pl. xiv, figs. 1, 4, 5 (*Taxites planus* Feist.).

(5) Nathorst (1908), pl. iii, figs. 13–17.

Description of the Specimens.—The imperfect specimen seen on Plate VII, fig. 1, enlarged $\frac{3}{2}$, shows a fairly broad axis with several narrow leaves, four of which at least are attached. The leaves appear to be opposite or subopposite, and somewhat contracted at the base. All are imperfect, but their length exceeds 3·5 cm. The breadth is about 5 mm., and the nerves are close and parallel, about 8 or more in number.

Another specimen in the British Museum collection is shown, natural size, on Plate VII, fig. 2. The axis here is less stout, being 2·5 mm. across. Three leaves are attached, which exceed 1·5 cm. in length, and are 5·5 mm. broad. The attachment here appears to be spiral. The nerves are more than 8 in number in each leaf.

Remarks.—In the stout axis and the subopposite insertion of the leaves, the larger of these specimens may be compared to members of the genus *Nageiopsis* Font. In other respects the habit is very similar to *Podozamites lanceolatus* (L. & H.).

It is doubtful whether either specimen is sufficiently perfect to admit of specific determination. In referring them provisionally to *N. longifolia* (Font.), I at the same time admit the possibility that they may stand nearer to Fontaine's *N. angustifolia*(1). There is also some similarity to Fontaine's(2) *Podozamites Emmonsi*, which also has a broad axis, though here the leaves are spirally arranged.

Occurrence.—Waikato Heads, Auckland (Neocomian).

Genus PAGIOPHYLLUM Heer, 1881.

(*Sect. Trav. Géol. Portugal*, p. 11.)

Pagiophyllum peregrinum (Lindley and Hutton). Plate XIII, fig. 1.

1833. *Araucaria peregrina* Lindley and Hutton, *Fossil Flora*, vol. ii, pl. lxxxviii.
1846. *Araucaria peregrina* Kurr, *Beitr. Foss. Flora Juras. Württembergs*, p. 9, pl. 1, fig. 1.
1858. *Araucaria peregrina*, Quenstedt, *Der Jura*, p. 272, pl. xxxix, figs. 1–3.
1870. *Pachyphyllum peregrinum* Schimper, *Traité Pal. Végét.*, vol. ii, p. 250.
1879. *Pachyphyllum peregrinum* Feistmantel, *Foss. Flora Gondwana Syst. (Pal. Indica)*, vol. i, pt. iv, pp. 28–218, pl. xi, fig. 5; pl. xii, figs. 3, 9.
1884. *Pachyphyllum peregrinum* Saporta, *Plant. Jurass.*, vol. iii, pp. 383, 653, pl. 173, figs. 9, 10; pl. 174; pl. 175, figs. 1, 2; pl. 176, figs. 1–3; pl. 225, figs. 3, 4.
1886. *Taxites manawao* Hector, *Det. Cat. & Guide, N. Zeal. Court, Ind. & Col. Exhib.*, p. 66, fig. 30*a*(6).
1894 *Pachyphyllum liasinum* Saporta, *Flor. Foss. Portugal*, p. 7, pl. i, fig. 17; pl. ii, fig. 1.
1900. *Pagiophyllum peregrinum* Ward, *20th Ann. Rep. U.S. Geol. Surv.*, p. 308, pl. xlv.
1904. *Pagiophyllum peregrinum* Seward(3), *Jurassic Flora*, vol. ii, p. 48, pl. v.
1906. *Pagiophyllum peregrinum* Zeiller, *Flore Foss. Bass. Houill. et Perm. Blanzy & Creusot*, p. 219, pl. li, figs. 2, 3.

Diagnosis.—The following are the characters of this species, as given by Seward(4): "Vegetative shoots monopodially branched, bearing crowded, spirally disposed, fleshy leaves. The leaves vary in shape and position; they are usually broadly triangular, sometimes reaching a length of 5 mm., imbricate and fairly closely appressed to the stem; in some shoots they are more open in arrangement and more distinctly falcate. The back of the leaves bears a broad median keel, and the lamina is frequently characterized by numerous longitudinal striations or wrinklings; the apex of the leaf may be obtuse or acuminate."

Description of the Specimens.—The specimen figured by Hector in 1886 (see above) is refigured on Plate XIII, fig. 1. Its greatest length is 7·5 cm. Four branches are seen,

(1) See Berry (1911), p. 389, pl. lxiii, figs. 3, 4.
(2) Fontaine (1883), p. 77, pl. xxxiii, fig. 2.
(3) This work contains a full synonymy of this species.
(4) Seward (1904^2), p. 49.

each clothed with the characteristic thick, fleshy, triangular leaves, closely imbricated, and these appear to me to be identical with those of British examples of this plant.

Remarks.—Zeiller (see above) has recently figured the cuticles and stomata of this plant.

Occurrence.—Mataura Falls, Southland (Middle Jurassic).

Genus STACHYOTAXUS Nathorst, 1886.

(*Floran vid Bjuf*, p. 98.)

Stachyotaxus (?) sp. Plate XIII, fig. 7.

Description of the Specimen.—Fructifications which appear to have some resemblance to Nathorst's(1) *Stachyotaxus* occur at Gore, but unfortunately none of them are sufficiently well preserved to be specifically determinable. One of these is seen on Plate XIII, fig. 7, somewhat enlarged. It measures 9 cm. in length. It consists of a broad axis bearing a large number of oval, stalked bodies, the exact nature of which it is impossible to determine, though if the resemblance to *Stachyotaxus* is a real one they are probably in some cases seeds borne on scales, and scales alone in others.

Remarks.—This specimen may be fairly closely compared with the *Stachyotaxus elegans* of Nathorst(1). Seward(2) has also figured two obscure specimens from Victoria, of Jurassic age, as " Female flowers of Ginkgoales ? " to one of which there is some slight resemblance.

Occurrence.—Mokoia, Gore, Southland (? Lower Jurassic).

Phylum ANGIOSPERMÆ.

DICOTYLEDONES.

Plate XIV.

One of the most interesting features of the small collection of fossil plants from Waikato Heads is the occurrence of a *few* Angiospermous leaves. These all occur on a single specimen, which is figured on Plate XIV. When this specimen reached me at Cambridge the leaves in question were not exposed, and it was only by further " developing " the piece of shale in question that they were brought to light. Their occurrence is of particular interest, for otherwise this flora is entirely Mesophytic in type, and it is clear that the Angiosperms were not the dominant race in the flora of Waikato Heads, as they are in nearly all Neophytic floras.

Some time ago I had the pleasure of showing the interesting specimen figured on Plate XIV to my friend Dr. L. Laurent, of Marseilles, an authority on the Tertiary floras. At my request he very kindly consented to write a note on the Angiosperms which occur associated with *Cladophlebis australis* (Morr.) at Waikato Heads, and I include here a translation of the note in question. I would return my sincere thanks to Dr. Laurent for his kindness in describing these fossils for me.

A Note on the Dicotyledonous Remains of Waikato Heads.

By Dr. L. Laurent, Conservateur au Muséum d'Histoire Naturelle de Marseille.

A quite peculiar interest attaches to the discovery of Angiospermous remains of the Cretaceous period, since we know relatively little on the subject of the ancestral types of this group. The discoveries made, both in Europe and North America, have indeed carried the date of the appearance of the higher plants further back; but, spite of all, the number of the first representatives of those fossil plants which it has been possible to refer with certainty to the Angiosperms is relatively very small, notably as regards

(1) Nathorst (1908), p. 11, pl. ii.

(2) Seward (1904[1]), p. 179, pl. xix, fig. 39.

the Lower Cretaceous, and, as Professor Seward(1) has very justly remarked, "it is highly probable that the suddenness with which the Dicotyledons took their place in the vegetation of the world is exaggerated by the scantiness of our fossil records."

It is thus hardly possible to attach too much importance to the discoveries which have just added new material to that which was already known from the Cretaceous beds of New Zealand, and I am grateful to Dr. E. A. Newell Arber for having confided to me the task of describing these remains belonging to the Dicotyledons, derived from the beds of Waikato Heads, in Auckland, New Zealand.

These remains are, unfortunately, neither very numerous nor very well preserved. One finds imprinted on a large slab, mingled with numerous remains of fronds of *Cladophlebis australis* (Morr.), three leaves of Dicotyledons (Plate XIV, at *a*, *b*, and *c*) the value of which is very unequal. One of them represents the apical part of a leaf (*a*), another a base (*b*), and a third (*c*) is so fragmentary that it can scarcely be utilized, some secondary nerves alone being visible. The nervation of the first two examples is well preserved, and can be studied in all its details. The characters which one can deduce from it, combined with an examination of the large nerves and the form(?), allow one to arrive at a fairly clear idea as to these two impressions (*a* and *b*), which probably belong to the same type.

ARTOCARPIDIUM Unger, 1850.

(*Denkschr. k. Acad. Wissen. Wien (Math.-Nat. Cl.)*, vol. ii, p. 166.)

Artocarpidium Arberi sp. nov. Plate XIV, *a*, *b*.

Diagnosis.—A. foliis ovatis ? trinerviis ? ; petiolo brevi ; margine integra ; nervis secundariis oppositis ; tertiario ultimoque reticulo in modum Artocarpearum disposito.

Description of the Specimen.—Some idea of the form of the leaf can be arrived at by reconstructing it from the basal and apical portions occurring on the same slab. As a matter of fact, the angle of the secondary nerves is about 30°, the contour presents an analogous curve, and as the network of the tertiary veins in both cases is identical it appears to me to be quite logical to assign these two fragments to the same species. Nevertheless, in the description which I am about to give of it I have especially in view the upper part, which, from the point of view of the nervation, is better preserved.

The leaf must have been coriaceous, judging by the impression which it has left on the sediments, and its general form was oval (?). The base is cordate, the margin entire.

All the veins are prominent. The limb is traversed by a straight and strong median nerve, which forms a continuation of a short petiole, but it is somewhat difficult to see from the impression whether it has been broken or whether we possess it entire. The secondary nerves, which are camptodromous, opposite, or subopposite, emerge from the midrib at an angle of about 30°, which remains the same throughout the whole extent of the limb, except towards the base, where it is a little more open. The first two basal nerves are opposite, and give off on their outer sides rather weak secondary nerves, so far as one can judge from the specimen.

The tertiary network is very important. It is composed of nerves, sometimes straight, sometimes anastomosing, forming a polygonal network between the secondary nerves. These nerves meet the midrib at right angles, and the neighbouring secondary nerve at a slightly more open angle, which gives the whole network a general aspect of a succession of flattened arches (*arque surbaissé*). There are no secondary incomplete nerves terminating within the network. The ultimate nervation is constituted by the reunion of branchlets forming among themselves an irregularly polygonal mesh.

(1) Seward (1904²), p. 155.

Remarks.—In comparison with *living* forms, if we consider the nervations of different orders separately we can compare this fossil with a large number of living forms, but the field of investigation is limited if we compare the relations of the different networks among themselves. The physiognomy of the fossil leaf depends especially on the angle of emergence of the secondary nerves, the mode of union (*rapprochement*) of the tertiary veins, and especially their behaviour in relation to the median nerve, which they meet at right angles, thus giving the whole network the appearance of concentric flattened arches (*un aspect concentrique surbaissé*). This last character especially rules out the tropical Rubiaceæ, such as the Gardenias of New Caledonia, and the Rhamnaceæ of the same region, such as *Alphitonia*. Certain Cornaceæ show a horizontal nervation, but differ very much on account of the relative importance of the secondary nerves. Many Euphorbiaceæ have leaves of a somewhat similar aspect, but the much more crowded and rarely bifurcated tertiary network, and the disposition of the ultimate mesh, renders the comparison untenable. Certain Styraceæ (*Styrax ferrugineum* Pohl., of Brazil) might be brought into line with our fossil but for the less bifurcated tertiary network, and its relations with the median and secondary nerves.

Among the Dilleniaceæ the genus *Tetracera* (*T. Euryandra* Vahl.) presents a tertiary network and an ultimate mesh very similar to that of the New Zealand fossil, if one considers only the portion included between two secondary nerves, but in its entirety the aspect is very different.

Pterospermum lanceæfolium Roxb., among those Sterculiaceæ which have a regular base, suggests itself at first glance, but the tertiary network is very different. While in the fossil it is reticulated, forming an irregularly polygonal mesh, the tertiary nerves are generally simple in *Pterospermum*, and, what is more, the ultimate mesh is elongated in a direction perpendicular to that of the fossil, being parallel to the secondary nerves.

Finally, we meet among the Artocarpeæ closer grounds for comparison in *Ficus*, *Olmedia*, and *Artocarpus*. Among the members of the genus *Ficus*, a large number, which have a tertiary nervation parallel to the secondary nerves, may be eliminated, but we find other species which present a network whose appearance is analogous to that which one observes in the fossil, especially in certain species of *Ficus* from Timor, which, except for a tendency to incompleteness of the secondary nerves, present the other characters of the fossil. The same is the case with *Ficus Sakalavarum* Bak. of Madagascar, in which the basal nerves are much more prominent. In *Olmedia* and *Artocarpus* (*Artocarpus rigida* B.C.) of the East Indian region, one does not see so marked a tendency to form incomplete secondary nerves as in *Ficus*. Except as regards the dimensions and the alternation of the secondary nerves, which are features of quite minimal importance, the other characters agree well with those observed in the fossil. It is thus with this group that the affinities of the fossil appear to lie closest.

As we cannot hope to meet with absolute identity between the modern genus and so ancient a fossil, we will place the latter in the fossil genus *Artocarpidium* Ung.

The authors who have adopted this genus have had especially in view the remains of the fructiferous receptacle; as for the foliar remains, they have been so little elucidated that they cannot be taken into consideration. For our part, the term *Artocarpidium* recalls especially the relations of comparative nervation which we find between the New Zealand fossil and the group of modern Artocarpeæ.

The comparison with *fossil forms*, including those already described in the numerous Cretaceous floras of both hemispheres, is rendered extremely difficult by the almost entire absence of nervation in the figures given by the authors. None of the fossils described by Ettingshausen(1) from the Cretaceous and Tertiary rocks of New Zealand can be compared with the impression here described. The same author(2), in the

1) Ettingshausen (1887[1]).

(2) Ettingshausen (1895), p. 22, pl. ii, fig. 11.

study which he has made of the Cretaceous flora of Australia, quotes an *Artocarpidium pseudo-cretaceum* Ett., and compares it with *A. cretaceum* Ett. from the chalk of Niederschöna(1). However, the figures given are quite rudimentary, and neither from them nor from the descriptions of this author can one establish any sort of comparison. As to *Ficus ipswichiana* Ett.(2), one cannot from the fragment of nervation drawn arrive at any idea of what it may be.

No equivalent to this fossil is to be found among the forms from the Cretaceous of Bohemia. On the other hand, we find a certain analogy with *Credneria Zenkeri* var. *acuminata* Rich.(3), especially as regards the tertiary nervation, but the arrangement of the secondary nerves and the form of the base are entirely different from that which we observe in the New Zealand fossil.

We cannot point to any satisfactory comparison with the numerous examples of *Ficus* described by Hosius and von der Marck(4) from the Cretaceous of Westphalia. In America, Lesquereux(5) figures in the flora of the Dakota group a *Ficus*, *F. distorta* Lesq., which presents no similarity to our example. Nor do we find any similarity with species from the Cretaceous of the Arctic regions, noticed by Heer in the *Flora Fossilis Arctica*, nor with those from Nebraska(6).

Certain Artocarpidiums have been recorded in the Tertiary floras of Europe—at Sotzka by Unger, and at Bilin and Monte Promina by Ettingshausen. However, the tertiary and ultimate nervations, which are the bases of comparison with recent or fossil examples, are completely wanting in the figures of the fossils mentioned.

It follows that the type of Waikato Heads deserves to be classed apart in the series of interesting fossil forms of the Lower Cretaceous period. Its Artocarpic nervation constitutes a very well-defined type in the series of primitive Dicotyledons, which, from the Lower Cretaceous period, emerge to our view with characters which are all but definitive, and which will come to characterize in due course the entire group in a general manner, without modifications of any importance. From this point of view this fossil, incomplete as it is, presents great interest, and I name it *Artocarpidium Arberi* sp. nov.

Genus PHYLLITES Sternberg, 1826.

(*Vers. Darstell. Flora Vorwelt*, Heft vi, p. xlvi.)

Phyllites sp. Plate XIVc.

Description of the Specimen.—Another very fragmentary leaf occurs on the same slab as the last specimens (Plate XIVc). Parts of three pairs of secondary nerves, which bifurcate at a short distance from their emergence from the midrib, are alone visible.

The data for comparison are here entirely lacking, and it is best not to assign a species to this fossil, which is evidently a Dicotyledonous fragment. It would be possible, moreover, to compare it to a great number of fossils described in the Cretaceous and Tertiary floras, without adding anything to our knowledge.

INCERTÆ SEDIS.

Genus CARPOLITHUS Sternberg, 1833.

(*Vers. Darstell. Flora Vorwelt*, Heft v, vi, pl. xl.)

Carpolithus McKayi sp. nov. Plate XI, fig. 6.

Diagnosis.—Seed small, oval, slightly pointed at one end, more or less rounded at the other, 11·5 mm. long and 9 mm. across at its widest point. Central "nucule"

(1) Ettingshausen (1867), p. 251, pl. ii, fig. 4.
(2) Ettingshausen (1895), p. 22, pl. ii, fig. 12*a*.
(3) Richter (1905), p. 12, pl. ii, fig. 5.
(4) Hosius and von der Marck (1880).
(5) Lesquereux (1883), p. 48, pl. xiv, fig. 4.
(6) Capellini and Heer (1867).

prominent, distinct, about 8·5 mm. long and 5·5 mm. across, slightly pointed at one end and rounded at the other, with a well-marked median groove. "Nucule" surrounded by a narrow rim or wing, of somewhat unequal breadth.

Remarks.—This seed is similar in type to many others occurring in Mesozoic rocks in various parts of the world. It has some resemblance to the *Samaropsis* cf. *S. parvula* of Feistmantel(1), from the Talchir group (Rhætic) of India, and to the *Carpolithes cinctus* of Nathorst(2), from the Rhætic of Höganäs, Sweden, though it is probably specifically distinct from either.

Type.—New Zealand Geological Survey collection.

Occurrence.—Wairoa Gorge, Mount Heslington, Nelson (Mesozoic).

Obscure Fructifications ? Plate XIII, figs. 2, 3, 5, 6.

Description of the Specimens.—In the collection from Waikato Heads a number of specimens occur showing branched axes, the primary branches being stout, and the secondary bearing a number of minute indistinct bodies at unequal intervals. Two of these are figured (enlarged) on Plate XIII, figs. 2 and 6. The latter shows a very stout primary and a slender secondary axis, bearing very indistinct oval organs. In one case the organs in question are borne on a branch of the third order. They do not appear to be seeds, but look more like sporangia, under the microscope.

The other specimen (fig. 2, twice enlarged) shows the fructifications (?) more clearly. They vary somewhat in size and shape, being subcircular, oval, or elliptical. Less distinct specimens are figured (somewhat enlarged) on figs. 3 and 5 of the same plate. These again show a fairly broad primary axis, and fructifications (?) borne on slender branches.

Remarks.—The nature of these fossils appears to me to be wholly obscure, and I am not acquainted with any to which they may be at all closely compared. There may be some resemblance to the fructifications from the Jurassic rocks of Siberia, ascribed by Heer(3) to *Ginkgo*, but the comparison is by no means a close one. A nearer case perhaps is Fontaine's(4) *Baieropsis pluripartita*, and one of the Victorian specimens figured by Seward(5) as "female flowers of Ginkgoales ?"

I am unable to express any opinion as to the nature of these fossils. They do not appear to be roots and root-tubercles. I think they are more probably fertile shoots bearing sporangia, but as to the class of plants to which they should be referred there appears at present to be no evidence.

Occurrence.—Waikato Heads, Auckland (Neocomian).

"Roots," Plate X, fig. 4.

The occurrence of beds full of rootlets, on the same horizon as those containing other plant-remains at Mataura Falls, was noted by McKay(6). Plate X, fig. 4, shows one of these roots. This specimen is in the British Museum collection (No. V. 11678). The lateral roots appear to be arranged spirally. It is quite impossible, of course, to say to what genus these roots belong.

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(1) Feistmantel (1886), vol. iv, pt. ii, p. 45, pl. xii*a*, figs. 7–15.
(2) Nathorst (1878[3]), *Younger Flora*, p. 52, pl. ii, figs. 2*a*, 3.
(3) Heer (1876[2]), pl. xi, figs. 9–12; (1878), pl. vi, fig. 8; (1880), pl. iv, &c.; *cf.* also Krystofovic (1910), pl. iii, fig. 5.
(4) Fontaine (1889), pl. xc, figs. 4, 4*a*.
(5) Seward (1904[1]), pl. xix, fig. 40.
(6) McKay (1881), p. 40.

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(1829.)	pp. 137–208, pls. xxviii–xxxvi, xxxviii–xlix, li–lii, liv–lvi, lxi, lxvi.
(1830.)	pp. 209–248, pls. l, liii, lvii–lviii, lxi *bis*, lxii, lxiv, lxv, lxvii, lxviii, lxx, lxxi, lxxiii, lxxvi.
(1831–32.)	249–264, pls. lix, lx, lxiii, lxix, lxxii, lxxiv, lxxv, lxxvii–lxxxii.
(1832–33.)	pp. 265–288, pls. lxxxiii–xcvii.
(1833–34.)	pp. 289–312, pls. lxxxii A, xcviii–cix.
(1834.)	pp. 313–336, pls. cx–cxiv, cxvii, cxviii, cxxiv, cxxvii, cxxviii, cxxx.
(1835–36.)	pp. 337–368, pls. cxv, cxvi, cxix–cxxiii, cxxv, cxxvi, cxxix, cxxxi–cxxxiv.
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,, 3, pp. 1–39, pls. xxvii–xxxix ; 1824.
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,, 5 and 6, pp. i–xlii, pls. i–xxvi ; 1833.
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INDEX I.

GENERA AND SPECIES.

(Including a few Names of Families.)

Names of genera and species in Roman type are those described in the present volume. The principal page-references to these are shown in heavy type. Names in italics represent synonyms, or plants to which only passing reference is here made.

D.

E.

F.

G.

P.

R.

S.

INDEX II.

GENERAL INDEX.

(For authors, see also "Biblography," pp. 66–72. A few important page-references are in heavy type).

G.

H.

I.

J.

K.

L.

M.

N.

O.

P.

R.

S.

T.

U.

V.

W.

Y.

Z.

Plate I.

Fig. 1. *Elatocladus conferta* (Old. & Morr.). From the Clent Hills, Canterbury. *New Zeal. Geol. Surv. Coll.* Natural size. (Rhætic.)

Fig. 2. *Sphenopteris (Ruffordia) Gœpperti* Dunk. From Mokoia, Gore, Southland.* *No. 626 in For. Mes. Plant Coll., Sedgwick Mus., Camb.* Natural size. (? Lower Jurassic.)

Fig. 3. *Elatocladus conferta* (Old & Morr.). From the Malvern Hills, Canterbury. *No. 611 in For. Mes. Plant Coll., Sedgwick Mus., Camb.* Natural size. (Lower Jurassic.)

Fig. 4. *Sphenopteris (Ruffordia) Gœpperti* Dunk. From the same locality, and No. 627 in the same collection as Fig. 2. Natural size. (? Lower Jurassic.)

Fig. 5. *Sphenopteris otagoensis* sp. nov. From Owaka Creek, Catlin's River, Otago, Zealand. *New Zeal. Geol. Surv. Coll.* × 2. (? Rhætic.)

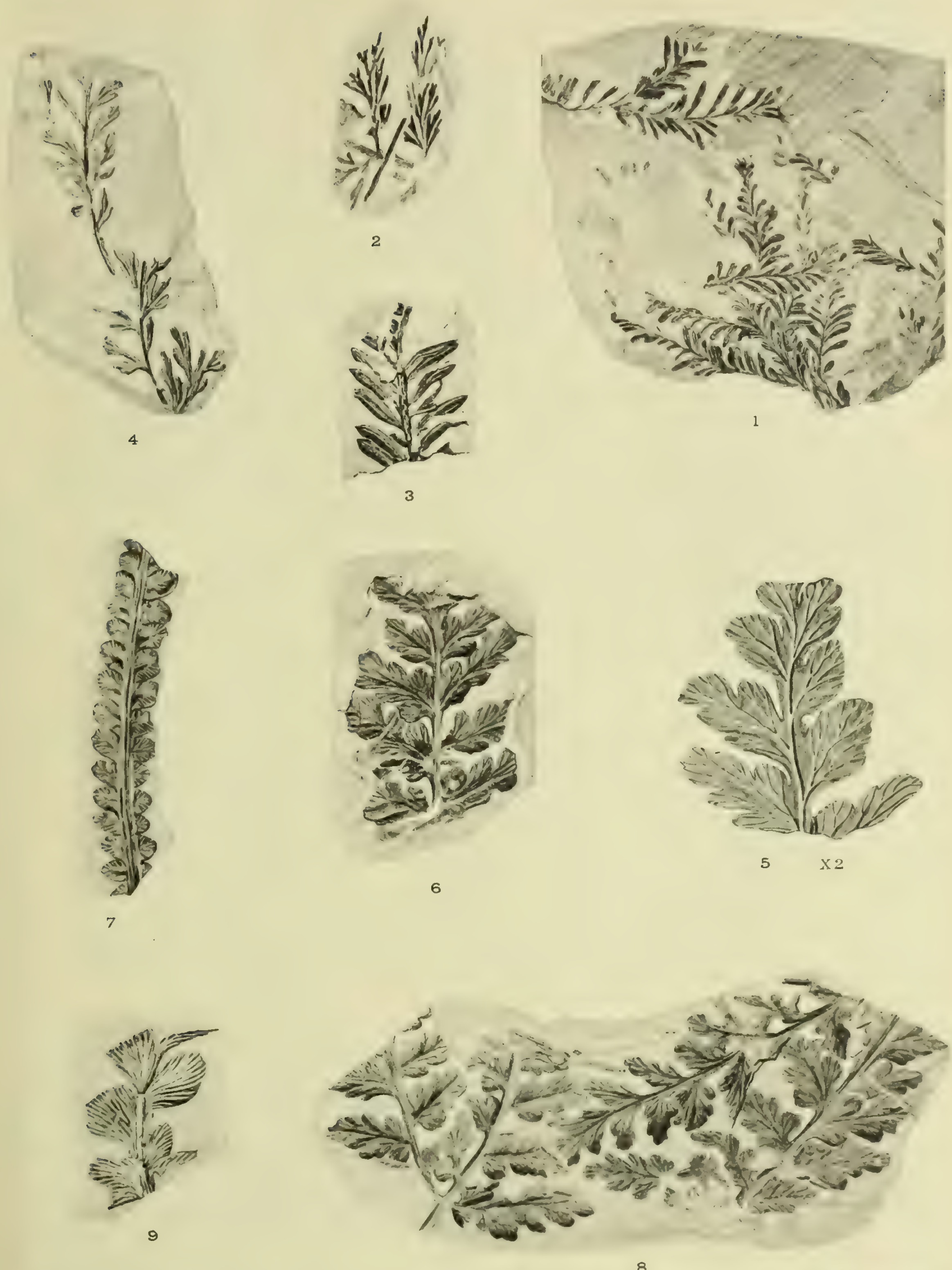
Fig. 6. *Sphenopteris otagoensis* sp. nov. From the same locality and in the same collection as Fig. 5. Natural size. (? Rhætic.)

Fig. 7. *Thinnfeldia odontopteroides* (Morr.). From the Clent Hills, Canterbury. *New Zeal. Geol. Surv. Coll.* Natural size. (Rhætic.)

Fig. 8. *Sphenopteris otagoensis* sp. nov. From the same locality and in the same collection as Fig. 5. Natural size. (? Rhætic.)

Fig. 9. *Thinnfeldia* sp. cf. *T. argentinica* (Gein.). From the Clent Hills, Canterbury. *New Zeal. Geol. Surv. Coll.* Natural size. (Rhætic.)

* See footnote (1) on page 12.



T. A. Brock del.

Sphenopteris, Thinnfeldia and Elatocladus.

Plate II.

Fig. 1. *Coniopteris hymenophylloides* (Brongn.). From Mokoia, Gore, Southland. *No. 632, For. Mesoz. Plant Coll., Sedgwick Mus., Camb.* Natural size. (? Lower Jurassic.)

Fig. 2. *Coniopteris hymenophylloides* (Brongn.). From the same locality, and No. 632 in the same collection. Natural size. (? Lower Jurassic.)

Fig. 3. *Coniopteris hymenophylloides* (Brongn.). From the same locality, and No. 631 in the same collection. Natural size. (? Lower Jurassic.)

Fig. 4. *Sphenopteris gorensis* sp. nov. From the same locality, and No. 628 in the same collection. Natural size. (? Lower Jurassic.)

Fig. 5. *Phyllotheca minuta* sp. nov. From the Clent Hills, Canterbury. *New Zeal. Geol. Surv. Coll.* Natural size. (Rhætic.)

Fig. 6. *Coniopteris hymenophylloides* (Brongn.). Fertile pinna. From the Malvern Hills, Canterbury. *No. 604, For. Mesoz. Plant Coll., Sedgwick Mus., Camb.* $\times \frac{3}{2}$. (Lower Jurassic.)

Fig. 7. *Sphenopteris Currani* (Ten.-Woods). From Mokoia, Gore, Southland. *No. 630, For. Mesoz. Plant Coll., Sedgwick Mus., Camb.* Natural size. (? Lower Jurassic.)

Fig. 8. *Sphenopteris Currani* (Ten.-Woods). A pinna of Fig. 7, enlarged to show the nervation. $\times \frac{5}{2}$. (? Lower Jurassic.)

Fig. 9. *Phyllotheca minuta* sp. nov. From the same locality and in the same collection as Fig. 5. Natural size. (Rhætic.)

Fig. 10. *Microphyllopteris* sp. From Owaka Creek, Catlin's River, Otago. *New Zeal. Geol. Surv. Coll.* Natural size. (? Rhætic.)

Fig. 11. *Thinnfeldia* sp. From Mokoia, Gore, Southland. *No. 629, For. Mesoz. Plant Coll., Sedgwick Mus., Camb.* Natural size. (? Lower Jurassic.)

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Phyllotheca, Coniopteris, Sphenopteris etc.

Plate III.

Fig. 1. *Linguifolium Lillieanum* Arber. Type specimen. From Mount Potts, Canterbury. *Brit. Mus. (Nat. Hist.).* × $\frac{7}{4}$. (Rhætic.)

Fig. 2. *Equisetites Nicoli* sp. nov. From Mokoia, Gore, Southland. *No. 633, For. Mesoz. Plant Coll., Sedgwick Mus., Camb.* Natural size. (? Lower Jurassic.)

Fig. 3. *Coniopteris hymenophylloides* (Brongn.). Partly fertile frond. Same specimen as Fig. 4 enlarged. × 2. (? Lower Jurassic.)

Fig. 4. *Coniopteris hymenophylloides* (Brongn.). Partly fertile frond. From the Malvern Hills, Canterbury. *No. 622, For. Mesoz. Plant Coll., Sedgwick Mus., Camb.* Natural size. (Lower Jurassic.)

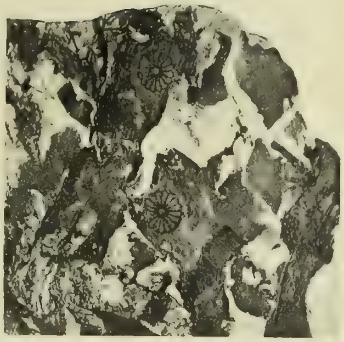
Fig. 5. *Coniopteris hymenophylloides* (Brongn.). Sterile frond. From the same locality, and No. 623 in the same collection. Natural size. (Lower Jurassic.)

Fig. 6. *Sphenopteris* sp. From the same locality, and No. 624 in the same collection. × 2. (Lower Jurassic.)

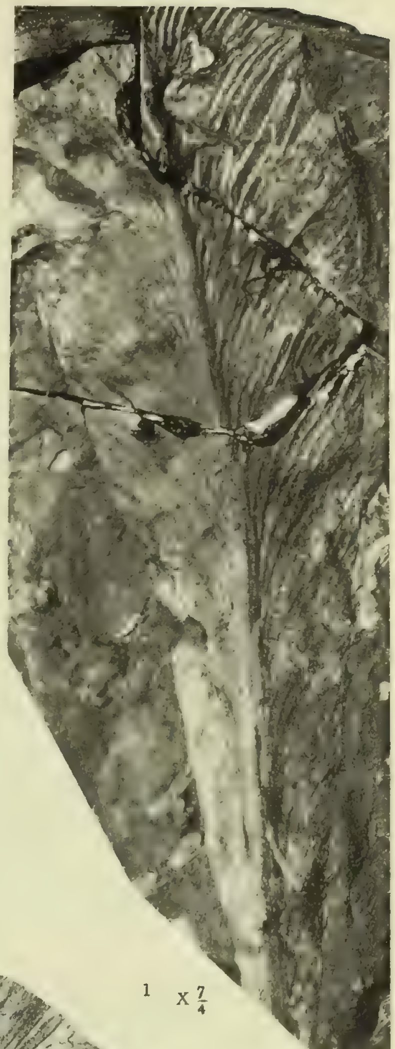
Fig. 7. *Linguifolium Lillieanum* Arber. From Mount Potts, Canterbury. *Brit. Mus. (Nat. Hist.).* × $\frac{3}{2}$. (Rhætic.)

Fig. 8. *Chiropteris lacerata* Arber. From Mount Potts, Canterbury. *Brit. Mus. (Nat. Hist.).* × $\frac{3}{2}$. (Rhætic.)

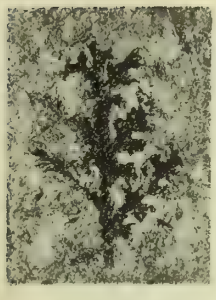
3 X2



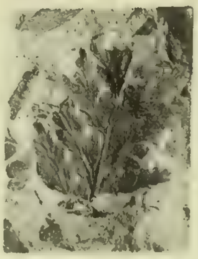
2



1 X $\frac{7}{4}$



6 X2



5

4

8 X $\frac{3}{2}$

7 X $\frac{3}{2}$

W. Tams, photo.

London Stereoscopic Co. imp.

Equisetites, Linguifolium, Chiropteris etc.

Plate IV.

Fig. 1. *Cladophlebis australis* (Morr.). From Waikato Heads, Auckland. *New Zeal. Geol. Surv. Coll.* Natural size. (Neocomian.)

Fig. 2. *Cladophlebis* cf. *C. Albertsi* (Dunk.). From the same locality, and V. 11636 in British Museum collection. Natural size. (Neocomian.)

Fig. 3. *Cladophlebis* cf. *C. Albertsi* (Dunk.) From the same locality and in the same collection. Natural size. (Neocomian.)

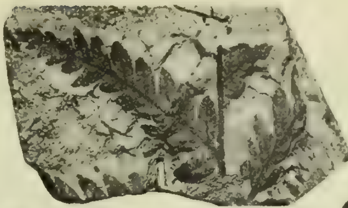
Fig. 4. *Tæniopteris vittata* Brongn. From Waikawa, Southland. *New Zeal. Geol. Surv. Coll.* Natural size. (Middle Jurassic.)

Fig. 5. *Cladophlebis australis* (Morr.). From Owaka Creek, Catlin's River, Otago. *New Zeal. Geol. Surv. Coll.* Natural size. (? Rhætic.)

Fig. 6. *Cladophlebis denticulata* Brongn. Pinnules enlarged to show the nervation and denticulation. From Mataura Falls, Southland. *V. 11700, Brit. Mus. (Nat. Hist.).* $\times \frac{5}{2}$. (Middle Jurassic.)

Fig. 7. *Cladophlebis* sp. From Waikato Heads, Auckland. *New Zeal. Geol. Surv. Coll.* $\times$ 2. (Neocomian.)

Fig. 8. *Cladophlebis australis* (Morr.). From Waikato Heads, Auckland. *New Zeal. Geol. Surv. Coll.* $\times \frac{9}{4}$. (Neocomian.)



2

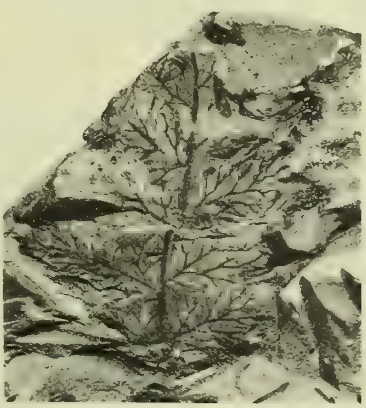
3

1

5

4

8 $\times \frac{9}{4}$



7 $\times 2$

6 $\times \frac{5}{2}$

W. Tams, photo.

London Stereoscopic Co.

Cladophlebis and Tæniopteris.

PLATE V.

Fig. 1. *Thinnfeldia lancifolia* (Morr.). From Mount Potts, Canterbury. *Brit. Mus. (Nat. Hist.)*. Natural size. (Rhætic.)

Fig. 2. *Thinnfeldia lancifolia* (Morr.). From Owaka Creek, Catlin's River, Otago. *New Zeal. Geol. Surv. Coll.* × $\frac{5}{3}$. (? Rhætic.)

Fig. 3. *Sphenopteris* sp. From McRae's, Hokonui Hills, Southland. *New Zeal. Geol. Surv. Coll.* × 2. (Rhætic.)

Fig. 4. *Thinnfeldia Feistmanteli* (Gothan). From Owaka Creek, Catlin's River, Otago. *New Zeal. Geol. Surv. Coll.* × 2. (? Rhætic.)

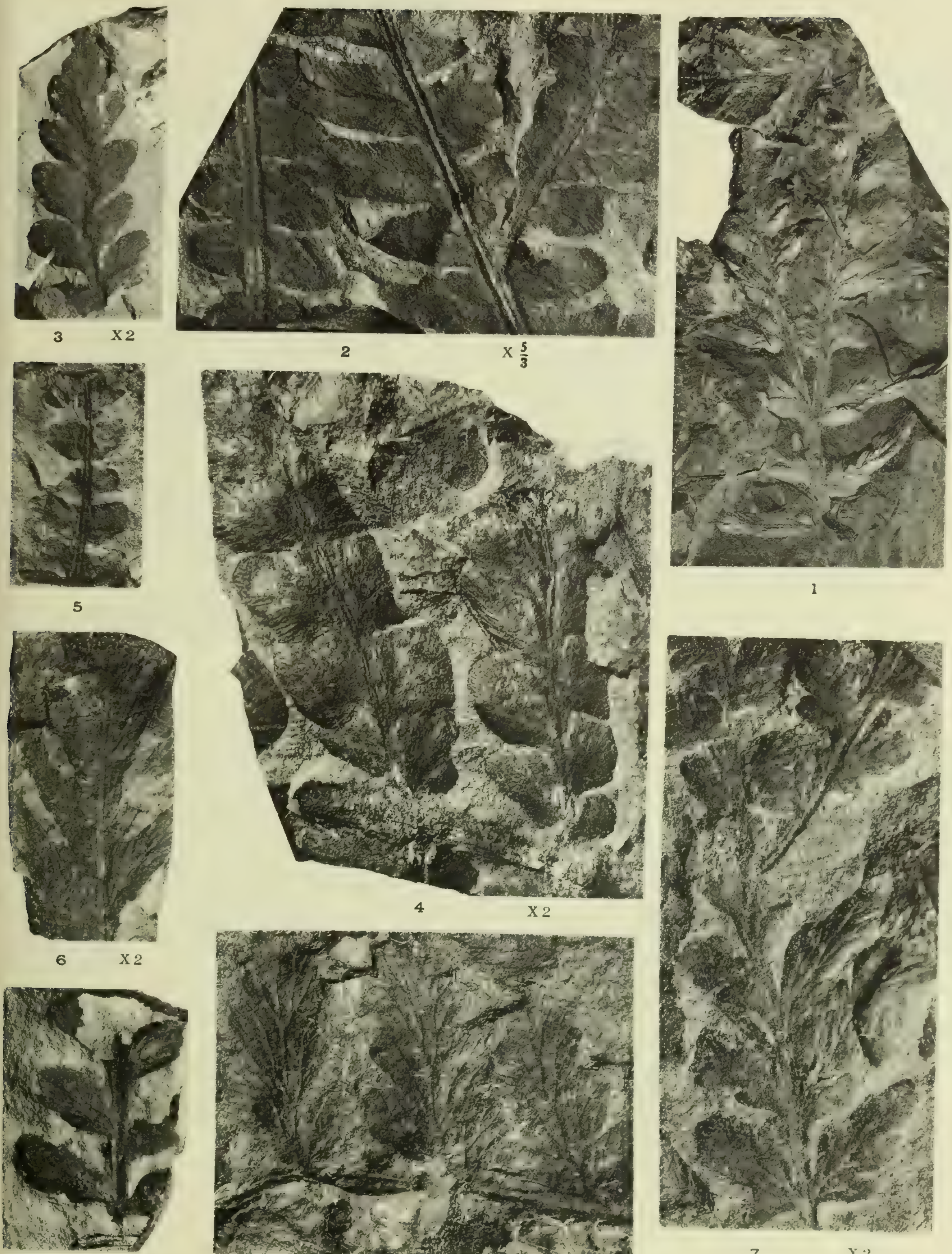
Fig. 5. *Thinnfeldia odontopteroides* (Morr.). From Owaka Creek, Catlin's River, Otago. *New Zeal. Geol. Surv. Coll.* Natural size. (? Rhætic.)

Fig. 6. *Thinnfeldia ? lancifolia* (Morr.). From McRae's, Hokonui Hills, Southland. *New Zeal. Geol. Surv. Coll.* × 2. (? Rhætic.)

Fig. 7. *Sphenopteris otagoensis* sp. nov. From Owaka Creek, Catlin's River, Otago. *New Zeal. Geol. Surv. Coll.* × 2. (? Rhætic.)

Fig. 8. *Sphenopteris owakaensis* sp. nov. From the same locality and in the same collection. × 3. (? Rhætic.)

Fig. 9. *Sphenopteris* sp. From McRae's, Hokonui Hills, Southland. *New Zeal. Geol. Surv. Coll.* × 2. (? Rhætic.)



3 X 2 — 2 X $\frac{5}{3}$ — 1 — 5 — 4 X 2 — 6 X 2 — 7 X 2 — 9 X 2 — 8 X 3

W. Tams, photo.

Thinnfeldia and Sphenopteris.

Plate VI.

Fig. 1. *Tæniopteris arctica* Heer. From Waikato Heads, Auckland. *New Zeal. Geol. Surv. Coll.* × 2. (Neocomian.)

Fig. 2. *Tæniopteris vittata* Brongn. From Waikawa, Southland. *New Zeal. Geol. Surv. Coll.* Natural size. (Lower Jurassic.)

Fig. 3. *Tæniopteris vittata* Brongn. From Waikawa, Southland. *New Zeal. Geol. Surv. Coll.* Natural size. (Lower Jurassic.)

Fig. 4. *Tæniopteris Thomsoniana* sp. nov. (type) and *Elatocladus conferta* (Old. & Morr.). From Mount Potts, Canterbury. *Brit. Mus. (Nat. Hist.).* × 2. (Rhætic.)

Fig. 5. *Tæniopteris Daintreei* McCoy. From the Malvern Hills, Canterbury. *No. 625, For. Mesoz. Plant Coll., Sedgwick Mus., Camb.* Natural size. (Lower Jurassic.)

Fig. 6. *Tæniopteris arctica* Heer. From Waikato Heads, Auckland. *V. 11632 Brit. Mus. (Nat. Hist.).* Natural size. (Neocomian.)

3

2

1 X 2

5

3

4 X 2

6

W. Tams, photo.

Tæniopteris and Elatocladus.

Plate VII.

Fig. 1. *Nageiopsis longifolia?* Font. From Waikato Heads, Auckland. *New Zeal. Geol. Surv. Coll.* × $\frac{3}{2}$. (Neocomian.)

Fig. 2. *Nageiopsis longifolia?* Font. From the same locality. *V. 11643, Brit. Mus. (Nat. Hist.).* Natural size. (Neocomian.)

Fig. 3. *Microphyllopteris pectinata* (Hect.). From the same locality. *V. 11640, Brit. Mus. (Nat. Hist.).* Natural size. (Neocomian.)

Fig. 4. *Microphyllopteris pectinata* (Hect.). From the same locality. *New Zeal. Geol. Surv. Coll.* × 2. (Neocomian.)

Fig. 5. *Microphyllopteris pectinata* (Hect.) and *Tæniopteris arctica* (Heer). From the same locality. *V. 11628, Brit. Mus. (Nat. Hist.).* × $\frac{7}{4}$. (Neocomian.)

Fig. 6. *Microphyllopteris pectinata* (Hect.). Part of Fig. 11, enlarged to show the nervation. *New Zeal. Geol. Surv. Coll.* × 4. (Neocomian.)

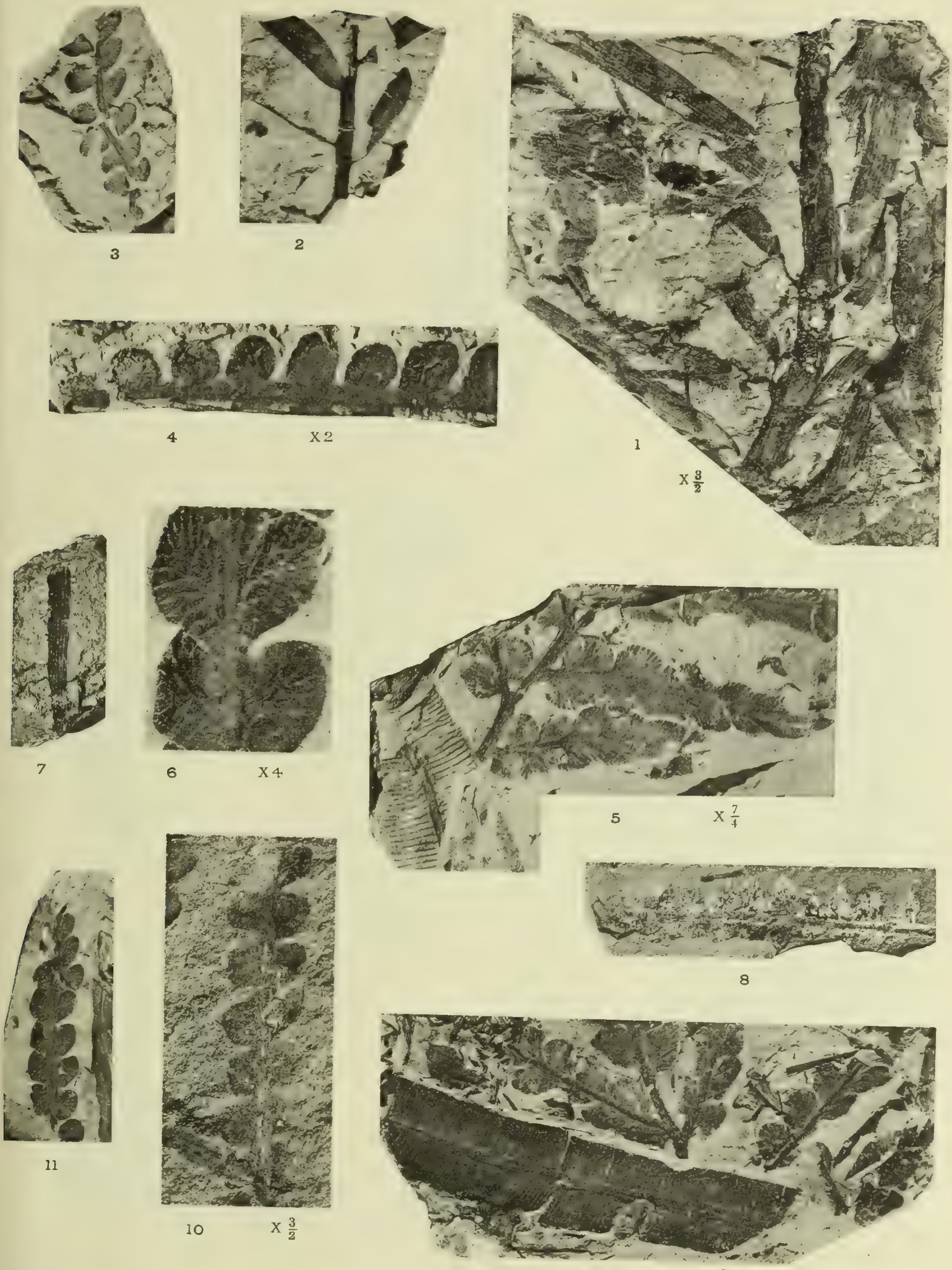
Fig. 7. Pinnule of a Cycadophyte. From Mokoia, Gore, Southland. *No. 606, For. Mes. Plant Coll., Sedgwick Mus., Camb.* Natural size. (Lower Jurassic.)

Fig. 8. *Microphyllopteris pectinata* (Hect.). From Mataura Falls, Southland. *New Zeal. Geol. Surv. Coll.* Natural size. (Middle Jurassic.)

Fig. 9. *Microphyllopteris pectinata* (Hect.) and *Tæniopteris arctica* Heer. From Waikato Heads, Auckland. *V. 11631, Brit. Mus. (Nat. Hist.).* × $\frac{7}{5}$. (Neocomian.)

Fig. 10. *Microphyllopteris pectinata* (Hect.). From Mataura Falls, Southland. *New Zeal. Geol. Surv. Coll.* × $\frac{3}{2}$. (Middle Jurassic.)

Fig. 11. *Microphyllopteris pectinata* (Hect.). From Waikato Heads, Auckland. *New Zeal. Geol. Surv. Coll.* Natural size. (Neocomian.)



W. Tams, photo.

Nageiopsis, Microphyllopteris and Tæniopteris.

Plate VIII.

Fig. 1. *Dictyophyllum obtusilobum ?* (Braun). From Mokoia, Gore, Southland. *No. 607. For. Mes. Plant Coll., Sedgwick Mus., Camb.* Natural size. (? Lower Jurassic.)

Fig. 2. *Nilssonia compta ?* (Phill.). From the same locality, and No. 608 in the same collection. Natural size. (Lower Jurassic.)

Fig. 3. *Nilssonia compta ?* (Phill.). From the same locality, and No. 609 in the same collection. Natural size. (Lower Jurassic.)

Fig. 4 *Tæniopteris Thomsoniana* sp. nov. From the Clent Hills, Canterbury. *New Zeal. Geol. Surv. Coll.* Natural size. (Rhætic.)

Fig. 5. *Araucarites cutchensis* (Feist.). From Mokoia, Gore, Southland. *No. 610, For. Mes. Plant. Coll., Sedgwick Mus., Camb.* $\times \frac{3}{2}$. (Lower Jurassic.)

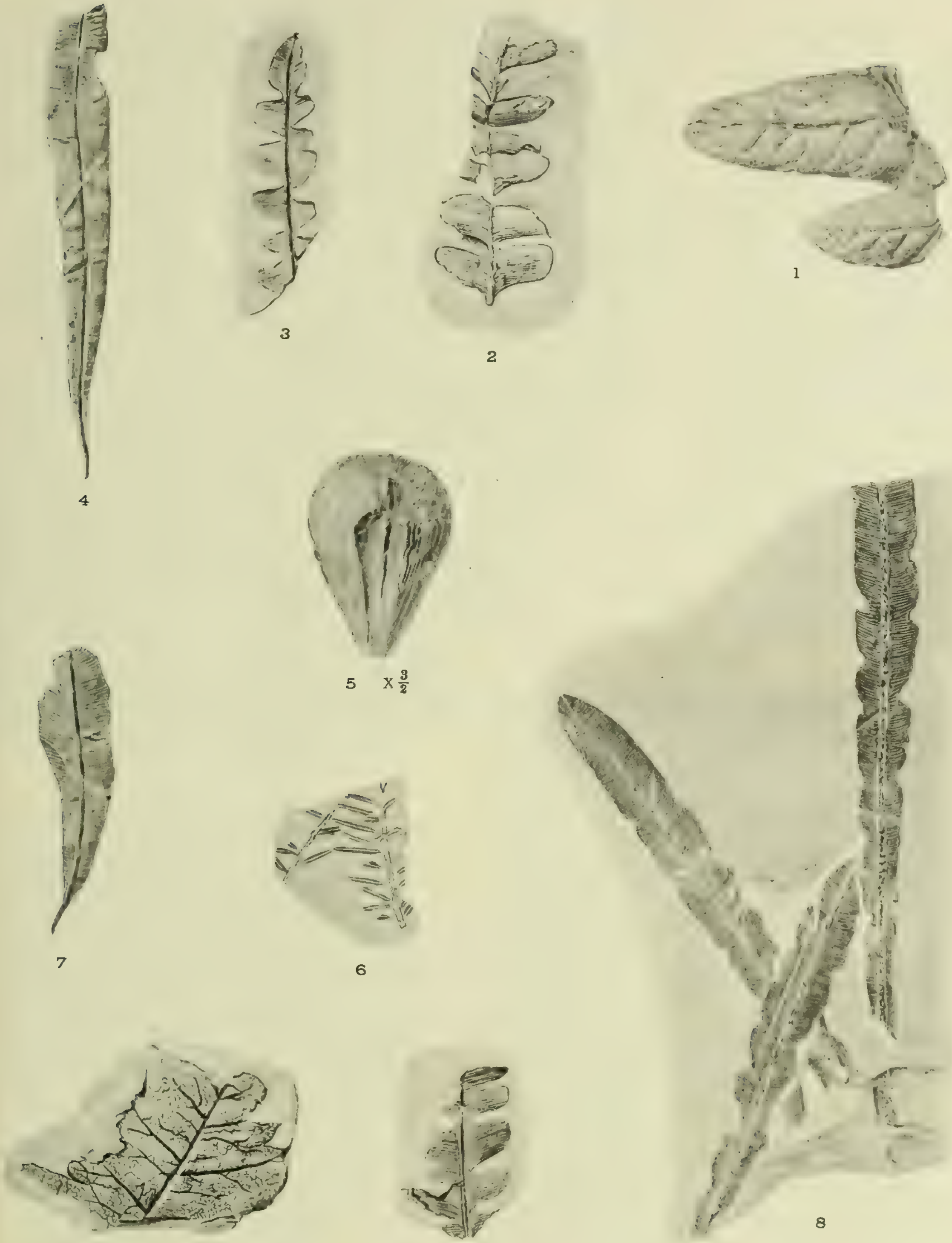
Fig. 6. *Elatocladus conferta* (Old. & Morr.). From the same locality, and No. 611 in the same collection. Natural size. (Lower Jurassic.)

Fig. 7. *Tæniopteris Thomsoniana* sp. nov. From the Clent Hills, Canterbury. *New Zeal. Geol. Surv. Coll.* Natural size. (Rhætic.)

Fig. 8. *Nilssonia elegans* sp. nov. From Mataura Falls, Southland. *New Zeal. Geol. Surv. Coll.* Natural size. (Middle Jurassic.)

Fig. 9. *Nilssonia compta ?* (Phill.). From Mokoia, Gore, Southland. *No. 609, For. Mes. Plant Coll., Sedgwick Mus., Camb.* Natural size. (Lower Jurassic.)

Fig. 10. *Dictyophyllum*, cf. *D. obtusilobum* (Braun). From the same locality, and No. 626 in the same collection. Natural size. (Lower Jurassic.)



T. A. Brock del.

London Stereoscopic Co. imp.

Dictyophyllum, Nilssonia, Taeniopteris etc.

PLATE IX.

Fig. 1. *Nilssonia elegans* sp. nov. From Mataura Falls, Southland. *New Zeal. Geol. Surv. Coll.* Natural size. (Middle Jurassic.)

Fig. 2. *Pterophyllum mataurieusis* Hect. Enlarged to show the nervation. From the same locality and in the same collection. × $\frac{5}{2}$. (Middle Jurassic.)

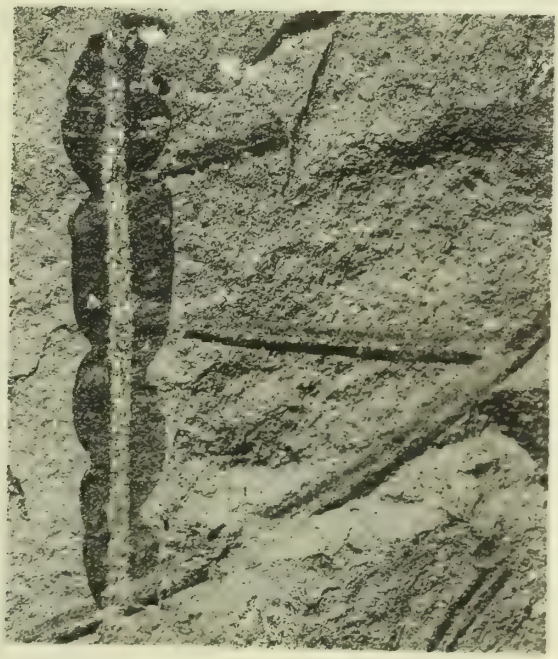
Fig. 3. *Nilssonia elegans* sp. nov. From the same locality and in the same collection. × 2. (Middle Jurassic.)

Fig. 4. *Tæniopteris crassinervis* (Feist.). An apical portion. From the same locality. *V. 11671, Brit. Mus. (Nat. Hist.).* Natural size. (Middle Jurassic.)

2 x $\frac{5}{2}$

1

4



3 X2

W. Tams, photo.

Nilssonia, Pterophyllum, Taeniopteris.

PLATE X.

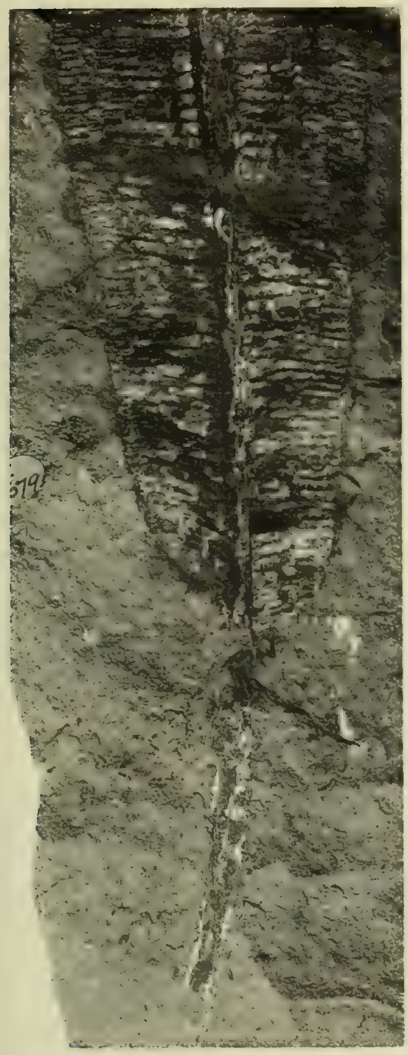
Fig. 1. *Tæniopteris crassinervis* (Feist.). A complete frond. From Mataura Falls, Southland. *New Zeal. Geol. Surv. Coll.* Reduced to $\frac{7}{11}$. (Middle Jurassic.)

Fig. 2. *Tæniopteris crassinervis* (Feist.). A young frond. From the same locality and in the same collection. Natural size. (Middle Jurassic.)

Fig. 3. *Tæniopteris crassinervis* (Feist.). A basal portion from the same locality. *V. 11679, Geol. Dept. Brit. Mus. (Nat. Hist.)*. Natural size. (Middle Jurassic.)

Fig. 4. Roots: From the same locality, and V. 11678 in the same collection. Natural size. (Middle Jurassic.)

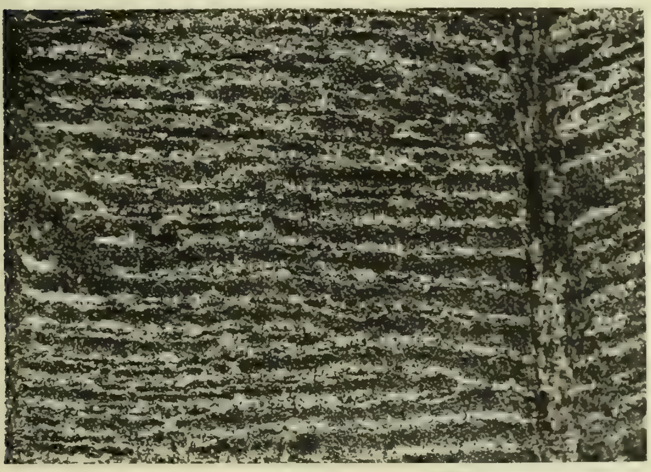
Fig. 5. *Tæniopteris crassinervis* (Feist.). Part of a frond, enlarged to show the nervation. From the same locality, and V. 11677 in the same collection. × 3. (Middle Jurassic.)



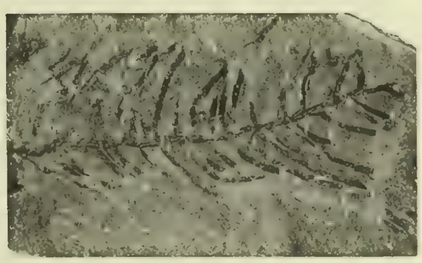
3

2

1 $\times \frac{7}{11}$



5 $\times 3$



4

W. Tams, photo.

Tæniopteris.

Plate XI.

Fig. 1. *Ptilophyllum acutilobum* Morr. From Waikawa, Southland. *New Zeal. Geol. Surv. Coll.* × 2. (Middle Jurassic.)

Fig. 2. *Ptilophyllum acutilobum* Morr. From the same locality and in the same collection. × $\frac{2}{3}$. (Middle Jurassic.)

Fig. 3. *Baiera robusta* sp. nov. From Mount Potts, Canterbury. *Brit. Mus. (Nat. Hist.)*. × $\frac{7}{6}$. (Rhætic.)

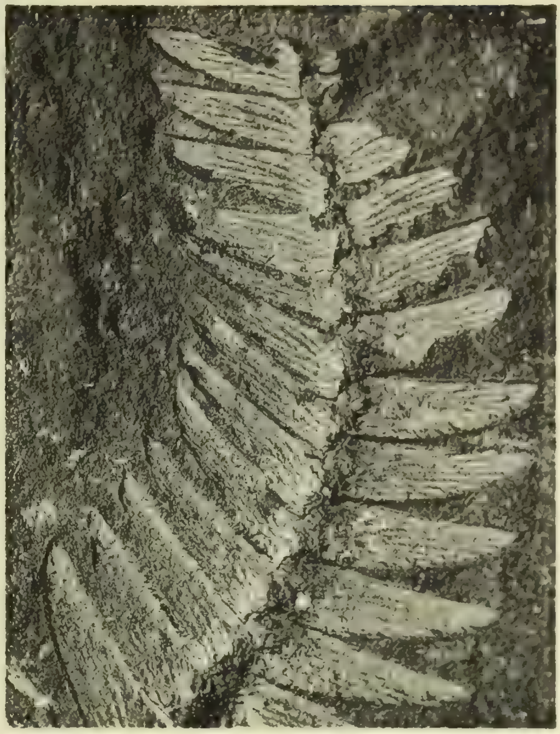
Fig. 4. *Baiera robusta* sp. nov. From the same locality and in the same collection. × $\frac{2}{3}$. (Rhætic.)

Fig. 5. *Ptilophyllum acutilobum* Morr. From Waikawa, Southland. *New Zeal. Geol. Surv. Coll.* × $\frac{2}{3}$. (Middle Jurassic.)

Fig. 6. *Carpolithus McKayi* sp. nov. From Wairoa Gorge, Mount Heslington, Nelson. *New Zeal. Geol. Surv. Coll.* × $\frac{2}{3}$. (? Rhætic.)

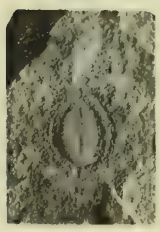
3 $\times \frac{7}{4}$

2



1 $\times 3$

4



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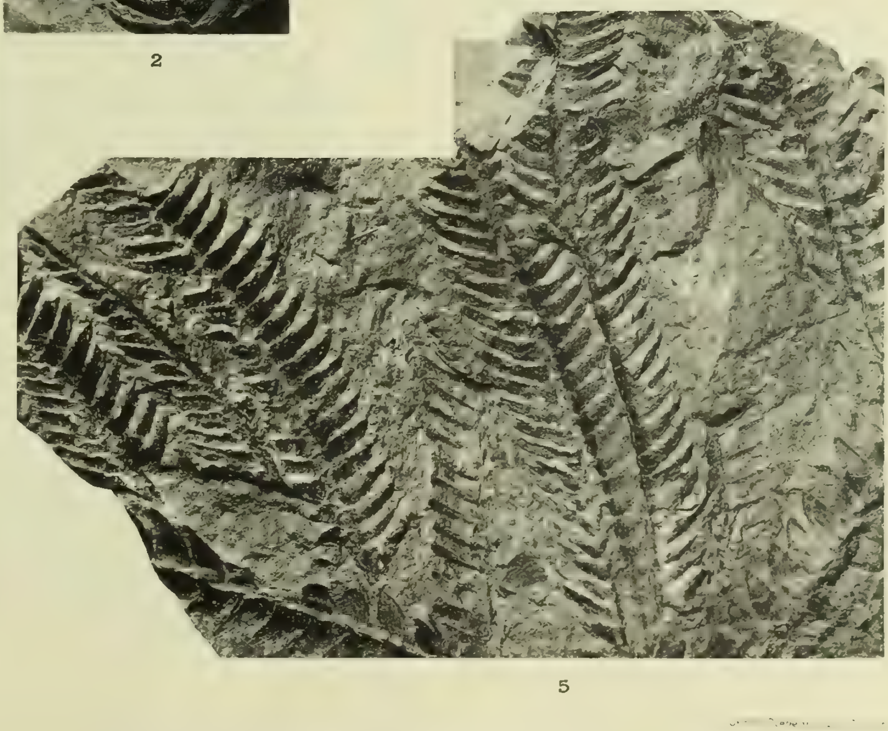


5

W. Tams, photo.

Ptilophyllum, Baiera, Carpolithus.

PLATE XII.

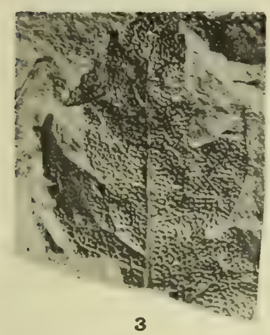
Fig. 1. *Pterophyllum mataurensis* Hect. From Mataura Falls, Southland. *V. 11675. Brit. Mus. (Nat. Hist.)*. × $\frac{2}{3}$. (Middle Jurassic.)

Fig. 2. *Dictyophyllum acutilobum* (Braun). From the same locality. *New Zeal. Geol. Surv. Coll.* Very slightly reduced. (Middle Jurassic.)

Fig. 3. *Dictyophyllum acutilobum* (Braun). From the Clent Hills, Canterbury. *New Zeal. Geol. Surv. Coll.* × $\frac{2}{3}$. (Rhætic.)

Fig. 4. *Dictyophyllum acutilobum* (Braun). From Mataura Falls, Southland. *New Zeal. Geol. Surv. Coll.* Natural size. (Middle Jurassic.)

Fig. 5. Stems of ? *Ptilophyllum* sp. From Waikawa, Southland. *New Zeal. Geol. Surv. Coll.* × $\frac{2}{3}$. (Middle Jurassic.)



3

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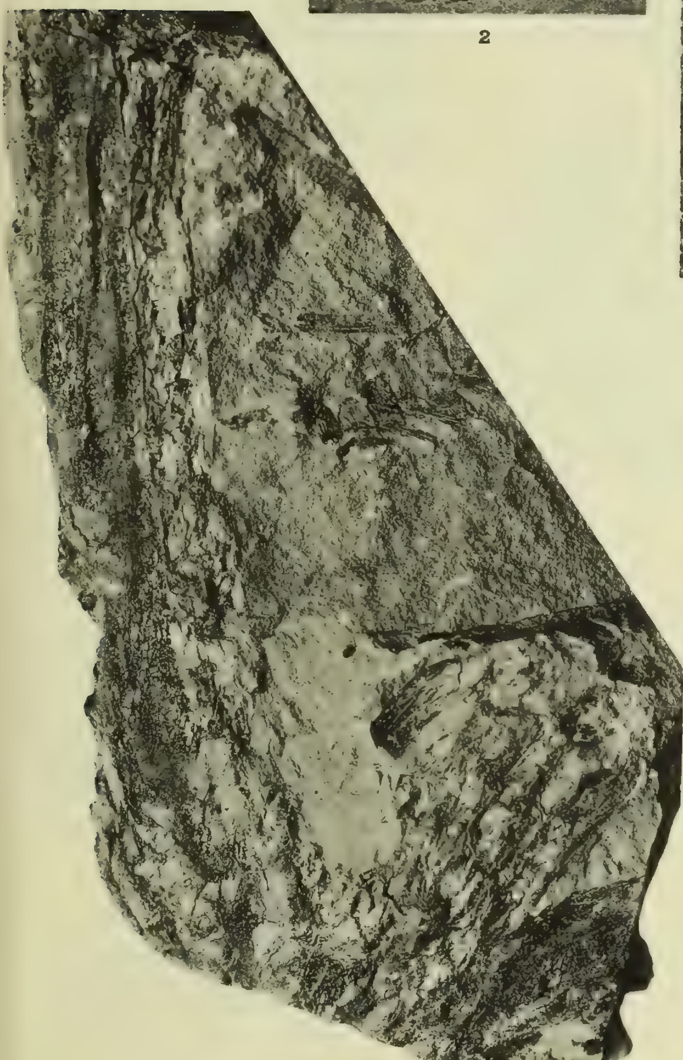
1



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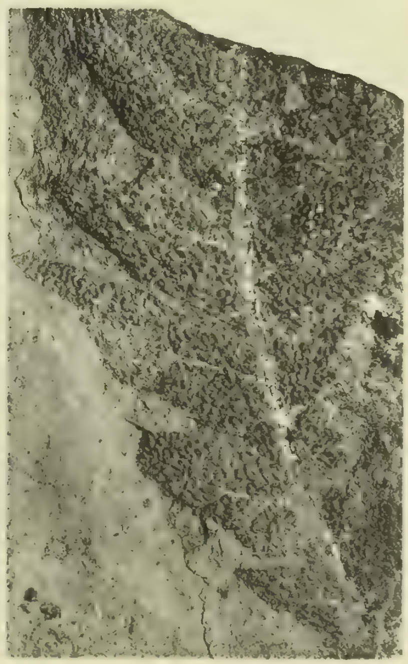


4 X $\frac{3}{2}$

W. Tams, photo.

Pterophyllum and Dictyophyllum

PLATE XIII.

Fig. 1. *Pagiophyllum peregrinum* (L. & H.). From Mataura Falls, Southland. *New Zeal. Geol. Surv. Coll.* $\times \frac{2}{3}$. (Middle Jurassic.)

Fig. 2. *Obscure ? fructification.* From Waikato Heads, Auckland. *New Zeal. Geol Surv. Coll.* $\times \frac{4}{3}$. (Neocomian.)

Fig. 3. *Obscure ? fructification.* From the same locality and in the same collection. Natural size. (Neocomian.)

Fig. 4. *Araucarites cutchensis* Feist. From Mokoia, Gore, Southland. *No. 610, For. Mesoz. Plant Coll., Sedgwick Mus., Camb.* $\times \frac{2}{3}$. (? Lower Jurassic.)

Fig. 5. *Obscure ? fructification.* From Waikato Heads, Auckland. *New Zeal. Geol. Surv. Coll.* Natural size. (Neocomian.)

Fig. 6. *Obscure ? fructification.* From the same locality and in the same collection. Natural size. (Neocomian.)

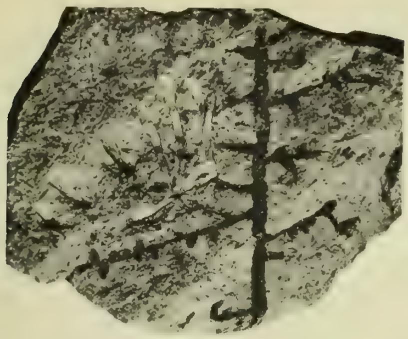
Fig. 7. *Stachyotaxus* sp. From Mokoia, Gore, Southland. *No. 612, For. Mesoz. Plant Coll., Sedgwick Mus., Camb.* $\times \frac{3}{2}$. (? Lower Jurassic.)

Fig. 8. *Brachyphyllum* sp. From Owaka Creek, Catlin's River, Otago. *New Zeal. Geol. Surv. Coll.* Natural size. (? Rhætic.)

Fig. 9. *Elatocladus* sp. From Waikawa, Southland. *New Zeal. Geol. Surv. Coll.* $\times \frac{7}{4}$. (Middle Jurassic.)

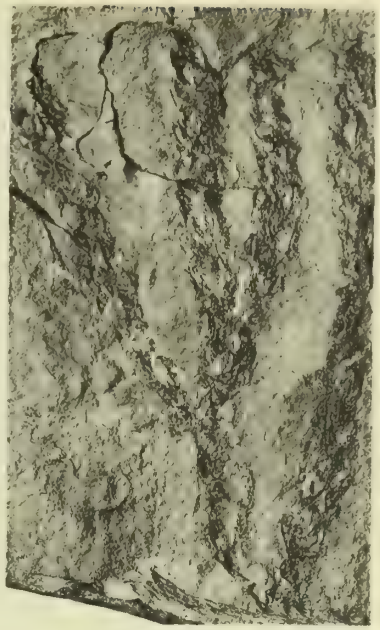
Fig. 10. *Brachyphyllum* sp. From Owaka Creek, Catlin's River, Otago. *New Zeal. Geol. Surv. Coll.* $\times 2$. (? Rhætic.)

Fig. 11. *Elatocladus conferta* (Old. & Morr.). From the Malvern Hills, Canterbury. *No. 621, For. Mesoz. Plant Coll., Sedgwick Mus., Camb.* Natural size. (Lower Jurassic.)



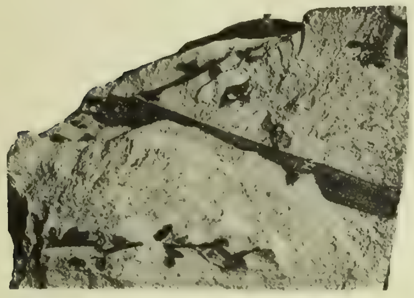
3 x $\frac{3}{2}$

2 X 2

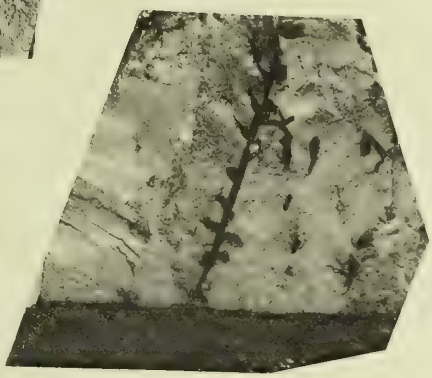


1

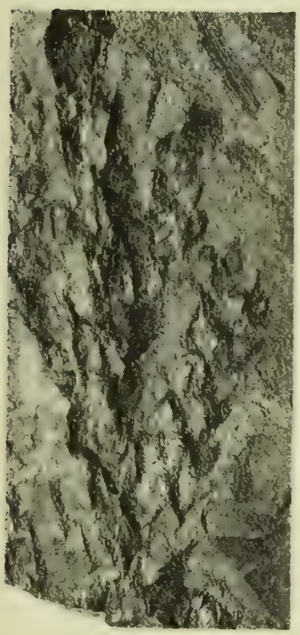
4



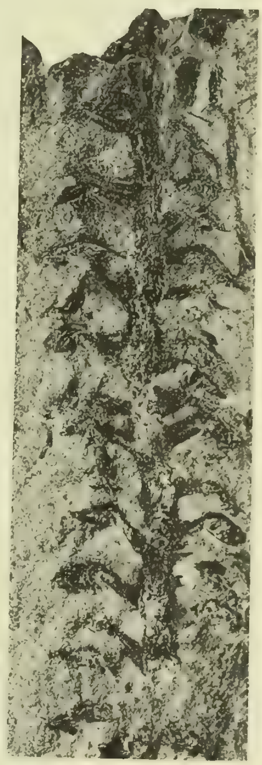
5 x $\frac{3}{2}$



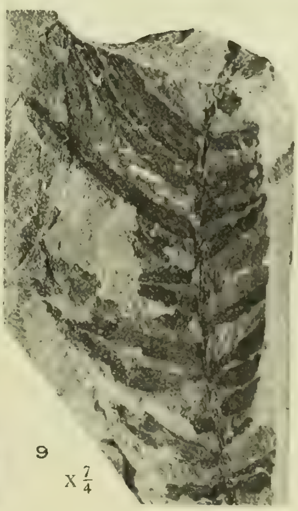
6 x $\frac{3}{2}$



10 X 2

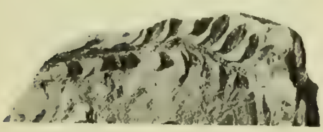


7 X $\frac{3}{2}$



9 X $\frac{7}{4}$

8



11

W. Tams, photo.

Pagiophyllum, Stachyotaxus, Brachyphyllum etc.

PLATE XIV.

Leaf of *Artocarpidium Arberi* Laur. seen at *a* (upper right-hand corner), another leaf of the same species seen at *b* (lower right-hand corner), and a leaf of *Phyllites* sp. seen at *c* (rather more than half-way up the left-hand side), with pinnæ of *Cladophlebis australis* (Morr.). From Waikato Heads, Auckland. *New Zeal. Geol. Surv. Coll.* × 2. (Neocomian.)

a

c

x 2

b

W. Tams, photo.

Artocarpidium & Cladophlebis.

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NEW ZEALAND.

Department of Mines.

GEOLOGICAL SURVEY BRANCH.

(P. G. MORGAN, Director.)

PALÆONTOLOGICAL BULLETIN No. 7.

DESCRIPTIONS AND REVISIONS

OF THE

CRETACEOUS AND TERTIARY FISH-REMAINS OF NEW ZEALAND.

BY

FREDERICK CHAPMAN, A.L.S., F.R.M.S., Etc.,
Palæontologist, National Museum, Melbourne.

ISSUED UNDER THE AUTHORITY OF THE HON. W. D. S. MACDONALD, MINISTER OF MINES.

WELLINGTON.
By Authority: Marcus F. Marks, Government Printer.
1918.

LETTER OF TRANSMITTAL.

GEOLOGICAL SURVEY OFFICE,
Wellington, 20th June, 1918.

SIR,—

I have the honour to submit herewith Palæontological Bulletin No. 7 of the Geological Survey Branch of the Mines Department.

This bulletin is entitled "Descriptions and Revisions of the Cretaceous and Tertiary Fish-remains of New Zealand," and was written by Mr. Frederick Chapman, A.L.S., F.R.M.S., Palæontologist to the National Museum, Melbourne.

The thanks of the Geological Survey are due to Mr. Chapman for the excellent manner in which he has accomplished the task of revision and description, and to the authorities controlling the National Museum for permitting Mr. Chapman to undertake the work.

The bulletin contains 47 pages of letterpress, and is illustrated by nine plates, two text-figures, and a map of New Zealand showing the principal localities mentioned.

I have the honour to be,
Sir,
Your obedient servant,
P. G. MORGAN,
Director, New Zealand Geological Survey.

The Hon. W. D. S. MacDonald,
Minister of Mines, Wellington.

PREFACE.

Between 1885 and 1887, collections of fish-remains, principally teeth, were forwarded to Mr. J. W. Davis, F.G.S., by Professor F. W. Hutton (Canterbury College), Sir Julius von Haast (Canterbury Museum), Mr. J. D. Enys (Castle Hill Station), Professor T. J. Parker (Otago University Museum), and the Geological Survey of New Zealand. As a result, Davis in 1888 published a paper in the *Scientific Transactions of the Royal Dublin Society* (series ii, vol. iv, pp. 1–62, pl. i–vii) in which he described thirty-five species of fish, together with one cetacean species. Of these thirty-six species, no less than twenty-nine were supposed to be new. Apparently all the New Zealand material examined by Davis was returned to New Zealand and redistributed to its owners. During the past few years the necessity for a revision of Davis's work has become apparent, and consequently in 1913 an arrangement was made with the Director of the National Museum, Melbourne, to allow Mr. Frederick Chapman to examine the type specimens and to redescribe them where necessary. Accordingly, early in 1914 all the type material in the Geological Survey and Canterbury Museum collections, together with additional specimens, was sent to the National Museum. Unfortunately, a few of the figured types and other specimens identified by Davis have been lost. Other material not seen by Mr. Chapman is in the Otago University and British Museums.

As a result of Mr. Chapman's revision, Davis's twenty-nine new species are reduced to fourteen—namely, *Notidanus marginalis* Davis sp., *Synechodus sulcatus* Davis sp., *Carcharias (Prionodon) aculeatus* Davis sp., *Odontaspis attenuata* Davis sp., *O. ensiculata* Davis sp., *O. exigua* Davis, *O. incurva* Davis sp., *Pristiophorus lanceolatus* Davis sp., *Trygon ensifer* Davis, *Myliobatis altus* Davis, *M. arcuatus* Davis, *M. plicatilis* Davis, *Sargus laticonus* Davis, and the cetacean *Parasqualodon serratus* Davis sp. This last species was said by Hector to be his *Kekenodon onamata*, but the validity of this claim is doubtful. Considerable changes in Davis's generic names have also been made. On the other hand, Mr. Chapman describes five new species, and identifies many foreign species which have hitherto not been found in New Zealand strata.

It is a matter for regret that very few copies of Davis's beautifully illustrated paper were circulated in New Zealand, and consequently many students are practically unacquainted with his work, and unable to identify by name the specimens of "sharks' teeth," &c., that occur more or less plentifully in New Zealand Tertiary and Cretaceous rocks. This difficulty, it is hoped, will be removed by the publication of Mr. Chapman's report, which, moreover, seems to place the nomenclature of the various species on a sound and satisfactory basis.

The type specimens in the Canterbury Museum have, on the whole, been well looked after, but several are lost or mislaid. Those from the Geological Survey collections were placed in a case in the Dominion (then Colonial) Museum, and for many years received very little attention. In fact, it was uncertain whether their ownership was to be assigned to the Museum or to the Geological Survey. In 1913 the specimens were loose in trays, and apparently some mixing had taken place. This confusion, however, was not serious, and has now probably been set right, except that in one or two cases the locality is unknown or very doubtful. It is also true that the original labels in various cases are quite insufficient to identify the exact horizon. Moreover, five of the figured types have been mislaid or lost.

Davis, presumably owing to bad labelling as well as to other causes, made many errors in his locality-records, &c. Some of these were corrected by Hector, and others are rectified on the following pages and in the descriptions of the plates. It is perhaps too much to hope that all mistakes capable of correction have been detected, and that no new misstatements have crept in, but every endeavour to avoid and to eliminate errors has been made. If any reader should find a statement requiring correction he is requested to be kind enough to inform the writer of this preface, who is responsible for many of the variations from Davis's records (see pages 33–39).

P. G. MORGAN.

CONTENTS.


NEW ZEALAND
(AOTEA-ROA)
Showing Localities of
Fossil Fish Remains
P. G. MORGAN
DIRECTOR
ENGLISH MILES
100 50 0 100
100 50 0 100 200
KILOMETRES
TASMAN
SEA
SOUTH
PACIFIC
OCEAN
North Cape
C Maria v. Diemen
Hokianga Har.
Parua Bay
Whangarei
Dargaville
Komiti Bluff
Kaipara Har.
Gt. Barrier I.
Hauraki
Gulf
Cuvier I
AUCKLAND
Waikato R.
Mercer
Mayor I.
Bay of
Plenty
White I
Motiti I.
Whale I
East Cape
Raglan Har.
(Whaingaroa Har.)
Raglan
Aotea Har
Kawhia Har.
Rotorua
Mokau R.
L. TAUPO
Ormond
Gisborne
Poverty Bay
NEW PLYMOUTH
C. Egmont
Ruapehu
Hawke Bay
Mahia Pen.
Esk R.
NAPIER
Wanganui
Wanganui R.
Ormondville
C. Farewell
Golden Bay
Tasman Bay
Cook Str.
Castlepoint
Whareama R.
NELSON
BLENHEIM
WELLINGTON
C. Palliser
C. Campbell
C. Foulwind
Brighton
Coverham
Clarence R.
Cobden
Greymouth
HOKITIKA
Kaikoura
Amuri Bluff
Waiau-ua R.
Hurunui R.
Greta
Waipara R.
Waimakariri R.
CHRISTCHURCH
Banks Pen.
Curiosity Shop
Jacksons Bay
Cascade Pt
Big Bay
Milford Sound
Rakaia R.
Rangitata R.
Timaru
Pareora R.
St. Andrews
Waihao R.
Waihao Forks
Waitaki R.
Oamaru
Shag Pt.
Waitati
Otago Pen.
DUNEDIN
SOUTHLAND
INVERCARGILL
Molyneux R.
Kaitangata
Foveaux Str.
Stewart I.
Boundaries of Land Districts
Old Provincial Districts
E. Long.

600_9.18_448.

DESCRIPTIONS AND REVISIONS

OF THE

CRETACEOUS AND TERTIARY FISH-REMAINS OF NEW ZEALAND.

I. INTRODUCTION.

The material on which the following report is based was forwarded to the National Museum, Melbourne, in 1914 by the Geological Survey of New Zealand, Wellington, and the Canterbury Museum, Christchurch. The collection comprises the types and figured specimens described by J. W. Davis, F.G.S., in 1888(1), together with additional fish-remains from the collections of the Geological Survey of New Zealand and from the Canterbury Museum. The total number of fossils examined is 551. The collection of fish-remains sent to Mr. Davis by the Geological Survey numbered 250 specimens(2). In addition "many hundreds of specimens" were sent by Sir Julius von Haast from the Canterbury Museum collections, and others were forwarded by Mr. J. D. Enys and Professors F. W. Hutton and T. J. Parker(3).

The majority of the fishes herein described or referred to can be separated into their respective Cretaceous and Tertiary facies, but a small number is found bridging the expected gap between Cretaceous and Tertiary, which helps to show in some measure the existence of a passage series (the Cretaceo-Tertiary) with closely annectent elements in the fauna. This graduated series is found in the Amuri and Weka Pass sections to show, chiefly by the Foraminifera, that there is no very definite break up to the Miocene stages. That a feeble unconformity did occur is seen by the careful stratigraphical work now carried on in the field, corroborated by microsocopic study of the rocks concerned. The conclusions that may be drawn therefrom point to a feeble time-break at the close of the Amuri limestone formation and before the deposition of the Weka Pass stone. The literature on the subject is already voluminous, and it is only necessary here to present the results of my investigations of the fish-remains, leaving to those on the spot the task of reconciling these results with the field evidence.

Owing to changes of nomenclature since 1888, and further researches into the relationships of some of the New Zealand fossils, an emended list of Davis's species is here given.

(1) "On Fossil Fish-remains from the Tertiary and Cretaceo-Tertiary Formations of New Zealand," *Sci. Trans. Roy. Dublin Soc.*, ser. 2, vol. iv, pp. 1–62, pl. i–vii.
(2) See J. A. Thomson, *Palæont. Bull. No. 1*, New Zealand Geological Survey, 1913, p. 21.
(3) J. W. Davis, *loc. cit.*, pp. 1–2.

List of Fossil Fishes described by J. W. Davis, F.G.S., in Trans. Roy. Dublin Soc., Ser. 2, Vol. IV, 1888, with the Emended Names suggested in this Paper.

Page in Davis's Memoir.	Davis's Determinations.	Revised Names.	Page in this Memoir.
8	*Galeocerdo aculeatus* Davis ..	*Carcharias (Prionodon) aculeatus* Davis sp.	8
9	*Carcharodon angustidens* Agassiz (*pars*)	*Carcharodon auriculatus* Blainville sp.	18
11	*Carcharodon angustidens* Agassiz (small tooth from Esk River)	*Carcharodon rondeletii* Müller and Henle	20
12	*Carcharodon megalodon* Agassiz	*Carcharodon megalodon* Agassiz ..	19
13	*Carcharodon robustus* Davis ..	*Carcharodon auriculatus* Blainville sp.	18
15	*Otodus obliquus* Agassiz ..	*Lamna crassa* Agassiz sp.	16
15	*Lamna huttoni* Davis ..	*Odontaspis elegans* Agassiz sp. ..	11
17	*Lamna incurva* Davis (*pars*) ..	*Odontaspis incurva* Davis sp. ..	13
17	*Lamna incurva* Davis (*pars*) ..	*Scapanorhynchus rhaphiodon* Agassiz sp.	10
18	*Lamna ensiculata* Davis ..	*Odontaspis ensiculata* Davis sp. ..	12
19	*Lamna marginalis* Davis (*pars*)	*Lamna compressa* Agassiz	15
19	*Lamna marginalis* Davis (*pars*)	*Lamna crassa* Agassiz sp.	16
19	*Lamna attenuata* Davis ..	*Odontaspis attenuata* Davis sp. ..	10
20	*Lamna lanceolata* Davis ..	*Pristiophorus lanceolatus* Davis sp. ..	20
21	*Lamna carinata* Davis ..	*Scapanorhynchus subulatus* Agassiz sp.	8
21	*Lamna hectori* Davis ..	*Scapanorhynchus rhaphiodon* Agassiz sp.	10
22	*Odontaspis acuta* Davis ..	*Lamna bronni* Agassiz	14
23	*Odontaspis exigua* Davis ..	*Odontaspis exigua* Davis	12
24	*Odontaspis kaikoraensis* Davis..	*Scapanorhynchus subulatus* Agassiz sp.	8
25	*Odontaspis sulcata* Davis (*pars*)	*Synechodus sulcatus* Davis sp. ..	5
25	*Odontaspis sulcata* Davis (*pars*)	*Synechodus validus* sp. nov. ..	6
26	*Oxyrhina vonhaastii* Davis (*pars*)	*Isurus retroflexus* Agassiz sp. ..	18
26	*Oxyrhina vonhaastii* Davis (*pars*)	(?) *Lamna crassa* Agassiz sp. ..	16
27	*Oxyrhina recta* Davis ..	*Isurus retroflexus* Agassiz sp. ..	18
28	*Oxyrhina enysii* Davis ..	*Lamna apiculata* Agassiz sp. ..	13
29	*Oxyrhina acuminata* Davis ..	*Isurus hastalis* Agassiz sp.	17
30	*Oxyrhina grandis* Davis ..	*Isurus desori* Agassiz sp.	16
30	*Oxyrhina fastigiata* Davis ..	*Isurus minutus* Agassiz sp. ..	17
31	*Oxyrhina subvexa* Davis ..	*Lamna apiculata* Agassiz sp. ..	13
32	*Oxyrhina lata* Davis	*Isurus hastalis* Agassiz sp.	17
33	*Notidanus primigenius* Agassiz	*Notidanus primigenius* Agassiz ..	5
34	*Notidanus marginalis* Davis (*pars*)	*Notidanus marginalis* Davis ..	4
34	*Notidanus marginalis* Davis (*pars*)	*Galeocerdo davisi* Chapman and Pritchard	7
36	*Notidanus dentatus* A. S. Woodward	*Notidanus dentatus* A. S. Woodward ..	4
37	*Trygon ensifer* Davis (*pars*) ..	*Trygon ensifer* Davis	22
37	*Trygon ensifer* Davis (*pars*) ..	*Labrodon confertidens* and *L. depressus* Chapman and Pritchard	27
39	*Myliobatis plicatilis* Davis ..	*Myliobatis plicatilis* Davis	23
40	*Myliobatis arcuatus* Davis ..	*Myliobatis arcuatus* Davis	23
40	*Myliobatis altus* Davis ..	*Myliobatis altus* Davis	23
41	*Callorhynchus hectori* E. T. Newton	*Callorhynchus hectori* E. T. Newton ..	24
42	*Ischyodus brevirostris* Agassiz ..	*Ischyodus thurmanni* Pictet and Campiche	24
43	*Sargus laticonus* Davis ..	*Sargus laticonus* Davis	28
43	*Sargus* (otoliths of) Davis ..	*Cestracion novo-zelandicus* sp. nov. ..	7

In the systematic portion of this work the fossil fishes are arranged zoologically, but the following tables may be found useful for reference when examining the different faunas :—

List of Fishes here recognized as Cretaceous in New Zealand.

Notidanus dentatus Smith Woodward.
Synechodus sulcatus Davis sp.
Synechodus validus sp. nov.
Scapanorhynchus subulatus Agassiz sp.
Scapanorhynchus rhaphiodon Agassiz sp.
Lamna crassa Agassiz sp.
Lamna appendiculata Agassiz sp.
Ischyodus thurmanni Pictet and Campiche.
Callorhynchus hectori Newton.
(?) *Thrissopater* sp.
Diplomystus coverhamensis sp. nov.

List of Fishes common to the Upper Cretaceous and Tertiary of New Zealand.

Odontaspis incurva Davis sp.
Lamna apiculata Agassiz sp.
(?) *Isurus desori* Agassiz sp.
Carcharodon auriculatus Blainville sp.
(?) *Trygon ensifer* Davis.

List of Fishes found only in the Tertiary Series of New Zealand.

Notidanus marginalis Davis.
Notidanus primigenius Agassiz.
Cestracion coleridgensis sp. nov.
Cestracion novo-zelandicus sp. nov.
Galeocerdo davisi Chapman and Pritchard.
Carcharias (Prionodon) aculeatus Davis sp.
Odontaspis attenuata Davis sp.
Odontaspis contortidens Agassiz.
Odontaspis elegans Agassiz sp.
Odontaspis ensiculata Davis sp.
Odontaspis exigua Davis.
Lamna bronni Agassiz.
Lamna compressa Agassiz.
Isurus hastalis Agassiz sp.
Isurus minutus Agassiz sp.
Isurus retroflexus Agassiz sp.
Carcharodon megalodon Agassiz.
Carcharodon rondeletii Müller and Henle.
Pristiophorus lanceolatus Davis sp.
Pristiophorus napierensis sp. nov.
Myliobatis altus Davis.
Myliobatis arcuatus Davis.
Myliobatis plicatilis Davis.
Scombroclupea cf. *macrophthalma* Heckel sp.
Labrodon confertidens Chapman and Pritchard.
Labrodon depressus Chapman and Pritchard.
Sargus laticonus Davis.

II. SYSTEMATIC DESCRIPTION.

Class PISCES.

Subclass SELACHII Cuvier.

Order PLAGIOSTOMI Dumeril (Sharks and Rays).

Suborder DIPLOSPONDYLI Hasse.

Family **Notidanidæ.**

Genus NOTIDANUS Cuvier.

Notidanus dentatus A. S. Woodward. Plate VI, figs. 9–12.

Notidanus dentatus A. S. Woodward, 1886, *Geol. Mag.* (n.s.), dec. 3, vol. iii, p. 214, pl. vi, figs. 17, 18. Davis, 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 36, pl. vi, figs. 9–12. A. S. Woodward, 1889, *Cat. Foss. Fishes Brit. Mus.*, pt. i, p. 159. Chapman, 1914, *Australasian Fossils*, p. 269.

Abbreviated Description. — "Principal cone of lower lateral teeth relatively small; secondary cones three or four in number; anterior denticulations of very large size" (1).

Observations.—This particular type of tooth with large anterior denticles is compared by Smith Woodward with "the very rare *N. pectinatus* from the English Chalk; but this is a much smaller species, and differs in possessing a larger series of cones behind the principal" (2).

The type specimen is in the British Museum collection, and two of the plesiotypes figured by J. W. Davis (Plate VI, figs. 11, 12) are in the present collection.

Other examples of the lower teeth, more or less imperfect, occur in a series of fossils marked "Loc. No. 13, West Wing, Amuri Bluff" (3), also submitted to the writer.

Occurrence.—The tooth of this species is a well-defined form, and is apparently confined to one locality—viz., Amuri Bluff, in rock with associated Belemnites (*Belemnites lindsayi* Hector sp.).

Age.—Upper Cretaceous (Senonian).

Notidanus marginalis Davis. Plate VI, fig. 8; Plate IX, fig. 1.

Notidanus marginalis Davis, 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 34, pl. vi, fig. 8 (*non* 7) (4). A. S. Woodward, 1888, *Cat. Foss. Fishes Brit. Mus.*, pt. i, p. 167. Chapman, 1914, *Australasian Fossils*, p. 268, fig. 130A.

Description (emended).—Teeth of lower jaw comparatively thin, compressed, especially at the base. External surface flat, slightly concave below; internal surface slightly convex. There are five thin sharp cones, decreasing rapidly in size from front to back, and disposed along the base at a lower angle than is usual in this genus. The anterior (largest) cone is serrated on the forward edge, the serrations, five or six in number, decreasing in size towards the root. All the cones are smooth and gently convex on each surface, and the edges are sharp and irregularly and sparsely notched. Root moderately large and thin, the internal surface at first thicker, but rapidly thinning off to a knife-like basal margin; the upper margin rises to a greater height on the inner surface.

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(1) Smith Woodward, 1889, *loc. cit.*, p. 159.

(2) *Idem*, 1886, *loc. cit.*, p. 215.

(3) The locality numbers quoted in this way "(loc. No. 13)" are those of the Geological Survey. Numbers quoted in this way "(620)," with or without parentheses are those of the Canterbury Museum collection.

(4) The tooth figured on pl. vi, fig. 7, of Davis's monograph, as Dr. A. S. Woodward has already pointed out (*Cat. Foss. Fishes Brit. Mus.*, pt. i, 1889, p. 167), is referable to *Galeocerdo* (see *postea*, p. 7).

Dimensions.—Holotype: Length of tooth, 23 mm.; greatest height, (*circ.*) 13 mm.; greatest thickness of root at anterior end, 3 mm.; height of crown, 6 mm.; deepest part of root, 8 mm.

Relationships.—As already remarked by J. W. Davis, the above tooth somewhat resembles that of *N. serratissimus* Agassiz, a species ranging from the Lower Eocene to the Lower Miocene. This differs, however, from Davis's species in the generally smaller and more numerous posterior series of cones. *N. marginalis* differs essentially in the almost equal size of the two anterior cones, those of *N. primigenius* and *N. serratissimus* being graduated.

Occurrence.—Three specimens of this species are represented in the present collection —viz., the holotype(1), from Broken River (Trelissick Basin); an imperfect example with two large anterior cones, from the "uppermost beds, Waipara Formation, Waipara" (labelled "*Notidanus primigenius*"); and another, a rather minute form, having a series of only four denticles, from the Awatere Series of the Mohaka Crossing, Napier–Taupo Road. The example from Waipara I have no hesitation in assigning to *N. marginalis* from the character of the anterior serrations of the forward cone, which are more numerous in this species.

Age.—Tertiary (Miocene and Pliocene).

Notidanus primigenius Agassiz. Plate VI, fig. 6.

Notidanus primigenius Agassiz, 1843, *Poiss. fossiles*, vol. iii, p. 218, pl. xxvii, figs. 6–8, 13–17 (figs. 4, 5).
Notidanus recurvus Agassiz, 1843, *ibid.*, p. 220, pl. xxvii, figs. 9–12.
Notidanus primigenius Agassiz: A. S. Woodward, 1886, *Geol. Mag.*, dec. 3, vol. iii, p. 216, pl. vi, figs. 19–22. Davis, 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 33, pl. vi, fig. 6. A. S. Woodward, 1889, *Cat. Foss. Fishes Brit. Mus.*, pt. i, p. 163. Eastman, 1904, *Maryland Geol. Surv. Miocene*, p. 77, pl. xxix, figs. 6 *a*, *b*.

Observations.—The only specimen in the collection is a tooth from the upper jaw, and this has already been figured by Davis under the above name. It is essentially the same in all particulars as the example figured by Smith Woodward (*loc. cit.*, 1886, fig. 21). Dr. Woodward notes the close relationship of this species with *N. serratissimus*.

Occurrence.—Plesiotype (tooth from upper jaw): In the white limestone of Cave Valley, Oamaru. Coll. F. W. Hütton, Canterbury Museum, Christchurch.

Age.—Tertiary (Miocene). Hutchinsonian.

Suborder ASTEROSPONDYLI Hasse.

Family **Cestraciontidæ** Agassiz.

Genus SYNECHODUS Smith Woodward.

Synechodus sulcatus Davis sp. Plate V, figs. 11 and 13.

Odontaspis sulcata Davis, 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 25, pl. v, figs. 11, 13 (*non* 12).
Synechodus sulcatus Davis sp.: A. Smith Woodward, 1888, *Geol. Mag.*, dec 3, vol. v, p. 499. *Idem*, 1889, *Cat. Foss. Fishes Brit. Mus.*, pt. i, p. 330.

Description.—(Davis, p. 25:) "Teeth with large base, 0·5 in. to 0·8 in. in extent; the central cone rises to a height slightly less than half the breadth of the base; in a tooth 0·6 in. across the base the height of the cone is 0·25 in., and its width 0·15 in.; on each side of the median cone are two or three lateral cones, diminishing in size as they recede from the centre. All the cones are deeply grooved at the base; the grooves disappear midway up the surface. The upper part is smooth; the lateral margins are smooth, and, where unworn, form a sharp cutting-edge. The base is 0·1 in. in depth, anteriorly concave and somewhat retreating, posteriorly more or less produced."

(1) Davis had two cotypes, represented by figs. 7 and 8 of his pl. vi, but one of these (his fig. 7) was shown by Chapman and Pritchard to be a *Galeocerdo*, and was taken by them as the holotype of *G. davisi*. (See p. 7.) Hence the remaining specimen is here regarded as the holotype of *N. marginalis*.

Observations.—The above teeth, originally described under the genus *Odontaspis* by Davis, were subsequently shown to belong to the Cestraciont genus *Synechodus* by Smith Woodward. This genus is typical of various Cretaceous strata in Europe; it has also been found in the Cretaceous (Salamanquean) of Patagonia, and is represented by a single species in the Eocene of Maryland. From the characters shown in the very perfect jaws of *Synechodus dubrisiensis* Mackie sp., from the Chalk of Sussex, figured by Woodward(1), the figured type (here regarded as a cotype) of Davis (Plate V, fig. 11) is evidently an example of dentition series II or III, belonging to the anterior region of the jaw. The cotype (Plate V, fig. 13) is probably referable to a more posterior series. As regards the specimen illustrated by Davis's fig. 12, pl. v (numbered 13 in error on page 58 of his paper), and stated by him to have its " surface smoothed by abrasion," I have examined it closely, and conclude that it has not been abraded to such an extent as would remove the sulcate ornament, but was originally smooth excepting close to the base, and represents a new species.

Occurrence.—Cotypes (two specimens figured by Davis); also two other examples: Black grit, East Wing, Amuri Bluff (loc. No. 8).

Age.—Upper Cretaceous (Senonian).

Synechodus validus sp. nov. Plate V, fig. 12; Plate IX, fig. 2.

Odontaspis sulcata Davis (*pars*), 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 25, pl. v, fig. 12.

Description. — Dentition robust as compared with *S. sulcatus*. Central cone high, smooth, regularly tapering, margins slightly concave near the base. Lateral denticles about one-third the height of the central cone, sharp at the apex but in general form as in the central cone; surface near the base very slightly striate. Root heavier and stronger than in *S. sulcatus*, and without vertical striations, instead of which there is a finely punctate surface.

Dimensions.—Width of dentition at the base, 17·5 mm. Height of central cone from base of root, 11·5 mm. Height of central cone, 8 mm.; width at base, 5 mm. Height of secondary cone, 3 mm.

Observations.—This specific form is easily separated from the foregoing, *S. sulcatus*, by its more robust character, the smooth surface of the cones, and the more pyramidal form of the central cone, which has not the deeply concave margin seen in the basal portion of *S. sulcatus*.

Occurrence.—Although relegated to the black grit of the Amuri Bluff by Davis in his description under "*Odontaspis sulcata*," this specimen is associated with fragments of Belemnites, and the matrix of the rock is different; it would therefore seem to belong to the Belemnite beds of the East Wing of Amuri Bluff (loc. No. 3).

Age.—Upper Cretaceous (Senonian).

Genus CESTRACION Cuvier.

Cestracion coleridgensis sp. nov. Plate IX, figs. 3 *a, b*.

Description.—The present form is represented by three narrow teeth resembling the antero-lateral teeth of *Cestracion*, but of much more slender proportions than usual. The crown is strongly arched, and has a definite submedian ridge, coarsely crenulated along the top. The outer slope is narrower, and vermiculately vertically ridged, the inner slope rather deeply excavated with a sharp articulating border.

Dimensions.—Holotype: Length, 10·5 mm.; greatest width (near centre), 2·75 mm.; greatest height (at centre), 2 mm.

Observations.—All the specimens are from the same locality. In the holotype the submedian ridge is very distinct, whilst that of the other two is more like the structure

(1) *Geol. Mag.*, dec. 3, vol. v, 1888, p. 498 (woodcut).

in the living *Cestracion*. The crown is more arched and prominent than in the usual form of *Cestracion* teeth, but otherwise it agrees in generic characters, differing most of all in its slender proportions. In the latter feature it is suggestive of the teeth of *Acrodus;* but in that genus the shape is more evenly ovate and pointed, and the median ridge more regular. One of the specimens (the holotype) was named by J. W. Davis "*Hybodus* ?—derivative ?"; the tooth, however, does not show the cuspidate crown of that genus, and probably *Acrodus* was intended, of which genus it is very suggestive.

Relationships.—A lateral crushing-tooth of the general shape of the above species has been identified by Smith Woodward(1) with Winkler's *Cestracion duponti*, from the Eocene of Brussels. The present species is still narrower than Winkler's, and is more strongly arched coronally. Another narrow tooth of this character has been recorded, but not named, by Smith Woodward(2) from the London Clay of Highgate Archway, London. Ameghino has figured a slender tooth after the type of the above species, *Acrodus rothi*(3), from the Miocene of Patagonia, which differs in its more depressed crown.

Occurrence.—Coleridge Creek, Trelissick Basin, Canterbury.

Age.—Tertiary (Miocene). Mount Brown Series.

Cestracion novo-zelandicus sp. nov. Plate VII, figs. 8 *a–c*; Plate IX, figs. 4 *a, b*, 5 *a, b*.

"Otoliths, ? *Sargus*" Davis, 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 45, pl. vii, fig. 8.

Description.—Teeth from the middle lateral rows sinuately ovate, in length slightly more than twice the breadth, moderately arched. Submedian ridge thick and rather ill-defined, having the surface on either side strongly grooved and pitted, but not so finely cancellated as in the living *Cestracion philippi*. It seems to have been slightly smaller than that species, judging by the teeth now examined. A tooth from about the seventh row forward is long and narrow, with a sinuous twist; the surface is moderately convex, with an obscure submedian ridge and grooves at right angles to it merging into cancellated marginal areas. The base, with its articulating edges, is well defined.

Dimensions.—Lateral teeth, 9 mm. in length; width, 4 mm. Anterior lateral tooth (probably of a slightly larger example), 11 mm. long, 4 mm. wide.

Observations.—The above species I have no hesitation in referring to the dentition of *Cestracion*. These teeth more nearly resemble the lateral pavement teeth of the living Port Jackson shark than the allied Victorian species, *C. cainozoicus*(4); the latter being easily distinguished by the larger and broader teeth, and the smoother surface, on which the submedian keel is often almost obsolete.

Occurrence.—The above specimens are from Coleridge Creek, Trelissick Basin.

Age.—Tertiary (Miocene). Mount Brown Series.

Family **Carchariidæ** Müller and Henle.

Genus GALEOCERDO Müller and Henle.

Galeocerdo davisi Chapman and Pritchard. Plate VI, figs. 7 *a–c*.

Notidanus marginalis Davis (*pars*), 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 34, pl. vi, fig. 7 (*non* fig. 8).

Galeocerdo sp. A. S. Woodward, 1889, *Cat. Foss. Fishes Brit. Mus.*, pt. i, p. 167.

Galeocerdo davisi Chapman and Pritchard, 1904, *Proc. Roy. Soc. Vict.*, vol. xvii (n.s.), pt. i, p. 273. Chapman, 1914, *Australasian Fossils*, p. 269, 271.

Observations.—The holotype of this species was erroneously described as *Notidanus* by J. W. Davis. It was subsequently named after Mr. Davis by Dr. Pritchard and myself

(1) *Geol. Mag.*, dec. 3, vol. viii, 1891, p. 105, pl. iii, fig. 1.
(2) *Cat. Foss. Fishes Brit. Mus.*, pt. i, 1889, p. 336.
(3) *Anales del Museo Nacional de Buenos Aires*, ser. 3, vol. viii, 1906, p. 177, pl. i, fig. 4.
(4) Chapman and Pritchard, *Proc. Roy. Soc. Vict.*, vol. xvii (n.s.), pt. i, 1904, p. 270, pl. xi, figs. 5–8; pl. xii, fig. 2.

when describing similar specimens from Victoria. It is distinguished from other Tertiary teeth of the genus *Galeocerdo* by its intermediate characters between *G. latidens* Agassiz(1) and *G. aduncus* Agassiz(2), having the depressed cusp of the former and the heavy base of the latter species.

Occurrence.—In Victoria *G. davisi* is found in the Janjukian (Miocene) of the Gellibrand River coastal section, and in the Kalimnan (Lower Pliocene) of Grange Burn and Beaumaris. Our remarks(3) on the stratigraphical horizon of the New Zealand tooth require to be modified, as it seems to occur in the Oamaruian at Castle Hill Station, Canterbury, the age of which is Miocene, and not Upper Cretaceous or Oligocene as formerly stated.

Age.—Tertiary (Miocene).

Genus CARCHARIAS Cuvier.

Subgenus Prionodon Müller and Henle.

Carcharias (Prionodon) aculeatus Davis sp. Plate I, figs. 1 *a–c*, 2 *a*, *b*, 3.

Galeocerdo aculeatus Davis, 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 8, pl. i, figs. 1–3.
Carcharias (Prionodon) aculeatus Davis sp., A. S. Woodward, 1889, *Cat. Foss. Fishes Brit. Mus.*, pt. i, p. 440.

Observations.—The specimens referred by Davis to the above species were placed by that author in the genus *Galeocerdo*, and compared with *G. minor* and *G. latidens*. They differ, however, principally in the absence of the deep posterior notch at the base of the crown.

Martin(4) has figured almost similar teeth under the name of *Carcharias (Prionodon) dijki* from the Tertiary (Miocene) of Ngembak, Java; but they differ in having a shorter and wider cone.

The teeth figured by Gibbes(5) under Agassiz's name of *Galeocerdo minor* resemble the above, but the apex of the crown is not so acute or so strongly curved.

Occurrence.—The type specimens occurred in the Oamaru Series (Miocene) of Coleridge Gully, Trelissick Basin, and in the Awatere Series (Lower Pliocene) of Mohaka Crossing, Napier-Taupo Road. The above species, in excellent preservation, was collected by myself about two years ago at Neumerella, near Orbost, East Gippsland, from Miocene limestone.

Age.—Tertiary (Miocene and Lower Pliocene).

Family **Lamnidæ** Müller and Henle.

Genus SCAPANORHYNCHUS A. Smith Woodward.

Scapanorhynchus subulatus Agassiz sp. Plate III, figs. 13 *a–c*; Plate V, figs. 6 *a*, *b*, 7–10.

Lamna (Odontaspis) subulata Agassiz, 1843, *Poiss. fossiles*, vol. iii, p. 296, pl. xxxvii *a*, figs. 5–7.
Lamna undulata Reuss, 1845, *Verstein. böhm. Kreideform.*, p. 8, pl. iii, figs. 45–48.
Odontaspis constrictus Egerton, 1845, *Quart. Journ. Geol. Soc.*, vol. i, p. 171, woodcut.
Odontaspis oxyprion Egerton, 1845, *ibid.*, p. 171, woodcut.
Lamna subulata Agassiz: Reuss, 1846, *Verstein. böhm. Kreideform.*, pt. ii, p. 100, pl. xxiv, fig. 25. V. Kiprijanoff, 1854, *Bull. Soc. Imp. Nat. Moscou*, pt. ii, p. 394, pl. iii, figs. 39–45. Hébert, 1856, *Mém. Soc. géol. France*, ser. 2, vol. v, p. 355, pl. xxvii, fig. 10.
Odontaspis subulata Agassiz: Pictet and Campiche, 1858, *Foss. Terr. Crétacé St. Croix*, p. 87, pl. xi, figs. 1–8 (crowns only preserved).

(1) *Poiss. fossiles*, vol. iii, 1843, p. 231, pl. xxvi, figs. 22, 23.
(2) *Ibid.*, p. 231, pl. xxvi, figs. 24–28.
(3) *Proc. Roy. Soc. Vict.*, vol. xvii (n.s.), pt. i, 1904, p. 273.
(4) *Samml. geol. Reichs.-Mus. Leiden*, ser. 1, vol. iii, 1883, p. 28, pl. ii, figs. 21, 21*a*, 22, 23.
(5) *Journ. Acad. Nat. Sci. Philad.*, ser. 2, vol. i, 1849, p. 192, pl. xxv, figs. 63–65.

Odontaspis constrictus Stoliczka, 1873, *Cret. Fauna India (Palæont. Indica)*, vol. iv, pt. 4, p. 68, pl. xii, figs. 35–37.

Lamna subulata Agassiz : Geinitz, 1875, *Palæontographica*, vol. xx, pt. ii, p. 209, pl. xxxviii, figs. 29–36.

Odontaspis kaikoraensis Davis, 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 24, pl. v, figs. 6–10.

Lamna carinata Davis, 1888, *ibid.*, p. 21, pl. iii, fig. 13.

(?) *Scapanorhynchus subulatus* Agassiz sp. : A. S. Woodward, 1889, *Cat. Foss. Fishes Brit. Mus.*, pt. i, p. 356.

(?) *Odontaspis carinata* Davis sp. : A. S. Woodward, 1889, *ibid.*, p. 374.

Scapanorhynchus subulatus Agassiz sp. : Ameghino, 1906, *Anales del Museo Nacional de Buenos Aires*, ser. 3, vol. viii, p. 177, pl. i, figs. 7, 7*a*. Priem, 1907, *Bull. Soc. géol. France*, ser. 4, vol. vii, pp. 463, 464. A. S. Woodward, 1911, *Mon. Pal. Soc.*, vol. lxiv, p. 212, pl. xliv, figs. 18–21.

Observations.—The fish-teeth figured and described by J. W. Davis under the name of *Odontaspis kaikoraensis* have already been placed in the synonymy of Agassiz's *Lamna (Odontaspis) subulata* by Dr. Smith Woodward, and the species is there provisionally regarded as a *Scapanorhynchus* (goblin-shark). Although authorities state that there is no difference between the teeth of *Odontaspis* and *Scapanorhynchus*, there appear to be some peculiarities belonging to those of the latter genus—or, at any rate, to those fossils referred indubitably to that genus, as *Scapanorhynchus rhaphiodon*—which tend to separate them from *Odontaspis*. I refer especially to the characters of the strong vertically placed lateral cusps, and the tendency of the outer coronal face of the basal part of the tooth to be flatter, with vertical folds and a median depression. The great width and sometimes depth at the base, and the widespread denticles, are also other features, as pointed out by Davis for the New Zealand specimens, which serve to distinguish the genus from *Odontaspis*.

J. W. Davis has also figured an imperfect specimen, consisting of the apical part of the crown, of a tooth of the above species, to which he gave a distinct name, *Lamna carinata*. That author considered it " closely allied to the last described " (*L. lanceolata* Davis) (1), but also states that " it differs in being curved inwards, instead of straight towards the point." This specimen (type of *L. carinata*) is, however, quite distinct from the *Pristiophorus lanceolatus*, which teeth are laminar in form and not planoconvex on the reversed surfaces. A close examination of the type of *Lamna carinata* leads one to conclude that it is an imperfect but typical crown of *Scapanorhynchus subulatus* Agassiz sp. It comes, moreover, from the same locality as the " *Odontaspis kaikoraensis* " of Davis's monograph.

A fine series of teeth, exactly comparable with the New Zealand specimens, has been figured by H. B. Geinitz (*op. supra cit.*), whose illustrations show long-crowned teeth of the front of the jaw, as well as the wide-based and short-crowned teeth of the posterior series. Davis's fig. 6 of a specimen from Kaikoura, Marlborough, closely resembles the specimens figured by Kiprijanoff (*op. cit.*, pl. iii, fig. 41) from the Cenomanian of the Governments of Kursk and Orel, central South Russia.

This species of *Scapanorhynchus* is of wide distribution, being found in the Albian of Switzerland ; Albian to Senonian, south-eastern England ; Cenomanian, central South Russia ; Cenomanian and Turonian, Saxony and Bohemia ; Cenomanian and Senonian, Madagascar ; Senonian, northern France ; Danian, Holland ; Upper Cretaceous, Patagonia, south India, and New Zealand.

Occurrence.—Kaikoura Peninsula, Marlborough (618). Also East Wing, Amuri Bluff : black grit (Davis, pl. v, figs. 7–10). East Wing, Amuri Bluff : *Aporrhais* beds (coll. McKay, 1873, 1876). East Wing, Amuri Bluff : *Trigonia* beds. West Wing, Amuri Bluff ; loc. No. 13 (coll. McKay). Boby's Creek, Waipara River ; loc. No. 277 (coll. Hector, 1867).

Age.—Upper Cretaceous (Senonian).

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(1) *Pristiophorus lanceolatus* Davis sp. (See p. 20.)

Scapanorhynchus rhaphiodon Agassiz sp. Plate III, figs. 2 *a–c*, 16.

Lamna (Odontaspis) rhaphiodon Agassiz, 1843, *Poiss. fossiles*, vol. iii, p. 296, pl. xxxvii *a*, figs. 12–16 (*non* fig. 11).

Odontaspis rhaphiodon Agassiz sp.: Dixon, 1850, *Foss. Sussex*, pl. xxx, fig. 32.

Lamna raphiodon Agassiz: Geinitz, 1875, *Palæontographica*, vol. xx, pt. i, p. 295, pl. lxv, figs. 9–11.

Lamna hectori Davis, 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 21, pl. iii, fig. 16.

Lamna incurva Davis (*pars*), 1888, *ibid.*, p. 17, pl. iii, fig. 2 (*non* 3–5).

Scapanorhynchus rhaphiodon Agassiz sp.: A. S. Woodward, 1889, *Cat. Foss. Fishes Brit. Mus.*, pt. i, p. 353.

(?) *Lamna hectori* Davis: A. S. Woodward, 1889, *ibid.*, pt. i, p. 408.

Scapanorhynchus rhaphiodon Agassiz sp.: Priem, 1907, *Bull. Soc. géol. France*, ser. 4, vol. vii, pp. 463, 464. A. S. Woodward, 1911, *Mon. Pal. Soc.*, vol. lxiv, p. 211, pl. xliv, figs. 14–17.

Lamna hectori Davis: Chapman, 1914, *Australasian Fossils*, p. 269.

Scapanorhynchus rhaphiodon Agassiz sp.: Priem, 1915, *Bull. Soc. géol. France*, ser. 4, vol. xiv, p. 366, pl. x, figs. 8–10.

Observations.—The teeth of this species are of larger and stouter build than the foregoing. The inner coronal face is distinctly striated. The anterior teeth have no lateral denticles, this character being confined to the postero-lateral teeth, according to Dr. A. Smith Woodward.

The following description of the plesiotype (*Lamna hectori* Davis) is an emendation of Davis's (*op. cit.*, p. 21) :—

Tooth of median size, robust, equilateral, expanded near the base, with a minute denticle on each side. Median length of the crown, 11 mm.; from the apex to the extremity of the root it is 14·75 mm. Breadth above the base, 7 mm.; higher, the base is speedily reduced to one-half that diameter, and thus diminishes to a somewhat obtuse point. The external surface of the crown is depressed, with a broad median fold, extending from the base to beyond the centre. The margins are produced, flexuous, and moderately sharp. Examples showing the internal coronal surface are not uncommon, and exhibit the characteristic striated surface.

The specimen from Kaikoura figured by Davis (Plate III, fig. 2) under the name of *Lamna incurva* is a robust tooth of *Scapanorhynchus rhaphiodon*.

The distribution of this species in Europe is from the Cenomanian to the Senonian. It is also confined to the Upper Cretaceous in India and the Caspian Sea.

Occurrence.—The plesiotype is from the West Wing, Amuri Bluff. Other specimens are from the same series—*Teredo* limestone and *Aporrhais* beds, East Wing, Amuri Bluff (coll. McKay, 1873 and 1876; loc. Nos. 11 and 6).

Age.—Upper Cretaceous (Senonian).

Genus ODONTASPIS Agassiz.

Odontaspis attenuata Davis sp. Plate III, figs. 11 *a–c*.

Lamna attenuata Davis, 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 19, pl. iii, figs. 11 *a–c*.

Odontaspis attenuata Davis sp.: A. S. Woodward, 1889, *Cat. Foss. Fishes Brit. Mus.*, pt. i, p. 374. Chapman and Pritchard, 1904, *Proc. Roy. Soc. Vict.*, vol. xvii (n.s.), pt. i, p. 277, pl. xi, figs. 10, 11. Chapman, 1914, *Australasian Fossils*, pp. 270, 271.

Observations.—This is a minute species which occurs in the Tertiary (Oamaru Series) of New Zealand at several Canterbury localities. The distinctive characters of the teeth are the slender shaft of the central cone, the finely pointed apex, and the rounded section of the cone. The base is wanting in the holotype, but specimens referred to this species from Victoria show the root to be strong and bifid, with a well-marked median canal at the base of the crown.

The Victorian examples are not uncommon, and have been recorded (*op. supra cit.*, p. 277) from the Miocene of Waurn Ponds and Belmont, near Geelong, as well as from the

Lower Aldingan beds, South Australia. In the Lower Pliocene (Kalimnan) of Victoria, *O. attenuata* occurs at Beaumaris, Port Phillip.

Occurrence.—Coleridge Gully (holotype, Plate III, fig. 11); Gorge Hill, Pareora (five specimens, included by Davis with *Odontaspis incurva*); Curiosity Shop beds, Rakaia River, Canterbury.

Age.—Tertiary (Miocene).

Odontaspis contortidens Agassiz. Text-fig. 1 *a*, *b*.

Lamna (Odontaspis) contortidens Agassiz, 1843, *Poiss. fossiles*, vol. iii, p. 294, pl. xxxvii *a*, figs. 17–23.

Odontaspis contortidens Agassiz: A. S. Woodward, 1889, *Cat. Foss. Fishes Brit. Mus.*, pt. i, p. 366.

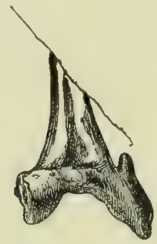
Odontaspis contortidens Agassiz: Chapman and Pritchard, 1904, *Proc. Roy. Soc. Vict.*, vol. xvii (n.s.), pt. i, p. 275. Chapman, 1914, *Australasian Fossils*, pp. 269–71, fig. 131B.

Observations.—Some specimens from the Canterbury Museum labelled "*Lamna huttoni*" I have determined as belonging to two species of *Odontaspis*—*O. attenuata* and *O. contortidens.* The latter species was found in some profusion in the Victorian Tertiary (Oligocene, Miocene, and Pliocene), and from a fully extensive series one may see that *O. contortidens* Agassiz differs from the allied *O. attenuata* Davis sp. in having a vertically striated inner coronal face and a wider crown; whilst *O. attenuata* has the internal surface rather irregularly striated, and the tooth is more constricted and attenuated. *O. contortidens* has not been before recorded from the New Zealand Tertiaries.

Occurrence.—Coleridge Gully, Trelissick Basin; Curiosity Shop beds, Rakaia River, Canterbury; Castle Hill shaft, Kaitangata (loc. No. 759).

Age.—Tertiary (Miocene).

TEXT-FIG. 1.—*Odontaspis contortidens*, Ag. Tertiary. Curiosity Shop beds, Rakaia River, Canterbury.



TEXT-FIG. 2.—*Lamna appendiculata*, Ag. sp. Upper Cretaceous. West Wing, Amuri Bluff.

Odontaspis elegans Agassiz sp. Plate III, figs. 1 *a–c*.

Lamna elegans Agassiz, 1843, *Poiss. fossiles*, vol. iii, p. 289, pl. xxxv, figs. 1–5 (*non* figs. 6, 7); pl. xxxvii *a*, fig. 59 (*non* fig. 58). R. W. Gibbes, 1849, *Journ. Acad. Nat. Sci. Philad.*, ser. 2, vol. i, p. 196, pl. xxv, figs. 98–102 (? figs. 96, 97). Dixon, 1850, *Foss. Sussex*, p. 203, pl. x, figs. 28–31. McCoy, 1867, *Ann. Mag. Nat. Hist.*, ser. 3, vol. xx, p. 192. *Idem*, 1874, in Brough Smyth's *Progress Report*, No. 1, p. 35. Johnston, 1877, *Proc. Roy. Soc. Tas.* for 1876, p. 86.

Lamna huttoni Davis, 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 15, pl. iii, fig. 1.

Odontaspis elegans Agassiz sp.: A. S. Woodward, 1889, *Cat. Foss. Fishes Brit. Mus.*, pt. i, p. 361. *Idem*, 1891, *Geol. Mag.*, dec. 3, vol. viii, p. 105. *Idem*, 1900, *Proc. Geol. Assoc.*, vol. xvi, p. 8, pl. i, figs. 15–18. Eastman, 1904, *Maryland Geol. Surv. Miocene*, p. 79, pl. xxx, figs. 2 *a*, *b*, 3. Chapman, 1917, *Proc. Roy. Soc. Vict.*, vol. xxix (n.s.), pt. ii, p. 137, pl. ix, fig. 4.

Observations.—The specimens from New Zealand described as *Lamna huttoni* by Davis undoubtedly belong to this species. Some of the teeth are of considerable length—as much as 47 mm. or more—and show the characteristic striated inner face seen in teeth of *Odontaspis elegans.*

O. elegans is distinguished from *O. cuspidata* Agassiz sp. by the absence of striæ on the inner coronal face of the latter. In referring to the relationship of *O. huttoni* with *O. elegans*, Davis remarks(1), "This species may be distinguished from *Lamna elegans* by its elongated and less triangular form, greater curvature, and its slightly contorted or twisted outline."

O. elegans is a widely distributed fossil, being found in the Eocene of the south-east of England, France, Belgium, and Germany; in Alabama and South Carolina, U.S.A., in similar deposits; and in the Lower Miocene of Belgium and Corsica. It also occurs in the Miocene of Victoria.

Occurrence.—Weka Pass stone, 1 ft. above junction with Amuri limestone, north-west of Mount Brown (coll. J. A. Thomson); Coleridge Gully; Cave Valley, Oamaru; Waipara (uppermost beds); Castle Hill shaft, Kaitangata (loc. No. 759).

Age.—Tertiary. Basal beds and Lower and Middle Oamaru Series.

Odontaspis ensiculata Davis sp. Plate III, figs. 6, 7 *a–c*.

Lamna ensiculata Davis, 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 18, pl. iii, figs. 6, 7.

Observations.—Although Davis mentions the strong bifurcation of the root, with its acutely ending lateral prongs, as distinctive characters, yet these and the doubtful feature of well-defined lateral denticles hardly distinguish it from *O. cuspidata* Agassiz sp.(2), to which form it seems very closely related, as Davis himself remarks. However, there are other minor characters, such as the erect or inwardly curving apex, and the convex outer surface of the coronal face, with an absence of a basal median sulcus, which may serve as distinguishing features.

Occurrence.—Oamaru.

Age.—Tertiary (Miocene).

Odontaspis exigua Davis. Plate V, figs. 3 *a*, *b*, 4, 5.

Odontaspis exigua Davis, 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 23, pl. v, figs. 3–5.

Observations.—This minute form is remarkable for the comparatively flat or outspread base, the sharp lateral denticles, and the striate inner face. On comparing the specimen shown in fig. 5 with Davis's "*Lamna*" *(Odontaspis) attenuata*, very close resemblances are seen: it may eventually be found to be a posterior tooth of the latter species. One of the examples shows double lateral denticles as in "*Odontaspis acuta*" Davis (= *Lamna bronni* Agassiz), and the general relationship appears to be centred round the type form *Odontaspis rutoti* Winkler sp., an Eocene fossil in England and Belgium. The two shorter and broader examples resemble *Lamna compressa*, in which they also agree in the style of root and striate inner surface of the crown.

Occurrence.—Broken River, Trelissick Basin, Canterbury.

Age.—Tertiary (Miocene).

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(1) *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, 1888, p. 16.
(2) *Poiss. fossiles*, 1843, vol. iii, p. 290, pl. xxxvii *a*, figs. 43–50.

Odontaspis incurva Davis sp. Plate III, figs. 3–5.

Lamna incurva Davis (*pars*), 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 17, pl. iii, figs. 3–5.
Odontaspis incurva Davis sp.: A. S. Woodward, 1889, *Cat. Foss. Fishes Brit. Mus.*, pt. i, p. 372. Chapman and Pritchard, 1904, *Proc. Roy. Soc. Vict.*, vol. xvii (n.s.), pt. i, p. 276. Chapman, 1914, *Australasian Fossils*, pp. 269, 271.

Observations.—This species is distinguished from Agassiz's related *O. contortidens* by the more robust crown, convex outer face, and depressed, smooth, inner face([1]), *contortidens* being a more slender form with convex and striated inner coronal surface.

Dr. Pritchard and the writer have already recognized the above species in the Miocene (Janjukian) and Lower Pliocene (Kalimnan) of Victoria, so that it has an extensive geological range—viz., from Upper Cretaceous to Lower Pliocene.

Occurrence.—Cretaceous horizons: Kaikoura Peninsula; Amuri Bluff, West Wing; Mikonui Stream; White Rock, Malvern Hills; Boby's Creek, Waipara (loc. No. 277). Tertiary horizons: Upper marl-bed, Weka Pass (von Haast); Broken River, Trelissick Basin, and Curiosity Shop, Canterbury; Gorge Hill, Pareora; Waitaki Valley; Tata Island limestone, Nelson; Mercer, Waikato River, Auckland; Castle Hill shaft, Kaitangata (loc. No. 759).

Age.—Upper Cretaceous and Tertiary.

Genus LAMNA Cuvier.

Lamna apiculata Agassiz sp. Plate V, figs, 17 *a–c*, 18–20; Plate VI, figs. 4 *a–c*.

Otodus apiculatus Agassiz, 1843, *Poiss. fossiles*, vol. iii, p. 275, pl. xxxii, figs. 32–35.
Oxyrhina woodsi McCoy, MS.: T.-Woods, 1862, *Geol. Observations in South Australia*, p. 80 (2 figs.).
Oxyrhina enysii Davis, 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 28, pl. v, figs. 17 *a–c*, 18–20.
Oxyrhina subvexa Davis, 1888, *ibid.*, p. 31, pl. vi, figs. 4 *a–c*.
Lamna apiculata Agassiz sp.: Chapman and Pritchard, 1904, *Proc. Roy. Soc. Vict.*, vol. xvii (n.s.), pt. i, p. 278. Chapman, 1914, *Australasian Fossils*, pp. 268, 269, 271, fig. 130D.

Observations.—This is a common form of Selachian tooth, occurring frequently in both New Zealand and Victorian strata. The basal portion is nearly always worn away, but where present it carries minute lateral denticles. The crown is of median length, triangular, with a slight backward curve; the outer face is flatly convex, and the inner gently convex. As regards the character of the denticles, Smith Woodward writes([2]), in a footnote to the description of *Oxyrhina hastalis*, as follows: "Some rare teeth (one from the 'Calcaire de Veteuil') agreeing in every respect with this description, but characterized by the presence of a rudimentary lateral denticle, are named *Otodus apiculatus* L. Agassiz. A rudimentary denticle has always been noted in *O. mantelli*, thus suggesting that *Otodus apiculatus* is a synonym of *Oxyrhina hastalis*." From a large series of teeth of *Isurus (Oxyrhina) hastalis* from the Victorian Tertiaries I have no hesitation in regarding *Lamna (O.) apiculata* as distinct; the posterior smaller teeth in *I. hastalis* tending to become regularly triangular without the trenchant backward curve seen in *Lamna apiculata*.

In Victoria *L. apiculata* ranges from the Oligocene (Balcombian) to the Lower Pliocene (Kalimnan).

Occurrence.—Cretaceous: West Wing, Amuri Bluff (loc. No. 13). Tertiary: Weka Pass stone; Trelissick Basin (type of *O. enysii*, 871, &c.); Hog's Back, Trelissick Basin (type of *O. subvexa*, 620); Curiosity Shop, Rakaia River; Waipara (upper beds).

Age.—Cretaceous and Tertiary (Eocene to Miocene).

([1]) A unique example of this species was found with traces of striæ on the inner surface of the crown, showing that even this character is not absolutely reliable, though of a general rule.
([2]) *Cat. Foss. Fishes Brit. Mus.*, pt. i, 1889, p. 387.

Lamna appendiculata Agassiz sp. Text-fig. 2, p. 11.

Otodus appendiculatus Agassiz, 1843, *Poiss. fossiles*, vol. iii, p. 270, pl. xxxii, figs. 1–25. R. Gibbes, 1849, *Journ. Acad. Nat. Sci. Philad.*, ser. 2, vol. i, p. 199, pl. xxvi, figs. 138–40. Pictet and Campiche, 1858, *Foss. Terr. Crétacé St. Croix*, p. 82, pl. x, figs. 3, 4. Geinitz, 1875, *Palæontographica*, vol. xx, pt. i, p. 294, pl. lxv, figs. 6, 7; pt. ii, p. 208, pl. xxxviii, figs. 37–54. Etheridge, 1888, *Proc. Linn. Soc. N.S. Wales*, ser. 2, vol. iii, p. 158, pl. iv, fig. 1.

Lamna appendiculata Agassiz sp.: A. S. Woodward, 1889, *Cat. Foss. Fishes Brit. Mus.*, pt. i, p. 393. Ameghino, 1906, *Anales del Museo Nacional de Buenos Aires*, ser. 3, vol. viii, p. 178, pl. i, figs. 12, 12*a*. Priem, 1907, *Bull. Soc. géol. France*, ser. 4, vol. vii, pp. 463, 464, figs. 2 and 5, woodcuts. A. S. Woodward, 1911, *Mon. Pal. Soc.*, vol. lxiv, p. 206, pl. xliv, figs. 3–7; text-figs. 63–64. Priem, 1915, *ibid.*, ser. 4, vol. xiv, p. 366, pl. x, figs. 11–13.

Observations.—This species is fairly common in the Amuri Series. It shows the same characters as the European specimens, in the moderately sharp triangular crown with depressed convex outer face and basal median depression; the gently convex inner face; the short strong lateral denticles, and the rather widely spread root.

Lamna appendiculata has not before been recorded as a New Zealand fossil. It was described by R. Etheridge, jun., from the limestone (Rolling Downs Formation) of Kamilaroy, Leichardt River, north-west Queensland. *L. appendiculata* is a well-known species in the Albian-Senonian strata of Europe, and the Upper Cretaceous of Galicia, New Jersey, Patagonia, and Madagascar. In Queensland the Rolling Downs Formation is the lower series of the Cretaceous of that area, but contains a large preponderance of species common to itself and the Desert Sandstone above.

The figures of a tooth of *Lamna* from the Patagonian Formation of Patagonia given by Ameghino resemble Agassiz's *L. appendiculata* in the curved crown and blunt denticles, and should the determination prove correct it considerably extends the range of this otherwise typically Cretaceous genus, which, however, seems already to have been identified in Lower Eocene deposits of the north of France and Belgium.

Occurrence.—West Wing, Amuri Bluff (loc. No. 13).

Age.—Upper Cretaceous (Senonian).

Lamna bronni Agassiz. Plate V, figs. 1 *a*, *b*, 2 *a–c*; Plate VIII, fig. 3.

Lamna (Odontaspis) bronni Agassiz, 1843, *Poiss. fossiles*, vol. iii, p. 297, pl. xxxvii *a*, figs. 8–10.

Odontaspis acuta Davis, 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 22, pl. v, figs. 1, 2.

Odontaspis bronni Agassiz: A. S. Woodward, 1889, *Cat. Foss. Fishes Brit. Mus.*, pt. i, p. 360. *Idem*, 1892, *Geol. Mag.*, dec. 3, vol. viii, p. 111.

Lamna bronni Agassiz: Chapman and Pritchard, 1904, *Proc. Roy. Soc. Vict.*, vol. xvii (n.s.), pt. i, p. 279.

Observations.—A great deal of interest attaches to the specimens of "*Odontaspis acuta*" formerly described from the New Zealand Tertiaries by Davis. The same form was recorded from the Miocene of Waurn Ponds, Victoria, in 1904, by Dr. Pritchard and myself, under the older name of *Lamna bronni*, although at the time we were unaware of Smith Woodward's remark (*op. cit.*, p. 360) on Davis's specimens that "The teeth of *O. acuta* J. W. Davis, from the Oamaru System of New Zealand, are very similar to those of this species." In describing some fish-teeth from the Danian of Ciply, Dr. Smith Woodward in 1891 (*op. cit.*, p. 111) includes Davis's species in the synonymy of *O. bronni*, and incidentally remarks on its proximity to *Odontaspis rutoti* Winkler sp., in which it "affords another instance of the striking similarity existing between the latest Mesozoic and the earliest Tertiary fish-remains."

Besides the types figured by Davis, there is a very fine example of the above in the series now under examination from Milburn, Otago, and probably contemporaneous with the Waurn Ponds limestone of Victoria. This specimen measures 30 mm. in height and about 30 mm. in width. The crown is long, conical, and trenchantly curved, pointed and gently convex on the outer exposed surface. The base of the root is wanting, but at both sides there is a strong recurved and sharp denticle flanked on the outside by another smaller one (see Plate VIII, fig. 3).

Smith Woodward has placed the above form in *Odontaspis,* presumably because of its relationship with *O. rutoti.* The Victorian and New Zealand specimens, however, which have the crown expanded at the base, appear to be related to *Lamna.* With reference to *Odontaspis rutoti* and the present form, Ameghino has doubted[1] Dr. Pritchard's and my determination of the Victorian specimen, and suggests that we have mistaken *bronni* for *rutoti.* For reasons given above we are of the opinion that *O. rutoti* is a true *Odontaspis,* whilst *L. bronni* is generically distinct.

The distribution of *L. bronni* is in the Danian of Holland and Belgium, and in the Miocene of Victoria and New Zealand.

Occurrence.—Oamaru Series: Curiosity Shop beds, Canterbury; Trelissick Basin, Canterbury; Milburn, Otago; Ototara stone, Oamaru.

Age.—Tertiary (Miocene).

Lamna compressa Agassiz. Plate III, figs. 8 *a–c*, 9; Plate IX, figs. 6 *a*, *b*, 7.

Lamna compressa Agassiz, 1843, *Poiss. fossiles,* vol. iii, p. 290, pl. xxxvii *a*, figs. 35–42.

Lamna marginalis Davis (*pars*), 1888, *Trans. Roy. Dubl. Soc.,* ser. 2, vol. iv, p. 19, pl. iii, figs. 8, 9.

Lamna macrota Agassiz (vel *compressa*): A. S. Woodward, 1889, *Cat. Foss. Fishes Brit. Mus.,* pt. 1, p. 402.

Odontaspis macrota Agassiz sp.: A. S. Woodward, 1900, *Proc. Geol. Assoc.,* vol. xvi, p. 9, pl. i, figs. 19, 20.

Lamna compressa Agassiz: Chapman and Pritchard, 1904, *Proc. Roy. Soc. Vict.,* vol. xvii (n.s.), pt. i, p. 279. Chapman, 1914, *Australasian Fossils,* pp. 269, 271.

Observations.—Davis's fig. 8 probably represents an anterior tooth. The majority of those occurring in the present series are lateral teeth, the compressed crowns being rather broader. The base is usually either absent or worn down to the smallest trace. As pointed out by Dr. Pritchard and myself (*op. cit.,* 1904, p. 279), the southern type of this form of tooth agrees more nearly with Agassiz's *L. compressa* than with *L. macrota* Agassiz. Through an apparent error Davis's *Lamna marginalis* was included in the synonymy of *Odontaspis cuspidata* Agassiz sp. (Chapman and Pritchard, *op. cit.,* p. 277), and also in the reference to its occurrence in New Zealand.

L. compressa is an Eocene to Miocene species in Europe, and Eocene in North America. In Victoria (Australia) it occurs in the Miocene (Janjukian) and the Lower Pliocene (Kalimnan).

Occurrence.—Davis's types of "*L. marginalis*" were from the Broken River (Trelissick Basin) (879), Oamaru Series; *L. compressa* occurs also amongst specimens from the Castle Hill shaft, Kaitangata (loc. No. 759).

The specimens in the present collection labelled "*Lamna marginalis,* &c." from Weka Pass are not this form, but are referable to other species, belonging to *Lamna* and *Odontaspis.*

Age.—Tertiary (Eocene and Miocene).

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(1) *Anales del Museo Nacional de Buenos Aires,* ser. 3, vol. viii, 1906, p. 185 (footnote).

Lamna crassa Agassiz sp. Plate III, figs. 10 *a–c*; Plate VII, fig. 16.

Otodus crassa Agassiz, 1843, *Poiss. fossiles*, vol. iii, p. 271, pl. xxxvi, figs. 29–31. Kiprijanoff, 1854, *Bull. Soc. Imp. Nat. Moscou*, pt. ii, p. 384, pl. ii, figs. 4–20.

(?) *Oxyrhina vonhaastii* Davis (*pars*), 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 26, pl. iv, fig. 3 (*non* figs. 1, 2).

Lamna marginalis Davis (*pars*), 1888, *ibid.*, p. 19, pl. iii, figs. 10 *a–c*. (This specimen came from Amuri Bluff, and not from Broken River as stated by Davis.)

Otodus obliquus Agassiz: Davis, 1888, *ibid.*, p. 15, pl. vii, fig. 16.

Lamna crassa Agassiz sp.: A. Smith Woodward, 1889, *Cat. Foss. Fishes Brit. Mus.*, pt. i, p. 400.

Observations.—A fair number of specimens of an equiangular tooth of robust build and with a heavy and deep root are found in the Amuri Series. These are here referred to Agassiz's species *Lamna crassa*, and included therein is Davis's "*Otodus obliquus*." The latter species, found in the European Tertiaries, differs in many points, chiefly in the extended development of the crown, it being a more trenchant type of tooth; it also has a more widely extended and divided root than the New Zealand form. The New Zealand species of *Lamna crassa* measure about 2·5 cm. from base to apex, with a similar width. The base is, as a rule, broadly outspread and straight. The outer coronal surface of the tooth is flat to gently convex, and in most cases distinctly fluted with five or six vertical folds, though this feature is not entirely constant, and so precludes the making of even a variety of the form. Some examples of anterior teeth marked "? *Oxyrhina*" by Davis I am inclined to place here. They have lost the basal portion, but from their general appearance show relationship to *L. crassa*, and compare closely with Agassiz's figure of similar teeth (*op. cit.*, 1843, pl. xxxvi, fig. 29).

The tooth figured by Davis as "*Oxyrhina vonhaastii*" (pl. iv, fig. 3), from Boby's Creek, Waipara, probably belongs here; indications of a lateral denticle support its reference to *Lamna.*

Lamna crassa occurs in the Cenomanian of Bavaria and south-east Russia, and in the Danian of Belgium.

Occurrence.—West Wing, Amuri Bluff; East Wing, Amuri Bluff. Black grit: East and West Wings, Amuri Bluff. (?) Boby's Creek, Waipara (Saurian beds).

Age.—Upper Cretaceous (Senonian).

Genus ISURUS Rafinesque.

Isurus desori Agassiz sp. Plate V, figs. 15 *a–c*, 16 *a–c*.

Oxyrhina desori Agassiz, 1843, *Poiss. fossiles*, vol. iii, p. 202, pl. xxxvii, figs. 8–13.

Oxyrhina leptodon Agassiz, 1843, *ibid.*, p. 282, pl. xxxvii, figs. 3–5.

Oxyrhina grandis Davis, 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 30, pl. v, figs. 15, 16.

Oxyrhina desori Agassiz: A. Smith Woodward, 1889, *Cat. Foss. Fishes Brit. Mus.*, pt. i, p. 382. *Idem*, 1891, *Geol. Mag.*, dec. 3, vol. viii, p. 106. L. Seguenza, 1900, *Boll. Soc. Geol. Ital.*, p. 482, pl. v, figs. 1–12. Chapman and Pritchard, 1904, *Proc. Roy. Soc. Vict.*, vol. xvii (n.s.), pt. i, p. 281. Eastman, 1904, *Maryland Geol. Surv. Miocene*, p. 79, pl. xxx, fig. 4.

Isurus (?) *desorii* Agassiz: Jordan, 1907, *Univ. Calif. Publ. Geol. Bull.*, vol. v, No. 7, p. 112.

Oxyrhina desori Agassiz: Chapman, 1914, *Australasian Fossils*, pp. 269, 271.

Observations.—The form of those teeth which may be referred to Agassiz's type, *Isurus desori*, are generally more slender than in *I. retroflexus*, and the sinuate curvature of the edge is more extended, beginning closer to the base. All the New Zealand specimens are devoid of the root, but the coronal characters leave little room for doubt as to their specific identity with the above form.

I. desori is a Lower Eocene species in Belgium, Upper Eocene in North America and Europe, and Miocene and Pliocene in Europe. An Upper Cretaceous specimen from California is doubtfully referred by Jordan to the above species, which, by the way, makes its appearance in the New Zealand fauna either at the top of that formation or in the basal junction bed of the Tertiary.

Occurrence.—(?) Upper Cretaceous: (?) Amuri Bluff limestone (loc. No. 12). Tertiary: Grey marls, Weka Pass; Curiosity Shop, Canterbury (786, &c.); Trelissick Basin (915, type of *O. grandis*, Plate V, figs. 15, 16); Tokomairiro limestone, Waihola Gorge[1] (loc. No. 40); uppermost Mount Brown beds, Weka Pass, North Canterbury.

Age.—(?) Upper Cretaceous (Danian) and Tertiary (Eocene to Miocene).

Isurus hastalis Agassiz sp. Plate V, figs. 21 *a–c*; Plate VI, fig. 5.

Oxyrhina hastalis Agassiz, 1843, *Poiss. fossiles*, vol. iii, p. 277, pl. xxxiv, figs. 3–13, 15–17.
Oxyrhina xiphodon Agassiz, 1843, *ibid.*, p. 278, pl. xxxiii, figs. 11–17.
Oxyrhina trigonodon Agassiz, 1843, *ibid.*, p. 279, pl. xxxvii, figs. 17, 18.
Oxyrhina plicatilis Agassiz, 1843, *ibid.*, p. 279, pl. xxxvii, figs. 14, 15.
Oxyrhina acuminata Davis, 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 29, pl. v, figs. 21 *a–c*.
(?) *Oxyrhina lata* Davis, 1888, *ibid.*, p. 32, pl. vi, fig. 5.
Oxyrhina hastalis Agassiz: A. Smith Woodward, 1889, *Cat. Foss. Fishes Brit. Mus.*, pt. i, p. 385. L. Seguenza, 1900, *Boll. Soc. Geol. Ital.*, vol. xix, p. 484, pl. vi, figs. 23–28. Chapman and Pritchard, 1904, *Proc. Roy. Soc. Vict.*, vol. xvii (n.s.), pt. i, p. 280, pl. xi, figs. 12–14. Eastman, 1904, *Maryland Geol. Surv. Miocene*, p. 80, pl. xxx, figs. 5 *a*, *b*, 6 *a–c*. Ameghino, 1906, *Anales del Museo Nacional de Buenos Aires*, ser. 3, vol. viii, p. 179, pl. i, figs. 16, 16*a*, 16*e*, 16*i*. Chapman, 1914, *Australasian Fossils*, pp. 268, 269, 271, fig. 130c.

Observations.—The specimen of *Isurus* described by Davis under the name of *Oxyrhina acuminata* is comparable with Agassiz's "*O. xiphodon*," now referred to the synonymy of *Isurus hastalis*. The crown is slender, with a definite outward curve of the apex, which is quite sharp.

Davis has remarked[2], "The elongated teeth of *Oxyrhina xiphodon* Agassiz resemble this one in general outline, but may be distinguished by the median depression of the internal surface of the crown, and in the base of the enamel being equally curved on both the external and the internal surface." It may here be pointed out that figures of *Isurus (Oxyrhina) hastalis* and *xiphodon* given by Agassiz and other authors also show this feature, which can hardly be regarded as a specific one.

Isurus hastalis is one of the commonest Tertiary sharks, its teeth occurring in the Eocene of Alabama, South Carolina, U.S.A.; in the Miocene of Maryland, Virginia, and South Carolina, U.S.A.; in the Miocene of Patagonia; in the Miocene and Pliocene of Europe; and in the Oligocene, Miocene, and Pliocene of Victoria.

Occurrence.—Castle Hill Station, Trelissick Basin; coll. J. D. Enys (625).

Age.—Tertiary (Miocene).

Isurus minutus Agassiz sp. Plate VI, figs. 1 *a–c*, 2, 3.

Oxyrhina minuta Agassiz, 1843, *Poiss. fossiles*, vol. iii, p. 285, pl. xxxvi, figs. 39–47. Sismonda, 1849, *Mem. R. Accad. Sci. Torino*, ser. 2, vol. x, p. 44, pl. ii, figs. 36–39. O. G. Costa, 1854, *Palæont. Regno Napoli*, pt. ii, p. 85, pl. vii, figs. 52–58.
Oxyrhina fastigiata Davis, 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 30, pl. vi, figs. 1–3.
Oxyrhina minuta Agassiz sp.: Chapman and Pritchard, 1904, *Proc. Roy. Soc. Vict.*, vol. xvii (n.s.), pt. i, p. 283.

Observations.—The teeth here referred to Agassiz's species are comparatively small, usually under 15 mm. in length. The crown is moderately sharply conical, and the external and internal faces are depressed convex and strongly convex respectively.

[1] This locality is now known as Milburn. [2] *Op. supra cit.*, p. 29.

Isurus minutus has been recorded from the Victorian Oligocene (Balcombian) of Muddy Creek; from the Miocene (Janjukian) of Gellibrand River, Waurn Ponds, and Belmont, near Geelong; and from the Lower Pliocene (Kalimnan) of the Grange Burn, Hamilton.

In Europe this species is found in the Lower Miocene of Osnabrück, Prussia, and in the Miocene and Pliocene of Naples, Sicily, and Piedmont.

Occurrence.—Coleridge Gully, Trelissick Basin, Canterbury.

Age.—Tertiary (Miocene).

Isurus retroflexus Agassiz sp. Plate IV, figs. 1, 2 *a–c*.

Oxyrhina retroflexa Agassiz, 1843, *Poiss. fossiles*, vol. iii, p. 281, pl. xxxiii, fig. 10.
Oxyrhina crassa Agassiz, 1843, *ibid.*, vol. iii, p. 283, pl. xxxvii, fig. 16.
Oxyrhina vonhaastii Davis, 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iii, p. 26, pl. iv, figs. 1, 2 (*non* fig. 3).
Oxyrhina recta Davis, 1888, *ibid.*, p. 27, pl. v, fig. 14.
Oxyrhina crassa Agassiz: A. Smith Woodward, 1889, *Cat. Foss. Fishes Brit. Mus.*, pt. i, p. 389.
Oxyrhina retroflexa Agassiz: Chapman and Pritchard, 1904, *Proc. Roy. Soc. Vict.*, vol. xvii (n.s.), pt. i, p. 282. Chapman, 1914, *Australasian Fossils*, pp. 269, 271.

Observations.—One of the commonest forms of this genus both in New Zealand and Victoria is that formerly known from the first locality by Davis's species *vonhaastii*. The illustration of a mass of detached teeth from Oamaru given by Davis[1] affords a good idea of variation in the jaw. This is matched by a magnificent block of Batesford limestone in the National Museum, Melbourne, which contains no less than twenty-eight teeth of this species. The strongly bifurcated and divergent root, and the acutely conical crown with its roundly convex inner face, separate this species from *Isurus hastalis*.

Isurus retroflexus is distributed through the Middle and Upper Eocene of Europe and North America, and in the Miocene and Pliocene of Europe. In Victoria it occurs in the Miocene at Torquay, Waurn Ponds, and Casterton; in the Lower Pliocene at Grange Burn, Hamilton; whilst in Tasmania it is found in the Miocene of Table Cape.

Occurrence.—Oamaru; Broken River (Trelissick Basin); Curiosity Shop; Waipara (upper beds).

Age.—Tertiary (Miocene).

Genus CARCHARODON Müller and Henle.

Carcharodon auriculatus Blainville sp. Plate I, figs. 4 *a–c*, 5, 6, 7 *a–c*.

Squalus auriculatus de Blainville, 1818, *Nouv. Dict. d'Hist. Nat.*, vol. xxvii, p. 384.
Carcharodon auriculatus Agassiz, 1843, *Poiss. fossiles*, vol. iii, p. 254, pl. xxviii, figs. 17–19.
Carcharodon angustidens Agassiz, 1843, *ibid.*, p. 255, pl. xxviii, figs. 20–25, and pl. xxx, fig. 3. McCoy, 1875, *Prod. Pal. Vict.*, dec. 2, p. 8, pl. xi, figs, 2, 3. Davis, 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 9, pl. i, figs. 4–6 (*non* pl. vi, fig. 22).
Carcharodon robustus Davis, *ibid.*, p. 13, pl. i, fig. 7.
Carcharodon auriculatus Blainville sp.: A. Smith Woodward, 1889, *Cat. Foss. Fishes Brit. Mus.*, pt. i, p. 411. L. Seguenza, 1900, *Boll. Soc. Geol. Ital.*, vol. xix, p. 501, pl. v, figs. 14–18. Chapman and Pritchard, 1904, *Proc. Roy. Soc. Vict.*, vol. xvii (n.s.), pt. i, p. 283.
Carcharodon angustidens Agassiz: Priem, 1906, *Bull. Soc. géol. France*, ser. 4, vol. vi, p. 199, pl. viii, figs. 14, 15. Leriche, 1910, *Annales Soc. géol. du Nord*, vol. xxxix, p. 330.
Carcharodon auriculatus Blainville sp.: Chapman, 1914, *Australasian Fossils*, pp. 268, 269, 271, fig. 130E.
Carcharodon robustus Davis: Chapman, 1914, *ibid.*, p. 269.

Observations.—This species appears to have had an earlier origin in New Zealand than in any other part of the world[2]. Its hitherto known range was from Lower Eocene to

(1) *Op. supra cit.*, pl. iv, fig. 1.
(2) A species of *Carcharodon* (*C. longidens* Pillet) has been described from the (?) Danian of Haute Savoie (*Mém. Acad. Sci. Savoie*, ser. 3, vol. ix, 1883, p. 277).

Pliocene. On the assumption that the age of the Amuri limestone is Upper Cretaceous(1), it ranges thence through Oligocene to Miocene (Maerewhenua limestone). In Victoria *C. auriculatus* ranges from Oligocene to Miocene, in which latter formation it is of frequent occurrence.

Generally speaking, the crown of the tooth in *C. auriculatus* is evenly conical from root to apex, whilst *C. megalodon* has the base of the crown expanded, meeting the root at a low angle. The tooth described by Davis under the name of *C. robustus* has a closer resemblance to the above species than to *C. megalodon*, in the synonymy of which it has been placed by Smith Woodward(2), for the outer coronal face is flat rather than recurved as in *C. megalodon*, and the edges of the tooth gradually descend to the root in both *C. auriculatus* and *C. robustus*. If the number of serrations on the edge of the tooth is of any comparative value the type specimen of "*C. robustus*," with about 85 on the side, is close to the specimen of *C. auriculatus* from Weka Pass, with 90.

Occurrence. — Upper Cretaceous: Amuri limestone, Amuri Bluff (loc. No. 12). Tertiary: Weka Pass (884), plesiotype, Plate I, fig. 6; Waitaki (type of *C. robustus*, Plate I, fig. 7); Raglan (Whaingaroa Harbour), Auckland; upper beds, Waipara (858); Broken River, Trelissick Basin (624); Waihao Forks, South Canterbury (837); Curiosity Shop (227); Deep Creek, Blueskin, or Waitati, near Dunedin (coll. Professor Hutton); greensand overlying coal-bed, Kakahu River, South Canterbury (loc. No. 163); Tokomairiro limestone, Waihola Gorge (loc. No. 40).

Age.—Upper Cretaceous (Danian) and Tertiary (Eocene to Miocene).

Carcharodon megalodon Agassiz. Plate II, figs. 1 *a–c*, 2 *a–c*, 3.

Carcharodon megalodon Agassiz, 1843, *Poiss. fossiles*, vol. iii, p. 247, pl. xxix.
Carcharodon rectidens Agassiz, 1843, *ibid.*, p. 250, pl. xxx*a*, fig. 10.
Carcharodon subauriculatus Agassiz, 1843, *ibid.*, p. 251, pl. xxx*a*, figs. 11–13.
Carcharodon productus Agassiz, 1843, *ibid.*, p. 251, pl. xxx, figs. 2, 4, 6–8.
Carcharodon polygyrus Agassiz, 1843, *ibid.*, p. 253, pl. xxx, figs. 9–12.
Carcharodon megalodon Agassiz: Gibbes, 1848, *Journ. Acad. Nat. Sci. Philad.*, ser. 2, vol. i, p. 143, pl. xviii; pl. xix, figs. 8, 9. McCoy, 1875, *Prod. Pal. Vict.*, dec. 2, pl. xi, fig. 4. Martin, 1883, *Samml. geol. Reichs.-Mus. Leiden*, ser. 1, vol. iii, p. 23, pl. i, fig. 12. Davis, 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 12, pl. ii, figs. 1–3. A. S. Woodward, 1889, *Cat. Foss. Fishes Brit. Mus.*, pt. i, p. 415. L. Seguenza, 1900, *Boll. Soc. Geol. Ital.*, vol. xix, p. 503, pl. vi, figs. 1–3. Chapman and Pritchard, 1904, *Proc. Roy. Soc. Vict.*, vol. xvii (n.s.), pt. i, p. 284. Leriche, 1908, *Ann. Soc. géol. du Nord*, vol. xxxvii, p. 304. Chapman, 1914, *Australasian Fossils*, pp. 269, 270, 271.
Carcharodon megalodon Charlesworth sp.: Eastman, 1904, *Maryland Geol. Surv. Miocene*, p. 82, pl. xxxi, figs. 1 *a–c*, 2, 3, 4 *a*, *b*. Ameghino, 1906, *Anales del Museo Nacional de Buenos Aires*, ser. 3, vol. viii, p. 181, fig. 48; pl. ii, figs. 21, 21*a*, 21*e*, 22, 22*a*.
Carcharodon chubutensis Ameghino, 1906, *ibid.*, p. 181, fig. 49.
Carcharodon branneri Jordan, 1907, *Univ. Calif. Publ. Bull. Dept. Geol.*, vol. v, No. 7, p. 116, fig. 15.

Observations.—The New Zealand fish-teeth referable to the above species are typical and well preserved. They show the broad crown, rapidly widening towards the base, and the serrations are more numerous and less indented than in *C. auriculatus*. Thus in the example from Weka Pass there are 102 serrations on the anterior edge and 75 on the posterior edge. The specimen from Boby's Creek, probably an anterior tooth, shows 97 serrations on one edge and 98 on the other; that from Cape Foulwind shows 123 serrations on the posterior and about 150 on the anterior side.

In North America *C. megalodon* has a range from Eocene to Miocene; in Europe, from Miocene to Pliocene; whilst it has also been recorded from the Miocene of Burma, Java, and Patagonia. In Victoria *C. megalodon* ranges from Oligocene to Lower Pliocene.

(1) The evidence of the Foraminifera is strongly in favour of this determination.
(2) *Cat. Foss. Fishes Brit. Mus.*, pt. i, 1889, p. 417.

Occurrence.—Cape Foulwind, Westport, Nelson (plesiotype, Plate II, fig. 1); Weka Pass (plesiotype, Plate II, fig. 2); Boby's Creek, near Waipara (plesiotype, Plate II, fig. 3) (1).

Age.—Tertiary (Eocene to Miocene).

Carcharodon rondeletii Müller and Henle. Plate VI, fig. 22; Plate VIII, figs. 1, 2.

Carcharodon rondeletii Müller and Henle, 1841, *Syst. Beschreib. Plagiostom.*, p. 70.
Carcharodon sulcidens Agassiz, 1843, *Poiss. fossiles*, vol. iii, p. 254, pl. xxx *a*, figs. 3–7.
Carcharodon angustidens Agassiz: Davis, 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 9, pl. vi, fig. 22.
Carcharodon rondeletii Müller and Henle: A. Smith Woodward, 1889, *Cat. Foss. Fishes Brit. Mus.*, pt. i, p. 420.
Carcharodon arnoldi Jordan, 1907, *Univ. Calif. Publ. Geol. Bull.* vol. v, No. 7, p. 114, fig. 13.
Carcharodon riversi Jordan (*pars.*), *ibid.*, p. 115, fig. 14*a* (*non* fig. 14*b*).
Carcharodon rondeletii Müller and Henle: Leriche, 1908, *Soc. géol. du Nord*, vol. xxxvii, p. 304.

Observations.—This species is the existing representative of the genus, the great white shark, now found living in waters extending from the Mediterranean to Australia. Three fossil examples occur in the present collection. They are as follows: (1) A perfect tooth, measuring 38·5 mm. in height and 31 mm. in width, probably from the anterior part of the jaw, and representing a fish about 25 ft. long. This is doubtfully recorded as from Caversham (Oamaru Series). The specimen appears, however, to be too fresh to have come from a bed as old as the Miocene. (2) A sharply pointed tooth minus a portion of the root, probably from the side of the jaw. This is from the Greta beds (Awatere Series). (3) An immature or postero-lateral tooth in excellent preservation, embedded in grey shelly limestone of the Napier Series. This specimen was figured and described by Davis as "an immature example of *Carcharodon angustidens*." The definitely triangular shape and deeply cut serrations leave little doubt as to its specific relationship.

As fossils, the teeth of *C. rondeletii* occur in the Eocene and (?) Miocene of South Carolina; in the Pliocene and Pleistocene of California; in the Newer Tertiary of Chile; and in the Pliocene of Italy, Sicily, and England.

Occurrence.—(?) Caversham; Greta beds (Awatere Series), North Canterbury; Napier Series, Esk River, Hawke's Bay (young example).

Age.—Tertiary (? Miocene; Lower and Upper Pliocene).

Suborder TECTOSPONDYLI Hasse.

Family **Pristiophoridæ** Gunther.

Genus PRISTIOPHORUS Müller and Henle.

Pristiophorus lanceolatus Davis sp. Plate III, figs. 12 *a–d*; Plate IX, fig. 8.

Lamna lanceolata Davis, 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 20, pl. iii, figs. 12 *a–d*.
Pristiophorus lanceolatus Davis sp.: Chapman, 1917, *Proc. Roy. Soc. Vict.*, vol. xxix (n.s.), pt. ii, p. 137, pl. ix, fig. 5.

Observations(2).—"The fossil fish-tooth figured by J. W. Davis as cited above has long been a puzzle as to its real relationship. That author himself was dubious about referring it to *Lamna*. Dr. A. S. Woodward, in his *Catalogue of Fossil Fishes*(3), remarks

(1) I have examined the matrix of this specimen, and have no hesitation in placing it with the Weka Pass stone. The Foraminifera found in this rock are listed in my forthcoming work on New Zealand Foraminifera.
(2) Quoted from Chapman, *op. supra. cit.*, p. 137.
(3) *Cat. Foss. Fishes Brit. Mus.*, pt. i, 1889, p. 410.

upon it as follows: 'The so-called *Lamna lanceolata* J. W. Davis (*Trans. Roy. Dublin Soc.*, ser. 2, vol. iv, 1888, p. 20, pl. iii, fig. 12), from New Zealand, is founded upon a tooth evidently not Selachian.'

"Whilst studying the structure of the rostral teeth in the living *Pristis* and allied genera, I was struck with the resemblance of Davis's fossil to the teeth of the Hobson's Bay saw-shark, *Pristiophorus*. Their generic identity was confirmed from the following features common to both: The flattened crown of the tooth is equally slightly convex on both surfaces. The base of the tooth is not furnished with a definite semi-calcified root as in *Lamna*, but appears to be torn from its base, suggesting a cartilaginous attachment. The tooth curves gently backwards, and at its junction with the basal cartilage the osteodentine is clearly marked off from the base. This line of attachment bends down to the anterior margin in both living and fossil species. The hollow root of the fossil tooth further indicates a hollow or membranous base seen on the rostral margin of the living *Pristiophorus*.

"The teeth of *Pristiophorus lanceolatus* are closely comparable to those of *P. nudipinnis* Günther(1), a saw-fish found in Hobson's Bay, Port Phillip, with these differences: The fossil specimens are larger, stouter, and more strongly curved. The size of the New Zealand specimen indicates a fish having a length of about 6 ft. or more.

"The genus *Pristiophorus* is rare in the fossil condition. Represented by some detached vertebræ from the Molasse of Baltringen, Würtemberg(2), and by an undescribed form from the Upper Cretaceous of Mount Lebanon (Smith Woodward)."

The fossil examples of *Pristiophorus lanceolatus* from the Victorian Tertiary were found in the Lower Pliocene (Kalimnan) of Beaumaris, Port Phillip.

Occurrence.—Tertiary. Miocene: Broken River (Trelissick Basin); Curiosity Shop beds, Canterbury; also recorded by Davis from Castle Hill, Trelissick Basin, Canterbury. Pliocene: Napier, Hawke's Bay, in limestone.

Age.—Tertiary (Miocene and Pliocene).

Pristiophorus napierensis sp. nov. Plate IX, figs, 9 *a*, *b*, 10, 11 *a*, *b*, 12, 13.

Description of Rostral Teeth.—The rostral teeth of this species are rather longer and more parallel-sided than the preceding species, *P. lanceolatus*. Elongate, roundly acuminate at the tip, both surfaces depressed convex, slightly more rounded than in *P. lanceolatus*. The upper surface is distinguished by its more roundly convex face and general convexity, seen edgewise. Base strongly swollen and bulbous, stained a dark reddish-brown; remainder of tooth of a pink or plum-brown colour. Surface smooth. Under-surface of base with a shallow depression or ligamental pit.

Dimensions.—Length of cotype, 24 mm.; width at base, 5 mm.; width half-way along tooth, 3 mm.; thickness half-way along tooth, 1·5 mm. Length of another specimen (figured), 20 mm.; width at base, 4·25 mm.

Description of Oral Teeth.—Teeth minute; anterior teeth elongately triangular; crown slender, smooth, sharply pointed, with the sides more or less deeply concave. Inner surface strongly concave, the recurved point being very conspicuous. Base thick and swollen in proportion to the size of the cusp, the surface generally with numerous depressions or pittings, due to their strong setting in cartilage; in the middle of the

(1) Günther, *Cat. Fishes Brit. Mus.*, vol. viii, 1864, p. 432. McCoy, *Prod. Zool. Vict.*, vol. i, 1885, pl. lvi, fig. 2.

(2) C. Hasse, *Das naturl. Syst. Elasm. Besond. Theil*, p. 103, pl. xiii, figs. 6, 7.

basal portion a median sulcus is well developed, but is deeper and more extended anteriorly than that in *Scapanorhynchus* and *Odontaspis*, to which the teeth otherwise bear some resemblance. Posterior teeth with a flatter base and shorter cusp.

Dimensions.—Anterior tooth (cotype), 7·5 mm. in length, 5·5 mm. in breadth, 4·25 mm. in thickness at the base. A posterior tooth (figured) measures 3·5 mm. in length, 4 mm. in breadth at the base.

Observations.—This occurrence of the oral teeth of *Pristiophorus* in the fossil condition is extremely interesting, for it constitutes a record, these not having been found before in any geological formation. The teeth at first suggested *Scapanorhynchus*, but several of their characters cast suspicion on that surmise. However, the association with rostral teeth of *Pristiophorus* led to an examination of recent specimens of this shark from Hobson's Bay, which confirmed the relationship. Compared with recent specimens, the present species appears to represent a shark of about 8 ft. 6 in. in length. Some distinctive features are noticed in the fossil teeth before me as compared with the living species, such as the swollen bases of both rostral and oral teeth, the latter in the Hobson's Bay saw-shark having a flatter and more outspread base. This difference may not be more than specific, although the rostral teeth in *P. napierensis* are less like the living form than *P. lanceolatus*.

Occurrence.—Napier limestone, Napier (ex coll. Canterbury Museum).

Age.—Tertiary (Pliocene).

Family **Trygonidæ** Müller and Henle.

Genus TRYGON Adanson.

Trygon ensifer Davis. Plate VI, figs. 14, 15.

Trygon ensifer Davis (*pars*), 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 37, pl. vi, figs. 14, 15. A. S. Woodward, 1899, *Cat. Foss. Fishes Brit. Mus.*, pt. i, p. 153.

Observations.—The teeth and so-called dermal ossicles referred by Davis to *Trygon ensifer* (*op. supra cit.*, p. 37, pl. vi, figs. 13 *a*, *b*) no doubt belong to the Labridæ, and are here referred to *Labrodon depressus* Chapman and Pritchard and *L. confertidens* Chapman and Pritchard. The spines, however, appear to be referable to *Trygon*, and come nearest to those of the living *Trygon benetti* Müller and Henle(1), from China, in which the spine is fairly broad and shorter than is usual in the genus; or to *Trygon walga* Müller and Henle(2), from India and the Red Sea, which it resembles in outline, excepting that in the living species the spine is more produced.

Smith Woodward, in his *Catalogue of Fossil Fishes*, refers to *Trygon ensifer* of Davis in the following terms: "The New Zealand fossil teeth and spines named *Trygon ensifer* J. W. Davis are evidently not Selachian."

The description of these spines as given by Davis is as follows(3): "A spine which is nearly perfect is 0·6 in. in length and 0·1 in. across the base. It is erect, compressed; the lateral margins are armed with a row of firmly attached recurved denticles which extend from the point two-thirds the length of the spine; towards the base they become smaller and gradually disappear. The anterior and posterior surfaces are slightly convex, with a smoothly enamelled surface. An internal canal extends from the base towards the apex. A second example (fig. 15) is longer and differs from

(1) *Syst. Beschreib. Plagiostom.*, 1841, p. 160, and figure.
(2) *Ibid.*, p. 159, and figure.
(3) Davis, *op. supra cit.*, p. 38.

the other which is represented, in the much smaller denticulation of the margin; it is from the chalk series of Amuri Bluff."

Two fragments of a wider spine of *Trygon* occur in the present collection, from the Tertiary of Waihola (? loc. No. 629). It may represent a distinct species, but the material is insufficient.

The genus *Trygon*, in its present restricted sense, occurs in the South Atlantic (Brazil, &c.), the Mediterranean, the Indian Ocean, and the China Seas.

Age and Occurrence.—(?) Upper Cretaceous (Danian): (?) Amuri limestone, Amuri Bluff (Davis). Eocene: Weka Pass stone, Waipara. Miocene: Coleridge Gully, Trelissick Basin.

Family **Myliobatidæ.**

Genus MYLIOBATIS Cuvier.

Myliobatis altus Davis. Plate VI, figs. 1 *a–c*, 2.

Myliobatis altus Davis, 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 40, pl. vii, figs. 1, 2.

Observations.—J. W. Davis has compared the above species with Agassiz's *M. regleyi*, from the Eocene near Brussels, Belgium, having thick massive median teeth. The type specimen has, unfortunately, suffered from fracture since it was first described, which prevents any additional observations being made beyond the fact that the surface of the crown is smooth to rugose, and pitted in the median area; the lateral plates are small and compressed, and in this respect resemble those of *M. goniopleurus* Agassiz(1), from the Eocene of the London Clay and Bracklesham.

Occurrence.—Broken River, Trelissick Basin.

Age.—Probably Tertiary, but the horizon of the specimen is uncertain. (See p. 37.)

Myliobatis arcuatus Davis. Plate VI, figs. 20 *a–c*, 21.

Myliobatis arcuatus Davis, 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 40, pl. vi, figs. 20, 21.

Observations.—The distinctive features of this species are the strong curvature of the median teeth, and the rough and fibrous surface of the crown.

Occurrence.—Broken River, Trelissick Basin. Davis adds "Castle Hill Station," which is practically the same locality.

Age.—Tertiary (Miocene).

Myliobatis plicatilis Davis. Plate VI, figs. 16 *a–c*, 17, 18 *a–c*, 19 *a–c*.

Myliobatis plicatilis Davis, 1888, *Trans. Roy. Dubl. Soc.*, ser, 2, vol. iv, p. 39, pl. vi, figs. 16–19.
Chapman, 1914, *Australasian Fossils*, p. 271.

Observations.—The heavy form and coarser plication of these teeth help to separate it from the closely allied *M. moorabbinensis* Chapman and Pritchard(2). In the latter species the articulating lamellæ average about 10 in 10 mm., whereas in *M. plicatilis* there are about 8 in the same space.

Occurrence.—Broken River, Trelissick Basin. Davis adds "Curiosity Shop beds; Castle Hill Station; Coleridge; Tokomairiro limestone, Waihola Gorge."

Age.—Tertiary (Miocene).

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(1) *Poissons fossiles*, vol. iii, 1843, p. 319, pl. xlvii, figs. 9, 10.
(2) *Proc. Roy. Soc. Vict.*, vol. xx (n.s.), pt. i, 1907, p. 60, pl. v, figs. 1–3.

Order HOLOCEPHALI.

Family **Chimæridæ.**

Genus ISCHYODUS Egerton.

Ischyodus thurmanni Pictet and Campiche. Plate VII, figs. 10–13.

Ischyodus thurmanni Pictet and Campiche, 1858, *Foss. Terr. Cretacé St.-Croix (Pal. Suisse)*, p. 76, pl. ix, fig. 8.

Ischyodus brevirostris Agassiz: E. T. Newton, 1876, *Quart. Journ. Geol. Soc.*, vol. xxxii, p. 326, pl. xxi, figs. 1–5. *Idem*, 1878, *Chimæroid Fishes Brit. Cret. Rocks (Mem. Geol. Surv. Gt. Brit.)*, p. 27, pl. ix. Davis, 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 42, pl. vii, figs. 10–13.

Ischyodus thurmanni Pictet and Campiche: A. S. Woodward, 1891, *Cat. Foss. Fishes Brit. Mus.*, pt. ii, p. 67. *Idem*, 1911, *Fishes of the English Chalk*, *Mon. Pal. Soc.*, vol. lxiv, p. 188, pl. xl, fig. 7, text-fig. 56. Chapman, 1914, *Australasian Fossils*, p. 269.

Observations.—The *Ischyodus brevirostris* of Agassiz (name only) has been shown by Smith Woodward to be superseded by the name given by Pictet and Campiche. An imperfect specimen, representing the under-surface of a jaw, was found in the present series, labelled in error "*Callorhynchus hectori*." Amongst fragmentary specimens is one from the black grit, Amuri Bluff, which shows the dentinal tubes of the teeth as figured by Newton (*op. cit.*, pl. xxi, fig. 3).

Ischyodus thurmanni is distributed through the Cretaceous of Europe as follows: In the Aptian or Lower Greensand of Kent, England; the Albian or Gault of Kent and Switzerland; the Cenomanian and Turonian of Cambridge and Kent, England.

Occurrence.—Recorded by Davis from the Amuri Bluff beds. The specimen examined from the present series is shown by the locality number to come from the black grit, East Wing, Amuri Bluff, McKay, 1873 and 1876 (loc. No. 8).

Age.—Upper Cretaceous (Senonian).

Genus CALLORHYNCHUS Gronow.

Callorhynchus hectori E. T. Newton. Plate VII, figs. 14, 15.

Callorhynchus hectori Newton, 1876, *Quart. Journ. Geol. Soc.*, vol. xxxii, p. 329, pl. xxi, figs. 6–9. Davis, 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 41, pl. vii, figs. 14, 15. Chapman, 1914, *Australasian Fossils*, p. 269, fig. 130B.

Observations.—The species referred to above appears still to be mainly represented by the fine specimen in the British Museum. Amongst Chimæroid fragments however, in the present collection there are two rock-specimens which contain portions of tritors broken across, and one of these shows the bifid character seen in *Callorhynchus*. These are therefore with little hesitation placed under the above species.

Occurrence.—Black grit, Amuri Bluff (Davis): East Wing, Amuri Bluff (loc. No. 10), McKay, 1873 and 1876 (present determinations).

Age.—Upper Cretaceous (Senonian).

Subclass TELEOSTEI (Bony Fishes).

Order PHYSOSTOMI Müller.

Family **Elopidæ.**

Genus THRISSOPATER Günther.

(?) **Thrissopater** sp. (Fish-scales.) Plate VIII, fig. 5.

Observations.—A considerable number of fish-scales are present in the series from West Wing, Amuri Bluff. They are of the type figured by Dr. C. T. Trechmann[1], and referred

[1] *Geol. Mag.*, dec. 6, vol. iv, 1917, p. 341, pl. xxi, fig. 13.

to in his paper by Dr. A. Smith Woodward, where he says they "may be regarded as belonging to an Elopine Clupeoid." The description there given by the same author equally applies to ours, and is as follows: "Its large covered area, displaying extremely fine concentric lines of growth, is crossed by numerous sharp radiating grooves which have become clefts by crushing. Its denser exposed area is nearly smooth, but bears faint traces of a few radiating lines. Usually in the scales of Elopines the radiating ornament on the exposed area is more conspicuous than in this case; but similarly feeble markings are observable on a scale in the type specimen of *Thrissopater megalops* from the English Chalk."

One of the scales amongst our specimens resembles that of *Osmeroides* in its strongly plicated radii of the free portion, but the scale is thin as in the remaining examples. Other somewhat similar scales are those formerly referred to "*Cladocyclus lewesiensis*" by Agassiz(1), but their outer edge was entire and not crimped or serrated(2).

Occurrence.—Specimens moderately common, from West Wing, Amuri Bluff (coll. McKay: loc. No. 13). One specimen from the *Aporrhais* beds, East Wing, Amuri Bluff (coll. McKay: loc. No. 6). *Trigonia* beds, East Wing, Amuri Bluff (coll. McKay: loc. No. 5). Also Sawpit Gully, near Coverham, Clarence Valley, about 150 ft. above flints.

Age.—Upper Cretaceous (Albian or Cenomanian and Senonian).

Family **Clupeidæ**.

Genus SCOMBROCLUPEA Kner.

Scombroclupea *cf.* **macrophthalma** Heckel sp. Plate VIII, fig. 6.

Clupea macrophthalma Heckel, 1849, in *Russegger's Reisen*, vol. ii, pt. iii, p. 344, pl. xxiii, fig. 2.

Scombroclupea macrophthalma Heckel sp.: Pictet and Humbert, 1866, *Nouv. Rech. Poiss. foss. Mt. Liban*, p. 71, pl. ix. A. S. Woodward, 1901, *Cat. Foss. Fishes Brit. Mus.*, pt. iv, p. 135, pl. vi, fig. 1.

Observations.—The present specimen consists of a head, moderately well preserved, together with about 15 anterior vertebræ. In some respects this specimen shows resemblances to the genus *Spaniodon*, but the pectoral fins are not so large. The premaxillary and maxilla forming the upper border of the mouth are shaped as in the Clupeidæ (restricted sense). There are no vestiges of anterior teeth, as in *Spaniodon*. In this and in the following particulars the New Zealand example agrees with the genus *Scombroclupea*. Thus the maxilla is robust and arched; mandible a little prominent; gape not extending beyond the anterior border of the orbit; pre-operculum forming a triangular expansion; remains of post-clavicular plate present.

The specific characters agreeing with *S. macrophthalma* are: the rays of the pectoral fin are articulated only at the extremity; the premaxilla is somewhat crushed, but the frontal is well preserved and shows the upward bend towards the parietal. The depth of the head in the opercular region is 30 mm.; the length to the back of the opercular plates, 49 mm.; depth of head at orbit equal to three times the diameter of the orbital cavity. The vertebræ are somewhat distorted, but appear to be rather longer than deep;

(1) *Poiss. fossiles*, vol v pt. i, 1837–44, pp. 8, 103, pl. xxv, figs. 5, 6.
(2) See Smith Woodward, *Foss. Fishes of the English Chalk*, pt. ii, *Mon. Pal. Soc.*, vol. lvii, 1903, p. 96.

neural spines comparatively shorter and stouter than in *Spaniodon*, and agreeing with *Scombroclupea*.

Occurrence.—Calcareous greensands, Weka Pass, Waipara district (loc. No. 74).

Age.—Eocene.

Genus DIPLOMYSTUS Cope.

Diplomystus coverhamensis sp. nov. Plate VIII, fig. 4.

Description.—Type specimen consisting of a contorted fish, nearly complete, but with a small portion of the tail wanting. Of rather small dimensions; body somewhat slender; length of head, including opercular region, about one and a half times the depth of the body. Opercular bones well developed, pre-operculum slightly expanded; operculum and suboperculum deep and narrow. Pectoral fin small and triangular. Vertebræ about 36 in the slightly imperfect specimen; centra constricted and longitudinally ridged. Scales fairly large for the size of the fish, subquadrately rounded, of cycloid type, finely concentrically corrugated. Towards the dorsal fin there is a series of large sharply bent ridge-scutes, and another on the ventral surface but nearer the head. Approximate length of fish when complete, 80 mm. Length of head, *circ.* 24 mm.; depth, *circ.* 16 mm.; depth of body anteriorly, *circ.* 13 mm. Average diameter of body-scales, 1 mm.; length of ridge-scales, 2 mm. to 3 mm.

Observations. — This species resembles *Diplomystus brevissimus* Blainville sp.(1) in general characters, but is a longer and more slender-proportioned fish; whilst the ridge-scales are not so long by about a millimetre. The occurrence of the above species in claystone nodules seems to indicate a fresh- or brackish-water habitat for this fish.

The genus *Diplomystus* is stated by Dr. Smith Woodward(2) to be found living in the rivers of New South Wales and Chile; whilst D. S. Jordan(3) says, "Species of similar appearance, usually but wrongly referred to the same genus, occur on the coast of Peru, Chile, and New South Wales." Whether *Diplomystus* really occurs living is open to some doubt, as Ogilby(4) remarks, "The above diagnosis is taken from the species now existing in Australia(5), without regard to the fossil forms, for which Cope established the genus." If distinct, the living species will find their place in *Hyperlophus* Ogilby(6).

As a generic type the fossil forms of *Diplomystus* are found in strata ranging from Upper Cretaceous (Mount Lebanon, Istria, Dalmatia, and Brazil), through Eocene (Green River shales, Wyoming), to Lower Oligocene (Ryde, Isle of Wight). According to the stratigraphical position and fossiliferous contents of the Cover Creek mudstones, these beds would seem to have most relationship with the lower part of the Upper Cretaceous in other localities.

Occurrence.—In a flat, rounded, nodular concretion, Cover Creek beds, Cover Creek, Coverham, Clarence Valley, Marlborough, a quarter of a mile above station hut. Collected by J. A. Thomson, 1912.

Age.—Upper Cretaceous (Albian or Cenomanian).

(1) *Clupea brevissimus* H. D. de Blainville, *Nouv. Dict. d'Hist. Nat.*, vol. xxvii, 1818, p. 364. *Clupea brevissima* Blainville: Agassiz, *Poiss. fossiles*, vol. v, pt. ii, 1839–44, p. 117, pl. lxi, figs. 6–9. Bassani, *Denkschr. k. Akad. Wiss., Math.-naturw. Cl.*, vol. xliv, 1882, p. 219, pl. vii, figs. 5, 6; pl. viii, figs. 1–3. *Diplomystus brevissimus* de Blainville sp.: A. S. Woodward, *Cat. Foss. Fishes Brit. Mus.*, pt. iv, 1901, p. 140.

(2) *Cat. Foss. Fishes Brit. Mus.*, pt. iv, 1901, p. 139; also in Zittel-Eastman, *Text-book of Palæontology*, vol. ii, 1902, p. 96.

(3) *Guide to Study of Fishes*, vol. ii, 1905, p. 52.

(4) *Edible Fishes of New South Wales*, 1893, p. 184.

(5) The fresh-water herring (*Diplomystus novæ-hollandiæ* Cuv. and Val. sp.).

(6) *Rec. Australian Mus.*, vol. ii, 1892, p. 26.

Order PHYSOCLYSTI Gill.

Suborder PHARYNGOGNATHI Müller.

Family **Labridæ** (Wrasses).

Genus LABRODON Gervais.

Labrodon confertidens Chapman and Pritchard. Plate IX, fig. 14.

Trygon ensifer Davis (*pars*), 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 37.

Labrodon confertidens Chapman and Pritchard, 1907, *Proc. Roy. Soc. Vict.*, vol. xx, (n.s.), pt. i, p. 65, pl. v, fig. 7. Chapman, 1914, *Australasian Fossils*, p. 271, fig. 131E.

Observations.—As noted in our original description, this species is characterized by the closely packed teeth, which have a polygonal outline excepting at the margin of the jaw, where they tend to become lunate. The diameter of the largest teeth in the New Zealand specimen is 2·5 mm. as compared with the Victorian of 3 mm. The smallest teeth in both New Zealand and Victorian specimens measure 0·75 mm. in diameter.

The Victorian specimen was found at Grange Burn, near Hamilton, in beds of Kalimnan or Lower Pliocene age.

Occurrence.—Weka Pass ; Broken River (probably loc. No. 454A = Coleridge Gully).

Age.—Tertiary (Miocene).

Labrodon depressus Chapman and Pritchard. Plate VI, figs. 13, 13 *a*, *b*.

Trygon ensifer Davis (*pars*), 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 37, pl. vi, figs. 13, 13 *a*, *b*.

Labrodon depressus Chapman and Pritchard, 1907, *Proc. Roy. Soc. Vict.*, vol. xx (n.s.), pt. i, p. 66, pl. v, figs. 8, 9. Chapman, 1914, *Australasian Fossils*, p. 271.

Observations.—Several examples of pavement teeth of *Labrodon* occur in the New Zealand collection. That figured by Davis (pl. vi, figs. 13, 13 *a*, *b*) is probably conspecific with the Victorian example found at Beaumaris, Port Phillip, of Kalimnan or Lower Pliocene age. Davis referred his specimen to *Trygon*, and linked it with the tail spine of *Trygon ensifer* Davis. Probably Davis's "dermal tubercles" are parts of the same series of palatal teeth. Davis's description of the teeth is as follows[1] : "The teeth vary in size from 0·1 in. to 0·05 in. in width. They have an imbricated arrangement, the anterior point of a tooth overlapping slightly the margins of those in front of it. The surface where not worn is prominent and rounded, but where the teeth have been much used they are worn smooth, and present an even pavement-like arrangement. They appear to be firmly attached to the jaws, a portion of the bony substance of which has in some cases broken away and remains attached to the teeth. The teeth are covered with enamel. The under-surface is more or less hollow."

The specimens mentioned by Davis as from the uppermost beds at Weka Pass belong to the preceding species, *L. confertidens*.

Occurrence.—Coleridge Gully, Trelissick Basin.

Age.—Tertiary (Miocene).

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(1) *Op. cit.*, p. 37.

Suborder ACANTHOPTERI Müller.

Family **Sparidæ** (Sea-breams).

Genus SARGUS Cuvier.

Sargus laticonus Davis. Plate VII, figs. 3–7

Sargus laticonus Davis, 1888, *Trans. Roy. Dubl. Soc.*, ser. 2, vol. iv, p. 43, pl. vii, figs. 3–7 (*non* fig. 8). A. S. Woodward, 1901, *Cat. Foss. Fishes Brit. Mus.*, pt. iv, p. 529. Chapman, 1914, *Australasian Fossils*, p. 272, fig. 130F. Chapman, 1917, *Proc. Roy. Soc. Vict.*, vol. xxix (n.s.), pt. ii, p. 140, pl. ix, fig. 9.

Observations.—This species is founded on the front teeth, which are broad, chisel-shaped, or spatulate, and incurved. The root is strong, and marked off by a slight constriction. The teeth are sometimes ground obliquely at the apex of the crown, and then curiously resemble a human canine. None of the serial molariform teeth were noticed in this series.

The species has a rather limited range, though abundant where found, and seems to be confined to the limestones of the Middle Oamaru Series. It was recently recorded from the Miocene Batesford limestone of Victoria by the writer.

The specimens recorded as "? otoliths of *Sargus*" by Davis have been described in this monograph under the name of *Cestracion novo-zelandicus.*

Occurrence.—Coleridge Gully; Broken River; Castle Hill Station, Trelissick Basin, Canterbury.

Age.—Tertiary (Miocene).

III. SUMMARY.

Analysis of Fauna.

In the foregoing work forty-three species of fossil fishes are enumerated. These include the thirty-five species described by Davis in 1888, several of which are here relegated to the synonymy of other forms.

The new species described in this work are: *Synechodus validus* (Upper Cretaceous); *Cestracion coleridgensis* (Miocene); *Cestracion novo-zelandicus* (Miocene); *Pristiophorus napierensis* (Pliocene); *Diplomystus coverhamensis* (Upper Cretaceous).

Of the total number described, thirty-seven species belong to the subclass Selachii, or the sharks and rays; and the remaining to the subclass Teleostei, or the bony fishes.

The greater abundance of the remains of Selachians, as compared with Teleosteans, may easily be explained from the fact that their remains in these deposits are represented by the teeth and spines, and occasionally by isolated vertebræ, although in the latter case these are of no real determinative value. The teeth of the Selachians are not only conspicuous as fossils by their comparatively large size, but more especially because they were periodically shed and replaced by the same individual, and thus their numbers were out of proportion to the sporadic remains left by the bony fishes. The latter, to figure as determinative fossils, had to be preserved under especially favourable conditions of quiet sedimentation and immunity from subsequent disturbance.

The number of species to each genus represented in the present collection is as follows:—

Notidanus ..	.. 3	*Lamna* ..	.. 5	*Callorhynchus*	.. 1
Synechodus	.. 2	*Isurus* ..	.. 4	*Thrissopater*	.. 1
Cestracion ..	.. 2	*Carcharodon*	.. 3	*Scombroclupea*	.. 1
Galeocerdo ..	.. 1	*Pristiophorus*	.. 2	*Diplomystus*	.. 1
Carcharias ..	.. 1	*Trygon* ..	.. 1	*Labrodon* ..	.. 2
Scapanorhynchus	.. 2	*Myliobatis* ..	.. 3	*Sargus* ..	.. 1
Odontaspis ..	.. 6	*Ischyodus* ..	.. 1		

Changes of Nomenclature.

Davis's "*Galeocerdo*" *aculeatus* is here referred to *Carcharias*, subgenus *Prionodon;* whilst one of the specimens figured by that author as *Notidanus marginalis* is a true *Galeocerdo*, which Dr. Pritchard and the writer named after Davis in 1904, when comparing the New Zealand fossil with a conspecific form found in the Kalimnan of Victoria.

The "*Odontaspis sulcata*" of Davis is here referred to the Cretaceous Cestraciont genus *Synechodus*, a relationship previously pointed out by Dr. A. Smith Woodward; whilst one of Davis's specimens is now taken as a new species on account of its robust build and smooth basal area.

The specimens figured by Davis as "otoliths of (?) *Sargus*" are renamed *Cestracion novo-zelandicus.* The teeth of this new species differ from the pavement teeth of the living Port Jackson shark in the coarser cancellation of the exterior.

Two species of the goblin-shark (*Scapanorhynchus*) are found in the Cretaceous of New Zealand, one of which, described as a new species of *Odontaspis* (*O. kaikoraensis*) by Davis, was referred by Dr. A. Smith Woodward to *Scapanorhynchus* in 1889. Both of these are European forms.

Four of Davis's species of *Lamna* are here placed with *Odontaspis*, in conformity with the present knowledge of that genus.

Two of Davis's species, "*Oxyrhina enysii*" and "*O. subvexa*," are here placed in the synonymy of *Lamna apiculata*, a Selachian species common in the Tertiaries of Victoria.

The "*Odontaspis acuta*" of Davis is now referred to *Lamna bronni* Agassiz, a suggestion to this effect having been made by Dr. A. Smith Woodward in 1889. Since then the species has been found in the Miocene of Waurn Ponds.

Davis's "*Lamna marginalis*" is regarded as identical with *Lamna compressa*, a shark which inhabited European and North American seas in Eocene and Miocene times, and which made its appearance in the Southern Ocean in the Miocene and Lower Pliocene.

Both "(?) *Oxyrhina vonhaastii*" (*pars*) and "*Otodus obliquus*" of Davis are identified with Agassiz's *Lamna crassa*, occurring in the Upper Cretaceous of New Zealand. *L. crassa* is a Cenomanian and Danian species in Europe.

The well-known genus *Oxyrhina*, having been preoccupied by a genus of dipterous insects, gives place to *Isurus*(1). Of this genus Davis's "*Oxyrhina grandis*" belongs to *Isurus desori* Agassiz sp.; "*O. acuminata*" and "(?) *O. lata*" to *I. hastalis* Agassiz sp.; "*O. fastigiata*" to *I. minutus* Agassiz sp.; and "*O. vonhaastii*" and "*O. recta*" to *I. retroflexus* Agassiz sp. These are all Tertiary forms, with a possible exception in *Isurus desori* Agassiz sp., which, although occurring abundantly in various Tertiary localities, is also found at Amuri Bluff either in the Amuri limestone of Upper Cretaceous (Danian) age or in the succeeding passage bed, the greensand conglomerate above the Amuri limestone (*fide* P. G. Morgan). A doubtful Cretaceous specimen has previously been recorded by Dr. Jordan from California, otherwise it is regarded as a typical Tertiary species.

The "*Carcharodon robustus*" of Davis is referred to the synonymy of *C. auriculatus*, apparently possessing no distinctive characters of specific value. Dr. Smith Woodward refers this species to the synonymy of *C. megalodon*, from which it differs, however, in having a narrower base.

The "immature example of *Carcharodon angustidens*" figured by Davis is clearly that of a small tooth of the living *C. rondeletii* Müller and Henle.

The affinities of "*Lamna lanceolata*" Davis were for a long time puzzling, until some similar forms were found in the Victorian Tertiaries, when, comparing these with the Hobson's Bay sawfish, it was seen that they were generically identical. The fossil is now referred to *Pristiophorus lanceolatus* Davis sp. Another species of *Pristiophorus* (*P. napierensis*) is here described as new, and is especially interesting, since it is accompanied by oral teeth.

The Chimæroid *Ischyodus thurmanni* Pictet and Campiche was formerly referred by Davis to *I. brevirostris* Agassiz, but this species-name, as pointed out by Smith Woodward and others, is a synonym of *I. thurmanni*.

The so-called dermal ossicles of "*Trygon ensifer*" Davis are here shown to be the palatal teeth of a wrasse (*Labrodon*), and the two species recorded from Victoria—namely, *L. confertidens* Chapman and Pritchard and *L. depressus* Chapman and Pritchard—are represented in the New Zealand Tertiaries.

(1) See F. Chapman, *Vict. Nat.*, vol. xxiv, Dec. 1917, p. 128.

Comments on the Distribution of the Fauna, and on the Stratigraphical Sequence of the Beds.

Notidanus marginalis Davis : The New Zealand specimens come from the uppermost Waipara and the Trelissick Basin. These occurrences compare closely with the distribution of a nearly allied form, *N. seriatissimus* Agassiz, which ranges from Lower Eocene to Lower Miocene in Europe ; for the " uppermost beds of the Waipara," according to the results of the writer's examination of the microzoa of New Zealand, appear to represent the basal Tertiary Series.

Synechodus is a characteristic Cretaceous genus in Europe, and occurs here in the black grit (Upper Cretaceous) of Amuri Bluff.

Galeocerdo davisi Chapman and Pritchard is a southern form, and is a Miocene fossil both in New Zealand and in Victoria ; in the latter region it is also found in the Lower Pliocene.

Carcharias (Prionodon) aculeatus Davis sp. is Miocene and Lower Pliocene in New Zealand, and Miocene in Victoria, where it has been found in Janjukian (Miocene) beds of the Orbost district, East Gippsland.

The Upper Cretaceous *Scapanorhynchus subulatus* Agassiz sp. is a valuable guide fossil, for its occurrence is world-wide and confined to that series.

Odontaspis attenuata Davis is Cretaceous and Miocene in New Zealand, but only Miocene and Lower Pliocene in Victoria. It may yet be discovered in the Australian Cretaceous, which as yet has not been well worked for fish-remains.

Odontaspis contortidens is here recorded from New Zealand for the first time, and in Miocene beds ; in the Victorian Tertiary it occurs in the Oligocene, Miocene, and Lower Pliocene.

O. elegans Agassiz sp. : This striking form was previously described by Davis as " *Lamna huttoni*." It is well known as an Eocene and Lower Miocene fossil in Europe, and is found in the Miocene of Victoria.

O. incurva Davis sp. has a rather extensive range in New Zealand, from the Upper Cretaceous to the Miocene, whilst in Victoria it is found in the Miocene and Lower Pliocene.

Lamna apiculata Agassiz sp. is another Selachian species which bridges the two formations, the Cretaceous and the Tertiary. In Victoria it ranges from Oligocene to Lower Pliocene.

Although not before recorded from New Zealand, *L. appendiculata* Agassiz sp. has been found in Queensland. It is typically Cretaceous elsewhere, as in New Zealand, but has also occurred in Lower Eocene beds in Europe.

Lamna bronni Agassiz sp. is, curiously, Danian in Holland and Belgium, but Miocene in Victoria and New Zealand.

L. compressa Agassiz is Eocene to Miocene in Europe, and Miocene and Lower Pliocene in Victoria, whilst in New Zealand it is Miocene.

L. crassa Agassiz sp. is Cenomanian and Danian in Europe, and Upper Cretaceous in New Zealand.

In *Isurus desori* Agassiz sp. we have a fossil which apparently bridges the gap between the Cretaceous and Miocene, since it occurs in the Amuri Bluff limestone(1) and in the grey marls of the Weka Pass. In Victoria it is confined to Lower Pliocene beds.

The commonest form of *Isurus* in the Victorian Tertiaries is *I. hastalis*, which is, however, rare in New Zealand, represented by Davis's " *Oxyrhina acuminata* " and possibly " *O. lata*." At present it is known only from the Miocene in New Zealand, as also in Patagonia, whilst it commences its history in Victoria in the Oligocene. In North America it is found as early as the Eocene. *Isurus minutus* is also Miocene in New Zealand, whilst

(1) The occurrence of *Isurus desori* in the Amuri limestone is doubtful. (See p. 30).

it has a considerable range (Oligocene to Lower Pliocene) in Victoria. It is Miocene and Pliocene in Europe. Undoubtedly the commonest form of the genus in New Zealand is *I. retroflexus* ("*Oxyrhina vonhaastii*" of Davis), where it is typically Miocene. In Victoria it ranges from Miocene to Lower Pliocene, whilst in Europe and North America it is a Middle Eocene to Pliocene fossil.

Of the giant *Carcharodon* sharks, the species *C. auriculatus* made its earliest appearance in New Zealand, unless the doubtful reference of a Danian occurrence in France can be verified. Commencing in the Amuri limestone stage (probably Danian), it also occurs in the successional beds of Weka Pass, right into the Miocene. In Victoria its range is from Oligocene to Miocene. *Carcharodon megalodon* appears in the basal Tertiary of New Zealand as well as in the Miocene. In North America it ranges from Eocene to Miocene, and in Europe from Miocene to Pliocene. In Victoria it is found in beds of Oligocene to Lower Pliocene ages, but is commonest in the Miocene. *C. rondeletii* is remarkable as a living species having so long a time-record as Eocene to Recent. It may have migrated from the North American basin at about the Pliocene period, since its history in Europe dates only from that time ; whilst it is still living in the Mediterranean. In New Zealand it is found doubtfully in the Miocene, and typically in Lower and Upper Pliocene.

Pristiophorus lanceolatus is distinctly a southern type of saw-shark, and has a longer record (Miocene and Pliocene) in New Zealand than in Victoria (Lower Pliocene). The accompanying species, *P. napierensis*, is apparently confined to the Pliocene.

The elephant-fish, *Ischyodus thurmanni*, appears to have found New Zealand a last refuge, as it there occurs in the Upper Cretaceous, probably Senonian, whilst in Europe its range in time extended from the Lower Cretaceous (Aptian) to the Turonian stage of the Upper Cretaceous.

The determination of *Scombroclupea* cf. *macrophthalma* appears to point to a survival into the Tertiary period of an Upper Cretaceous form found elsewhere, in Syria and Istria.

Diplomystus is of interest in its present occurrence as indicating brackish-water influences occurring in the lower part of the Upper Cretaceous of New Zealand. Probably these are the ancestral forms of the southern type of this fish now living in the rivers of New South Wales, and also along the coasts of Chile and Peru.

The presence of *Labrodon confertidens* extends the range of that species as far back as the Miocene, it having previously been found in Victoria in the Lower Pliocene.

The cutting-teeth of *Sargus laticonus* are extremely abundant in the New Zealand Miocene, at Trelissick Basin, and the occurrence of this species has lately been noted in the Miocene of Victoria. In both areas these sea-breams must have found very favourable feeding-grounds amongst the shell-fish, crustacea, and polyzoa upon which they preyed.

LOCALITIES FROM WHICH FISH-REMAINS WERE COLLECTED.

By P. G. Morgan.

It is a matter for regret that in some cases it is now apparently impossible to identify the exact locality, and more especially the bed, from which some of the fossils described on the previous pages were collected, whilst in other cases only a more or less uncertain identification of locality can be made. An examination of Davis's type specimens and their present labels shows that mistakes were made by him in his locality-records, but probably these were due mainly to the imperfect labelling of the material when received by him. So far as this could be done all errors have been rectified on the preceding pages and in the description of the plates accompanying this bulletin, but possibly one or two mistakes still remain or have been newly introduced. The excellence of Davis's figures makes it possible to identify his types (except a few which have been lost or mislaid) with certainty. It is, of course, in any case necessary to collect more material from each and every fossiliferous locality, so as to be able definitely to ascertain the range of each species; and now that Mr. Chapman's revision of Davis's work is available New Zealand workers will no doubt take much more interest in the collection of fish-remains than has been the case for many years past.

Attention may be drawn to the fact that Sir James Hector in 1894 corrected some of the locality-records in Davis's paper. He says, "I find that some slight confusion has taken place with regard to localities and formations, which I take this opportunity of rectifying according to the views adopted in the Geological Survey of the colony"(1). Hector's chief concern, however, was to preserve the integrity of the Cretaceo-Tertiary formation, as then understood by the Geological Survey. This seemed, not without reason, to be threatened by Davis's results. It is now known that, quite apart from the debated and still partly unsettled question of a conformable or unconformable succession from the Cretaceous to the Tertiary, the old Geological Survey was mistaken in some of its correlations—for example, in supposing that the Amuri limestone and the Ototara stone were of the same age(2), or that the Waiareka Series was "intermediate between the Amuri limestone and the Saurian beds towards the base of the Cretaceo-Tertiary formation"(3). Hence strata of Upper Cretaceous age were correlated with Oamaruian beds, containing a totally different fauna which is undoubtedly of Middle Tertiary age; and it is to be feared, therefore, that some of Hector's corrections were not very enlightening.

The writer proposes now to give lists of the fossils identified by Davis and Chapman according to locality, together with such explanatory remarks as may seem desirable. It is almost inevitable that some reference to the classification adopted by the present Geological Survey should be made. A more or less tentative table showing the Cretaceous and Tertiary formations is therefore given at the end of this section. The localities mentioned in the fossil-lists are taken in a rough geographical order from north to south and east to west.

Parua Bay, Whangarei.

Two small specimens of *Notidanus*, cf. *marginalis* Davis. Loc. No. 270. Collector: Cox, 1876.

Mercer, Waikato River, Auckland.

The only specimen from this locality sent to Mr. Chapman was identified by him as *Odontaspis incurva* Davis sp., thus confirming Davis's identification of the same specimen

(1) James Hector, *Reports of Geol. Explor. during 1892–93*, No. 22, 1894, p. 93. See also "Critical Notes on Mr. Davis's Paper," pp. 115–20 (same publication), and table following.

(2) This view is apparently still supported by P. Marshall. See his paper "The Younger Limestones of New Zealand," *Trans. and Proc. N.Z. Inst.*, vol. 48, 1916, pp. 87–99.

(3) Hector, *loc. cit.*, p. 116.

as *Lamna incurva* Davis. The matrix is bluish calcareous sandy mudstone, the "Leda marl" of Cox, and its horizon is not very far above the Waikato coal-measures. Loc. No. 101. Collector: McKay, 1875.

Raglan.

Carcharodon auriculatus Blainville sp. Probably collected by McKay in 1875. Horizon: Oamaruian (?).

Mokau River.

Isurus desori Agassiz sp. From Totoro (not Totara) limestone. Loc. No. 655 (presumably). Collector: Park, 1887. Horizon: Oamaruian (?).

Mohaka Crossing (Napier–Taupo Road).

Carcharias (Prionodon) aculeatus Davis sp.(1); *Notidanus dentatus* Davis; *Notidanus,* cf. *marginalis* Davis (pl. ix, fig. 9). Loc. probably No. 680 (Te Purutu, Mohaka Crossing). Collector: Probably McKay, 1887. Horizon: Wanganuian (?), or, according to Hutton, Pareoran.

Wairoa District, Hawke's Bay.

Odontaspis incurva Davis sp. Specimen presented to Museum by Mr. H. A. E. Hurley, Hastings, in 1903.

Esk River, Hawke's Bay.

Carcharodon rondeletii (young example). Recorded by Davis as *C. angustidens.* Hector also mentions *Scymnus acutus* as occurring at Esk River. This is an identification made by Davis(2). Loc. No. 683 (probably). Collector: McKay, 1886. Horizon: "Napier Series" (Pliocene).

Napier.

Pristiophorus napierensis Chapman. *Isurus* sp. Canterbury Museum collection. Horizon: Napier limestone (Petanian).

Whareama, Eastern Wairarapa, Wellington.

All the material labelled "Whareama" or "Locality No. 5" sent to Mr. Chapman is believed to have come from the "*Trigonia* bed," Amuri Bluff. The specimen identified by Davis as *Lamna incurva* Davis (= *Odontaspis incurva* Davis sp.) probably did come from Whareama, for Hector made no comment upon the record.

Tata Island, Nelson.

Mr. Chapman notes *Isurus, Lamna,* and *Odontaspis* spp. Davis also records the following: *Lamna incurva* Davis = *Odontaspis incurva* Davis sp.; *Notidanus marginalis* Davis; *Trygon ensifer* Davis. The specimens thus named by Davis seem to have been lost. The material sent to Mr. Chapman was also sent to Davis; and the old label, "*Lamna, Notidanus* fragments, *Trygon* tooth," is probably a copy of his MS. identification. Loc. No. 662 (probably). Collector: Hector, 1887 (?). Horizon: Oamaruian (Tata Island limestone).

Cobley's Creek, Nelson.

Carcharodon megalodon Agassiz. Recorded by Davis. The writer cannot ascertain the position of the locality mentioned. The specimen appears to have been lost.

Denniston Road, Westport.

Odontaspis cf. *incurva,* Davis sp. The specimen was collected by J. A. Bartrum about December, 1912, on the road between Waimangaroa and Denniston. Horizon: Upper Oamaruian (Pareoran). (See *N.Z. Geol. Surv. Bull. No. 17,* 1915, p. 92, &c.)

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(1) Not in material sent to Mr. Chapman.

(2) J. W. Davis, "Note on a Species of *Scymnus* from the Upper Tertiary Formation of New Zealand." *Geol. Mag.,* dec. iii, vol. v, 1888, pp. 315–16. Title quoted from *N.Z. Geol. Surv. Pal. Bull. 1,* 1913, p. 65.

Cape Foulwind, near Westport.

Carcharodon megalodon, Agassiz. The specimen may be from above or below the Cape Foulwind limestone. Horizon: Oamaruian. (See also *N.Z. Geol. Surv. Bull. No. 17.*)

Greymouth (Limestone Quarries).

Isurus sp. Loc. No. 35. Collector: McKay, 1873. Horizon: Cobden limestone (Oamaruian, probably Ototaran stage).

Coverham, Clarence Valley.

Diplomystus coverhamensis Chapman; *Thrissopater* sp. (scales). In nodules, Sawpit Gully mudstones. Horizon: Waiautoan or Clarentian (Albian or Cenomanian).

Kaikoura Peninsula.

Scapanorhynchus subulatus (two specimens). Davis also records *Carcharodon angustidens* Agassiz = *C. auriculatus* Blainville sp.; *Lamna incurva* Davis = *Odontaspis incurva* Davis sp.; *Lamna marginalis* Davis = *L. compressa* Agassiz sp. or *L. crassa* Agassiz sp.; *Lamna* sp. (?), vertebra. All the above specimens are ascribed to the Amuri limestone. A specimen of *Lamna carinata* Davis, and the type specimen of *Odontaspis kaikoraensis* Davis, are both referred to *Scapanorhynchus subulatus* Agassiz sp. by Mr. Chapman. They are embedded in grey calcareous arenaceous matrices that, in the writer's opinion, are almost certainly not Amuri limestone. The matrix of "*Lamna carinata*" also contains a fragment of a Belemnite (probably *Belemnites lindsayi* Hector). Both specimens are in the Canterbury Museum collection. The type of *Lamna carinata* Davis (pl. iii, fig. 13), together with the vertebra of "*Lamna* sp. (?)," is in the Otago Museum. The other material identified by Davis appears to have been mislaid or lost.

Amuri Bluff.

The following fossils appear to come from the phosphatic conglomerate below the "Weka Pass stone" and above the Amuri limestone: *Carcharodon* sp. (named *C. angustidens* by Davis); *Isurus desori* Agassiz sp.; *Isurus retroflexus* Agassiz sp. The last-named specimen is one of Davis's syntypes of "*Oxyrhina vonhaastii*" (Plate IV, fig. 2), and was supposed by him to come from Oamaru. Hector says positively that the specimen came from the greensand conglomerate at the base of the Weka Pass stone, East Wing, Amuri Bluff(1). The specimen of *Isurus desori* is evidently that assigned by Davis, under the name of *Oxyrhina grandis* Davis, to the "greensand conglomerate, South (? East) Wing, Amuri Bluff." Loc. No. 275 ("Grey marls, Weka Pass stone, and greensand conglomerate, East Wing, Amuri Bluff"). Collector: McKay, 1876. Horizon: Eocene (?).

The following fossils are stated to come from the Amuri limestone at Amuri Bluff (loc. No. 12; McKay, 1876): *Carcharodon auriculatus* Blainville sp.; *Isurus desori* Agassiz sp. The specimen of *C. auriculatus* is attached to a lump of unmistakable Amuri limestone. Mr. Chapman writes on the label: "I have tested the matrix for microzoa, and verified its Cretaceous affinities." The tooth of *Isurus desori* contains some greensandy matrix, and may or may not be from the Amuri limestone proper, the age of which is provisionally regarded as Danian. To the writer it seems likely that it came from the phosphatic horizon ("greensand conglomerate") above the Amuri limestone, as did other specimens.

Davis also records (pp. 38 and 60 of his memoir) *Trygon ensifer* Davis (pl. vi, fig. 15). The specimen figured by Davis has, unfortunately, been mislaid or lost. The record must be considered a very doubtful one.

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(1) *Loc. cit.*, 1894, p. 118.

The bulk of the specimens from Amuri Bluff are labelled "Locality No. 13 ('West Wing')," which includes the following subdivisions made by McKay in the "East Wing" beds: Saurian beds; black grit: grey sands; lower black grit; calcareous conglomerate (*Aporrhais* bed, *Trigonia* bed, Belemnite bed); lower or wood sands. Most of the specimens are from the "black grit" and "calcareous conglomerate" horizons. They include—*Notidanus dentatus* A. S. Woodward; *Synechodus sulcatus* Davis sp.; *Synechodus validus* Chapman; *Scapanorhynchus subulatus* Agassiz sp. (common); *Scapanorhynchus rhaphiodon* Agassiz sp. (fairly common); *Lamna apiculata* Agassiz sp.; *Lamna appendiculata* Agassiz sp. (fairly common); *Lamna crassa* Agassiz sp. (fairly common); *Ischyodus thurmanni* Pictet and Campiche; *Thrissopater* sp.; also many indeterminable fish-scales (one a Berycoid scale), vertebræ, &c., reptilian teeth (cf. *Polyptychodon*), *Metasqualodon* sp., &c.

In locality No. 6 (*Aporrhais* bed, East Wing) there occur *Scapanorhynchus subulatus* Agassiz sp.; *Scapanorhynchus rhaphiodon* Agassiz sp; *Thrissopater* sp.

The black grit of the "East Wing" (loc. No. 8) contains *Scapanorhynchus subulatus* Agassiz sp.; *Scapanorhynchus rhaphiodon* Agassiz sp.; *Lamna crassa* Agassiz sp. Davis also records *Odontaspis sulcata* Davis = *Synechodus sulcatus* Davis sp. or *S. validus* Chapman.

The black grit of the collection from the "West Wing" (loc. No. 13) may contain other species. The concretionary greensands of the "East Wing" (loc. No. 10) contain *Notidanus* sp.; *Callorhynchus hectori* E. T. Newton. The *Teredo* limestone of the "East Wing" (loc. No. 11) contains *Scapanorhynchus subulatus* Agassiz sp.; *Scapanorhynchus rhaphiodon* Agassiz sp.; *Notidanus* sp. (probably—locality number not preserved). Davis also records *Lamna marginalis* Davis = *L. compressa* Agassiz or *L. crassa* Agassiz sp.

The following two species of *Scapanorhynchus* probably occur in the *Trigonia* bed, "East Wing" (loc. No. 4), but none of the specimens are clearly labelled with the locality number: *S. subulatus* Agassiz sp.; *S. rhaphiodon* Agassiz sp.

Material from loc. No. 5, wrongly recorded in Geological Survey lists as "Whareama" instead of "*Trigonia* bed, Amuri Bluff," contains *Lamna crassa* Agassiz sp.; *Lamna* sp.; *Scapanorhynchus subulatus* Agassiz sp.; *Scapanorhynchus* sp.; *Thrissopater* sp. (scale).

The Belemnite bed, "East Wing" (loc. No. 3), may contain *Synechodus validus* Chapman.

Three specimens of *Odontaspis incurva* Davis from Amuri Bluff have no locality number, and are without matrix.

Davis also records the following species as occurring at Amuri Bluff (horizon not stated): *Lamna huttoni* Davis = *Odontaspis elegans* Agassiz sp.

Nearly all the Amuri Bluff specimens were collected by McKay in 1876. The horizon of all material below the Amuri limestone is Piripauan (Senonian).

Mikonui Stream, North of Amuri Bluff.

Davis records *Lamna incurva* Davis = *Odontaspis incurva* Davis sp.

Weka Pass, North Canterbury.

From the Mount Brown beds come *Isurus desori* Agassiz sp.; *Lamna apiculata* Agassiz sp. Collector: J. A. Thomson. Horizon: Oamaruian.

The following four species, as judged by the label or the matrix, come from the Weka Pass stone: *Odontaspis incurva* Davis sp. (874, Cant. Mus. "uppermost Waipara"); *Odontaspis* sp. ("Weka Pass stone"); *Isurus desori* Agassiz sp. (655, Cant. Mus.); *Scombroclupea* cf. *macrophthalma* Heckel sp. (loc. No. 74)—age, Eocene (?).

The following specimen is from an unspecified horizon: *Labrodon confertidens* Chapman and Pritchard (918, Cant. Mus.). The matrix of this specimen is a limestone which does not resemble characteristic Weka Pass stone, but does closely resemble some of the Coleridge Creek limestone, Trelissick Basin.

The horizon of the figured specimen of *Carcharodon auriculatus* Blainville (Plate I, fig. 6) is probably the grey marl (Hector). The horizon of the specimen of *C. megalodon* Agassiz (Plate II, fig. 2) is unknown, but no doubt it comes from some portion of the Tertiary succession.

MIDDLE WAIPARA RIVER, ETC.

North-west of Mount Brown, in the Weka Pass stone, at 1 ft. above the Amuri limestone, Dr. J. A. Thomson collected *Odontaspis elegans* Agassiz sp.

At Onepunga, Middle Waipara, he also collected from the Weka Pass stone *Isurus desori* Agassiz sp., *Lamna apiculata* Agassiz sp.

From the " uppermost beds " of the Waipara Formation, Waipara, come *Notidanus marginalis* Davis (922, Cant. Mus.); *Odontaspis elegans* Agassiz sp. (858, Cant. Mus.); *Lamna apiculata* Agassiz sp. (897, Cant. Mus. and Plate V, figs. 18–20); *Carcharodon auriculatus* Blainville sp. (858, Cant. Mus.).

From the " Waipara Formation," Waipara, come *Isurus retroflexus* Agassiz sp. (916, Cant. Mus.); *Isurus desori* Agassiz sp. (916, Cant. Mus.).

From the Weka Pass stone of Boby Creek comes *Carcharodon megalodon* Agassiz (Plate II, fig. 3).

From Boby Creek, locality No. 277, come *Scapanorhynchus subulatus* Agassiz sp.; *Odontaspis incurva* Davis sp.; vertebra of *Lamna* (?) Agassiz sp. Collector: Hector, 1867. The specimens are presumably all from the Cretaceous beds of Boby Creek.

WHITE ROCK QUARRY, OKUKU RIVER, NEAR LOBURN, ASHLEY.

No fish-remains from this locality are in the collections, but it happens that Davis described a cetacean tooth from " White Rock Quarries " as " *Squalodon serratus* Davis." Hector claimed that this fossil represented his " *Kekenodon onamata*," but Mr. Chapman refers it to the genus *Parasqualodon* (Plate VIII, fig. 9). Davis's specimen appears to have been lost.

TRELISSICK BASIN, CENTRAL CANTERBURY.

Most of the numerous specimens from this locality are labelled " Coleridge Creek " or " Coleridge Gully." Some are labelled " Broken River," others " Castle Hill Station," and one " Hog's Back." There would be little use in separating the specimens according to the ostensible localities, which are indicated in the following list by initial letters—C.C. for Coleridge Creek or Gully, B.R. for Broken River, C.H.S. for Castle Hill Station, and T.B. for Trelissick Basin. There can be little doubt that all the material is from Tertiary horizons, and nearly all must be of Oamaruian age(1) (Mount Brown beds).

Notidanus marginalis Davis (B.R., C.C.).
Cestracion coleridgensis Chapman (C.C.).
Cestracion novo-zelandicus Chapman (C.C.).
Galeocerdo davisi Chapman and Pritchard (C.H.S.).
Carcharias (Prionodon) aculeatus Davis sp. (C.C.).
Odontaspis attenuata Davis sp. (C.C.).
Odontaspis contortidens Agassiz (C.C.).
Odontaspis elegans Agassiz sp. (C.C.).
Odontaspis exigua Davis (B.R.).
Odontaspis incurva Davis sp. (B.R., C.C.).
Lamna apiculata Agassiz sp. (Hog's Back, B.R.).
Lamna bronni Agassiz (T.B.).
Lamna compressa Agassiz sp. (B.R.).
Isurus desori Agassiz sp. (B.R.).
Isurus hastalis Agassiz sp. (C.H.S.).

(1) *Myliobatis altus* appears to occur in pre-Oamaruian strata. See J. Hector, *loc. cit.*, 1894, p. 116, and also F. W. Hutton, in *Trans. N.Z. Inst.*, vol. 19, 1887, p. 399.

Isurus minutus Agassiz sp. (C.C.).
Isurus retroflexus Agassiz sp. (B.R.).
Carcharodon auriculatus Blainville sp. (B.R.).
Pristiophorus lanceolatus Davis sp. (B.R., C.C.).
Trygon ensifer Davis (C.C.).
Myliobatis altus Davis (B.R.).
Myliobatis arcuatus Davis (B.R.).
Myliobatis plicatilis Davis (B.R., C.C.).
Labrodon confertidens Chapman and Pritchard (B.R.).
Labrodon depressus Chapman and Pritchard (C.C.).
Sargus laticonus Davis (C.C., B.R.).

Other species of *Notidanus, Lamna, Isurus, Odontaspis,* &c., may possibly be represented by specifically unidentifiable material.

White Rock, Malvern Hills.

Notidanus marginalis Davis; *Odontaspis incurva* Davis sp. Specimens in Geological Survey collections; collector's name unknown. The record of *Lamna hectori* Davis (= *Scapanorhynchus rhaphiodon* Ag. sp.) in Hector's table (*loc. cit.*, opposite p. 120) is probably a mistake.

Curiosity Shop, Rakaia River.

Odontaspis incurva Davis sp. (loc. No. 311 and Cant. Mus.).
Odontaspis attenuata Davis sp. (Cant. Mus.).
Odontaspis contortidens Agassiz (Cant. Mus. and Geol. Surv.).
Odontaspis exigua Davis.
Lamna apiculata Agassiz sp. (Cant. Mus.).
Lamna bronni Agassiz (loc. No. 311).
Isurus desori Agassiz sp. (loc. No. 311 and Cant. Mus.).
Isurus retroflexus Agassiz sp. (Cant. Mus.).
Carcharodon auriculatus Blainville sp. (Cant. Mus.).
Pristiophorus lanceolatus Davis sp. (loc. No. 311).
Myliobatis sp. (loc. No. 311).

Davis also records *Myliobatis plicatilis* Davis.

McKay (1879) collected the specimens from loc. No. 311. The Canterbury Museum specimens were probably collected mainly by Sir Julius von Haast. Horizon: Oamaruian.

Kakahu, South Canterbury.

Mr. Chapman identifies *Carcharodon auriculatus* Blainville sp. (loc. No. 163, "greensands, lower coal-beds"); *Odontaspis* (?) sp. (loc. No. 164, "coal-beds"). Horizon: Ngaparan (?).

Davis also mentions *Oxyrhina lata* Davis = *Isurus hastalis* Agassiz sp.; *Trygon ensifer* Davis = (?); *Ischyodus brevirostris* Agassiz = *Ischyodus thurmanni* Pictet and Campiche.

The first-named specimen (Davis's holotype) is in the Otago Museum. The record of *Ischyodus brevirostris* appears to be an error.

Gorge Hill, Pareora, South Canterbury.

Mr. Chapman identifies *Odontaspis attenuata* Davis sp. (878, Cant. Mus.); *Odontaspis elegans* Agassiz sp. (868, Cant. Mus.); *Odontaspis incurva* Davis sp. (878, Cant. Mus.). Horizon: Oamaruian (Pareoran stage ?).

Waihao Forks, South Canterbury.

Carcharodon auriculatus Blainville sp. (837, Cant. Mus. and Plate I, fig. 5).

Waitaki Valley.

Odontaspis elegans Agassiz sp., Maerewhenua (Cant. Mus.); *Odontaspis incurva* Davis sp., Otekaieke (loc. No. 252), Maerewhenua limestone, and Maerewhenua Gold-diggings (loc. No. 177); *Carcharodon auriculatus* Blainville sp. (836, Cant. Mus. and Plate I, fig. 7).

Awamoko, Waitaki Valley.

Davis mentions the following two specimens from Awamoko: *Lamna huttoni* Davis = *Odontaspis elegans* Agassiz sp.; *Lamna* sp. (?), vertebra. The latter specimen is probably in the Otago Museum.

Oamaru District.

Notidanus primigenius Agassiz, Cave Valley, in Oamaru stone (864, Cant. Mus. and Plate VI, fig. 6); *Odontaspis elegans* Agassiz sp., Cave Valley (Cant. Mus. and Plate III, fig. 1), also in Oamaru stone (862, Cant. Mus.); *Odontaspis ensiculata* Davis sp. (889, Cant. Mus. and Plate III, fig. 6; also Geol. Surv. and Plate III, fig. 7). An unlabelled specimen of *Carcharodon megalodon* Agassiz may also come from the Oamaru district.

The collections sent to Mr. Chapman also included a specimen of *Odontaspis acuta* Davis from the Ototara or Oamaru stone, Oamaru. This was not renamed by him, but appears to be a young specimen of *Lamna bronni* Agassiz, as indicated by Mr. Chapman's revised list of names (p. 2).

Davis also records *Oxyrhina vonhaastii* Davis = *Isurus retroflexus* Agassiz sp. (Plate IV, fig. 1). This specimen is now in the Otago Museum.

Waitati (Blueskin), North of Port Chalmers.

Carcharodon auriculatus Blainville sp., Deep Creek (Cant. Mus. coll.).

Caversham, near Dunedin.

Carcharodon rondeletii Müller and Henle (Cant. Mus. and Plate VIII, fig. 1). There is some doubt concerning the locality of this specimen (see p. 20).

Waihola, about Twenty-four Miles South-west of Dunedin.

More or less fragmentary specimens, labelled "Waihola" and "Waihola Lake," were generically determined by Mr. Chapman as *Odontaspis* and *Lamna* spp. The material also includes a specimen labelled by Davis "*Trygon* spine, cf. *ensifer*."

Waihola Gorge (now called Milburn), between Waihola and Milton (Tokomairiro).

Lamna bronni Agassiz, in limestone, Milburn (Cant. Mus. and Plate VIII, fig. 3); *Isurus desori* Agassiz sp. labelled "Tokomairiro limestone," but the matrix is a brown sandstone; *Carcharodon auriculatus* Blainville sp. A specimen from the same locality (No. 40) as the last two specimens mentioned is labelled (probably by Davis) "(?) *Myliobatis* sp." The matrix is a brown sandstone similar to that of the *Isurus desori* specimen.

Kaitangata.

Some material from the Castle Hill shaft, Kaitangata, sent to Mr. Chapman contains *Odontaspis contortidens* Agassiz; *Odontaspis elegans* Agassiz sp.; *Odontaspis incurva* Davis sp.; *Lamna compressa* Agassiz; *Myliobatis* sp.; and also *Teredo directa* Hutton sp.*; Chelonian fragment (?). Loc. No. 759. Collector: Hector, 1891. Horizon: Wangaloan. Age: Eocene (?).

For list of Mollusca from the Wangaloa beds see H. Suter in P. Marshall, "Relations between Cretaceous and Tertiary Rocks," *Trans. N.Z. Inst.*, vol. 48, 1916, pp. 114–15; and P. Marshall, "The Wangaloa Beds," *Trans. N.Z. Inst.*, vol. 49, 1917, pp. 450–56. Many of the fossils named in the papers cited occur in the Castle Hill shaft collection made by Hector.

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* This species is considered by Suter to be identical with *Teredo heaphyi* Zittel. See *N.Z. Geol. Surv. Pal. Bull. 3*, 1915, p. 61.

TABLE OF CRETACEOUS AND TERTIARY FORMATIONS IN NEW ZEALAND.

Approximate Age.	General Classification.	North Island (South of Auckland).	North Canterbury and Marlborough.	South Canterbury and Otago.	Group and Stage Names.
Pliocene	Wanganui Series or System (Wanganuian)	Castlecliff beds .. .. Petane beds .. .. Waitotara beds	.. Greta and Motunau beds .. Awatere beds (part) ..	.. .. ..	Castlecliffian. Petanian. Waitotaran.
Miocene and (?) Oligocene	Oamaru Series or System (Oamaruian) ? Unconformity.	Waitemata beds .. Raglan limestone(¹), &c. .. Mercer (Leda) marl Waikato coal-measures	Awatere beds (part) .. Mount Brown beds, &c. ..	Pareora and Awamoa beds Hutchinson Quarry beds .. Ototara stone .. .. Waiareka beds .. .. Ngapara beds	Awamoan (Pareoran). Hutchinsonian. Ototaran. Waiarekan. Ngaparan.
Eocene	Mawheranui or Waimangaroa Series or System (Mawheranuian) ? Unconformity.	(?) Wheao Series (Gisborne)	(?) Grey marl .. .. Weka Pass stone ..	Hampden beds .. .. Wangaloa beds .. .. Kaitangata coal-measures	East Coast, South Island— Kaitangatan (includes Wangaloan stage). West Coast, South Island— Kaiatan. Islandian. Brunnerian. Paparoan.
Late Cretaceous ..	Waipara Series or System (Waiparan)	Mangatu Series (Gisborne)	Amuri limestone (Danian) Piripauan beds (Senonian)	Pukeiwitahi beds (including Shag Point coal-measures)	Piripauan (J. A. Thomson, 1917).
Middle Cretaceous(²)	Coverham, Waiautoa, or Clarence River Series (Albian or Cenomanian)	..	Coverham, Waiautoa, or Clarence River Series (Albian or Cenomanian)	..	Waiautoan or Clarentian (J. A. Thomson, 1917).
Early Cretaceous (Neocomian, &c.)	Port Waikato plant-beds .. (?) Kawhia Series (?) Awanui Series	Port Waikato plant-beds .. Kawhia Series Awanui Series	"Cannon-ball sandstone" at Amuri Bluff (?)	..	Kawhian, Awanuian.

(¹) The Raglan limestone may possibly be pre-Oamaruian.
(²) The threefold division of the Cretaceous is unusual, but is one that appears to suit New Zealand conditions. For an example and defence of its application in Europe see E. Haug, *Traité de Géologie,* **Deuxième Partie (1908-11)**, Fasc. ii, pp. 1165, 1169, &c.

INDEX I.

GENERA AND SPECIES.

Names of genera and species in Roman type are those described in the present bulletin. The principal page references to these are shown in heavy type. Names in italics represent synonyms, or species to which only passing reference is made in the text. The species mentioned or listed on pages 32–39 are not indexed.

INDEX II.

LOCALITIES, AUTHORS' NAMES, AND GENERAL.

(Names mentioned in the synonomy are not indexed.)

J.

K.

L.

M.

N.

O.

P.

Q.

R.

S.

T.

V.

W.

NOTE CONCERNING PLATES I–IX.

By P. G. Morgan.

Plates I–VII are reproduced from J. W. Davis's memoir "On Fossil Fish-remains from the Tertiary and Cretaceo-Tertiary Formations of New Zealand," *Sci. Trans. Roy. Dubl. Soc.*, ser. ii, vol. iv, 1888. The emended nomenclature given in the preceding pages is used in place of the original descriptions, which are also corrected as to locality, &c., as far as possible.

The specimens not examined on the present occasion consisted of six (including four types) in the Otago University Museum, four in the Natural History Department (British Museum), and the following nine specimens, which appear to have been lost:—

Plate III, fig. 2. *Scapanorhynchus rhaphiodon* (*Lamna incurva* of Davis), Kaikoura (Cant. Mus.).

Plate V, fig. 1. *Lamna bronni* (*Odontaspis acuta* of Davis), Curiosity Shop beds (Cant. Mus.).

Plate V, fig. 3. *Odontaspis exigua*, Castle Hill Station (ex coll. J. D. Enys, and possibly returned to him).

Plate VI, fig. 15. *Trygon ensifer*, Amuri limestone, Amuri Bluff (Geol. Surv.).

Plate VII, fig. 9. *Parasqualodon serratus* (*Squalodon serratus* of Davis), White Rock quarries (Cant. Mus.).

Plate VII, figs, 11, 12, 13. *Ischyodus thurmanni* (*Ischyodus brevirostris* of Davis), Amuri Bluff (Geol. Surv.).

Plate VII, fig. 15. *Callorhynchus hectori*, East Wing, Amuri Bluff (Geol. Surv.).

Plates VIII and IX are new plates, prepared under Mr. Chapman's direction.

Plate 1.

Figs. 1–3. *Carcharias (Prionodon) aculeatus* Davis sp.

1*a*, external aspect; 1*b*, internal aspect; 1*c*, lateral aspect. (Also 1*a* magnified 3 diameters.)

2*a*, external aspect, × 2; 2*b*, internal aspect, × 2.

3, small medio-lateral tooth, internal aspect, × 2.

Coleridge Gully. Ex coll. Canterbury Museum, Christchurch.

Figs. 4–7. *Carcharodon auriculatus* Blainville sp.

4, posterior tooth; 4*a*, external aspect; 4*b*, internal aspect; 4*c*, lateral aspect. Ex coll. Otago University Museum, Dunedin.

5, anterior tooth, internal aspect. Waihao Forks. Ex. coll. Canterbury Museum, Christchurch.

6, another specimen, internal aspect. Weka Pass. Ex coll. Canterbury Museum, Christchurch.

7, anterior tooth; 7*a*, external aspect; 7*b*, internal aspect; 7*c*, lateral aspect. Waitaki. Ex. coll Canterbury Museum, Christchurch.

(This fossil was Davis's type of *C. robustus*.)

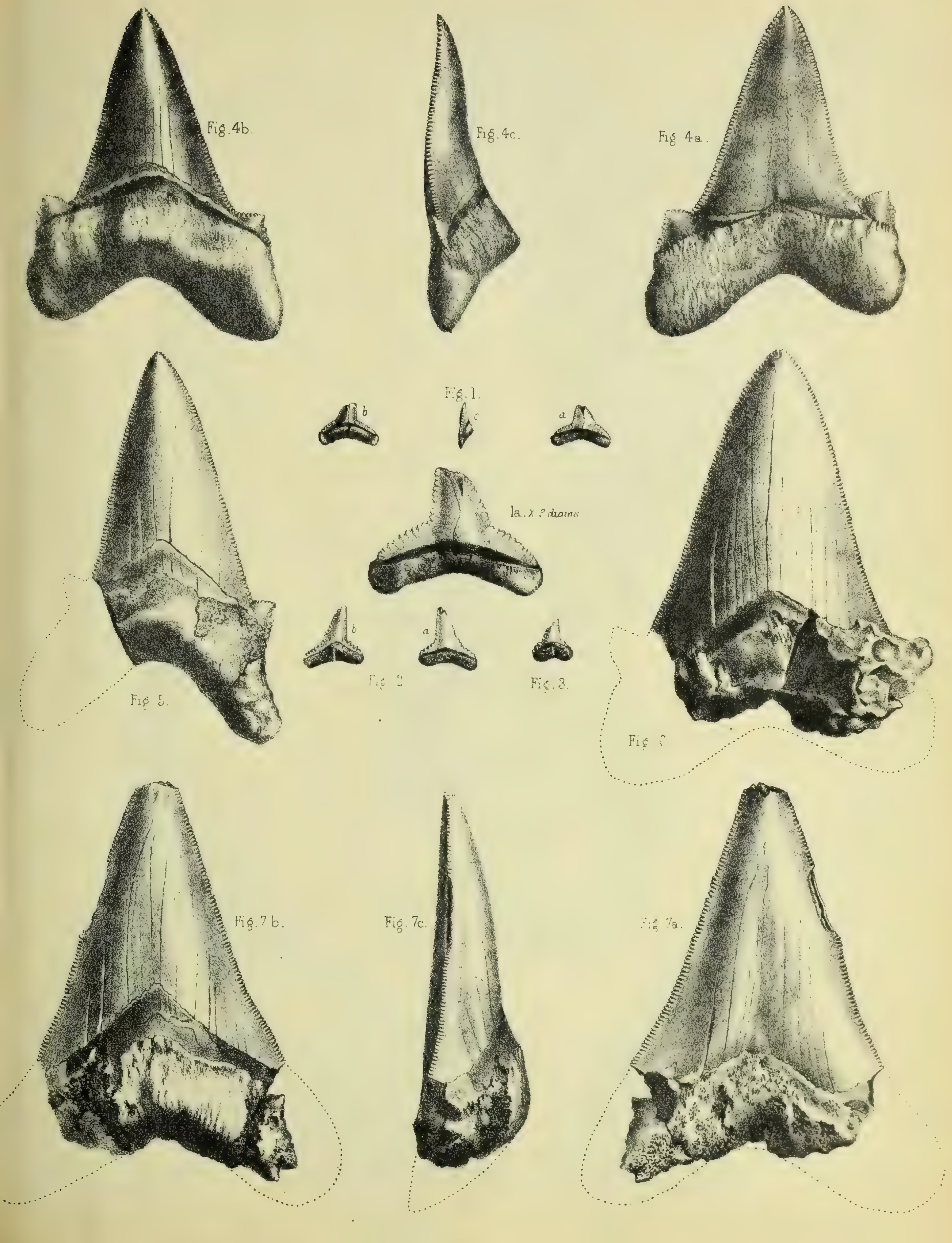
Fig. 4b.
Fig. 4c.
Fig 4a.
Fig. 1.
b
c
a
1a.
b
a
Fig. 3.
Fig 5.
Fig. 7b.
Fig. 7c.
Fig 7a.

Plate II.

Fig. 1. *Carcharodon megalodon* Agassiz.

1*a*, external aspect ; 1*b*, internal aspect ; 1*c*, lateral aspect. Cape Foulwind, Nelson. Ex coll. Geological Survey, Dominion Museum, Wellington.

Fig. 2 *Carcharodon megalodon* Agassiz.

2*a*, external aspect ; 2*b*, internal aspect ; 2*c*, lateral aspect. Weka Pass. Ex coll. Canterbury Museum, Christchurch.

Fig. 3. *Carcharodon megalodon* Agassiz.

Near Boby's Creek, Waipara. Ex coll. Geological Survey, Dominion Museum, Wellington.

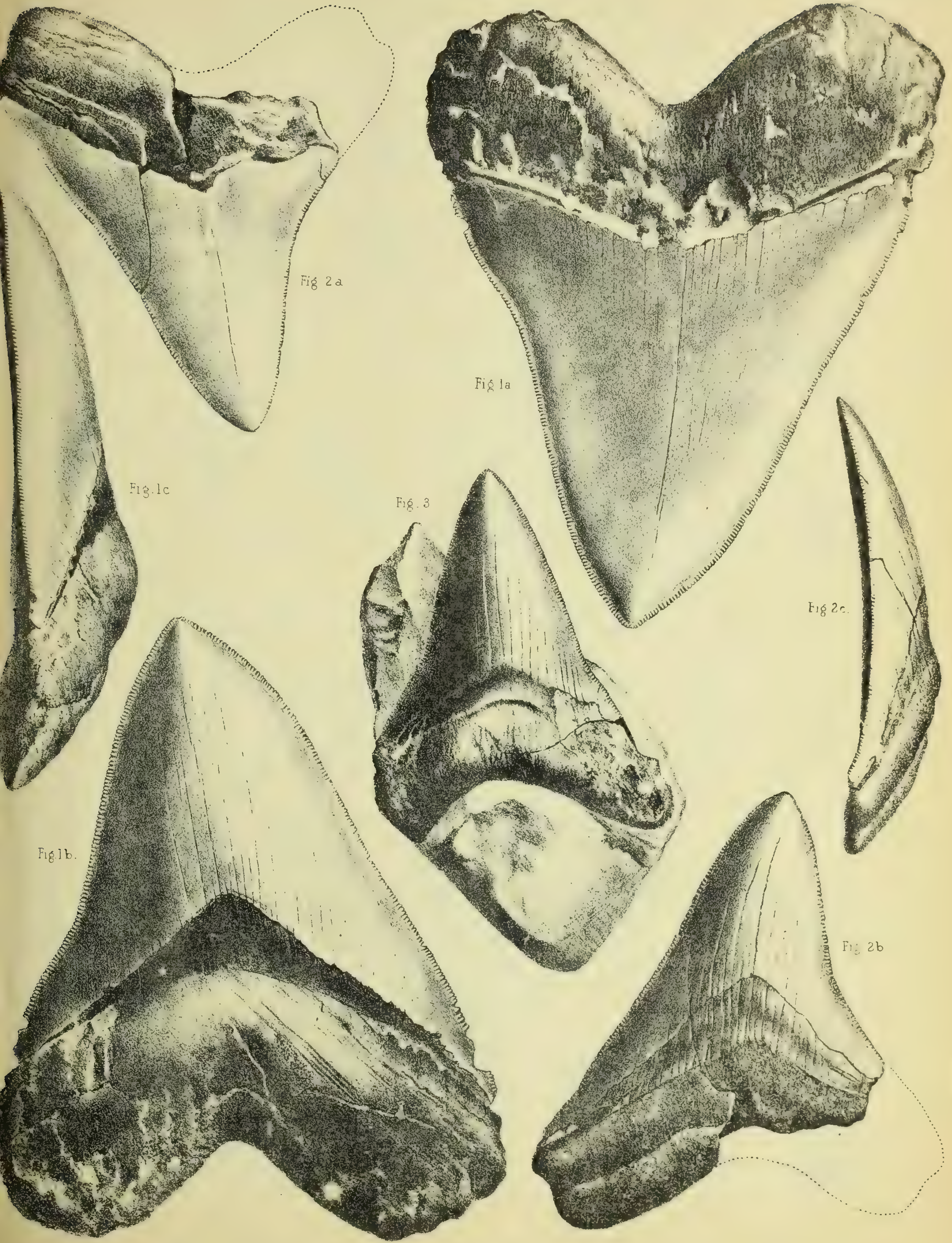
Fig 2a
Fig 1a
Fig. 1c
Fig. 3
Fig 2c.
Fig 1b.
Fig 2b

Plate III.

Fig. 1. *Odontaspis elegans* Agassiz sp.
1*a*, external aspect; 1*b*, internal aspect; 1*c*, lateral aspect. Cave Valley, Oamaru. Ex coll. Professor F. W. Hutton, Canterbury Museum, Christchurch.

Fig. 2. *Scapanorhynchus rhaphiodon* Agassiz sp.
2*a*, external aspect; 2*b*, internal aspect; 2*c*, lateral aspect. Kaikoura. Ex coll. Canterbury Museum, Christchurch.

Figs. 3–5. *Odontaspis incurva* Davis sp.
3, lateral aspect of a tooth. Coleridge Gully. Ex coll. Canterbury Museum, Christchurch.
4, lateral aspect of another specimen. Curiosity Shop beds. Ex coll. Canterbury Museum, Christchurch.
5, lateral aspect of another. Ex coll. Geological Survey, Dominion Museum, Wellington.

Figs. 6, 7. *Odontaspis ensiculata* Davis sp.
6, external aspect. Oamaru. Ex coll. Canterbury Museum, Christchurch.
7*a*, external aspect; 7*b*, internal aspect; 7*c*, lateral aspect. Oamaru. Ex coll. Geological Survey, Dominion Museum, Wellington.

Figs. 8, 9. *Lamna compressa* Agassiz.
8*a*, internal aspect; 8*b*, external aspect; 8*c*, lateral aspect. Broken River. Ex coll. Canterbury Museum, Christchurch.
9, internal aspect. Broken River. Ex coll. Canterbury Museum, Christchurch.

Fig. 10. *Lamna crassa* Agassiz sp.
10*a*, external aspect; 10*b*, internal aspect; 10*c*, lateral aspect. Amuri Bluff. Ex coll. Geological Survey, Dominion Museum, Wellington.

Fig. 11. *Odontaspis attenuata* Davis sp.
11*a*, external aspect; 11*b*, internal aspect; 11*c*, lateral aspect. (Magnified 3 diameters.) Coleridge Gully. Ex coll. Canterbury Museum, Christchurch.

Fig. 12. *Pristiophorus lanceolatus* Davis sp.
12*a*, lower surface; 12*b*, upper surface; 12*c*, edge view; 12*d*, base of tooth. Castle Hill Station, Canterbury. Ex coll. J. Davies Enys, Canterbury Museum, Christchurch.

Fig. 13. *Scapanorhynchus subulatus* Agassiz sp.
13*a*, external aspect; 13*b*, internal aspect; 13*c*, lateral aspect. Kaikoura Peninsula. Ex coll. H. J. Ingles, Otago University Museum, Dunedin.

Figs. 14, 15. (?) *Lamna* sp. Vertebræ.
Awamoko and Kaikoura. Ex coll. R. Gillies; T. J. Parker, Otago University Museum, Dunedin.

Fig. 16. *Scapanorhynchus rhaphiodon* Agassiz sp.
External aspect. West Wing, Amuri Bluff. Ex. coll. Geological Survey, Dominion Museum, Wellington.


Fig. 1
Fig. 3
Fig. 4
Fig. 8
Fig. 6
Fig. 10
Fig. 11 x 3
Fig 16.

Plate IV.

Figs. 1, 2. *Isurus retroflexus* Agassiz sp.

1, mass of detached teeth, probably belonging to one fish. Oamaru. Ex coll. Otago University Museum, Dunedin.

2, detached tooth; *a*, internal aspect; *b*, external aspect; *c*, lateral aspect. "Greensand conglomerate" (phosphatic layer) at base of Weka Pass stone, Amuri Bluff (loc. No. 275). Ex coll. Geological Survey, Dominion Museum, Wellington.

Fig. 3. (?) *Lamna crassa* Agassiz sp.

External aspect. "Amuri Series," Amuri Bluff. Ex coll. Geological Survey, Dominion Museum, Wellington. The specimen is embedded in a water-worn pebble.

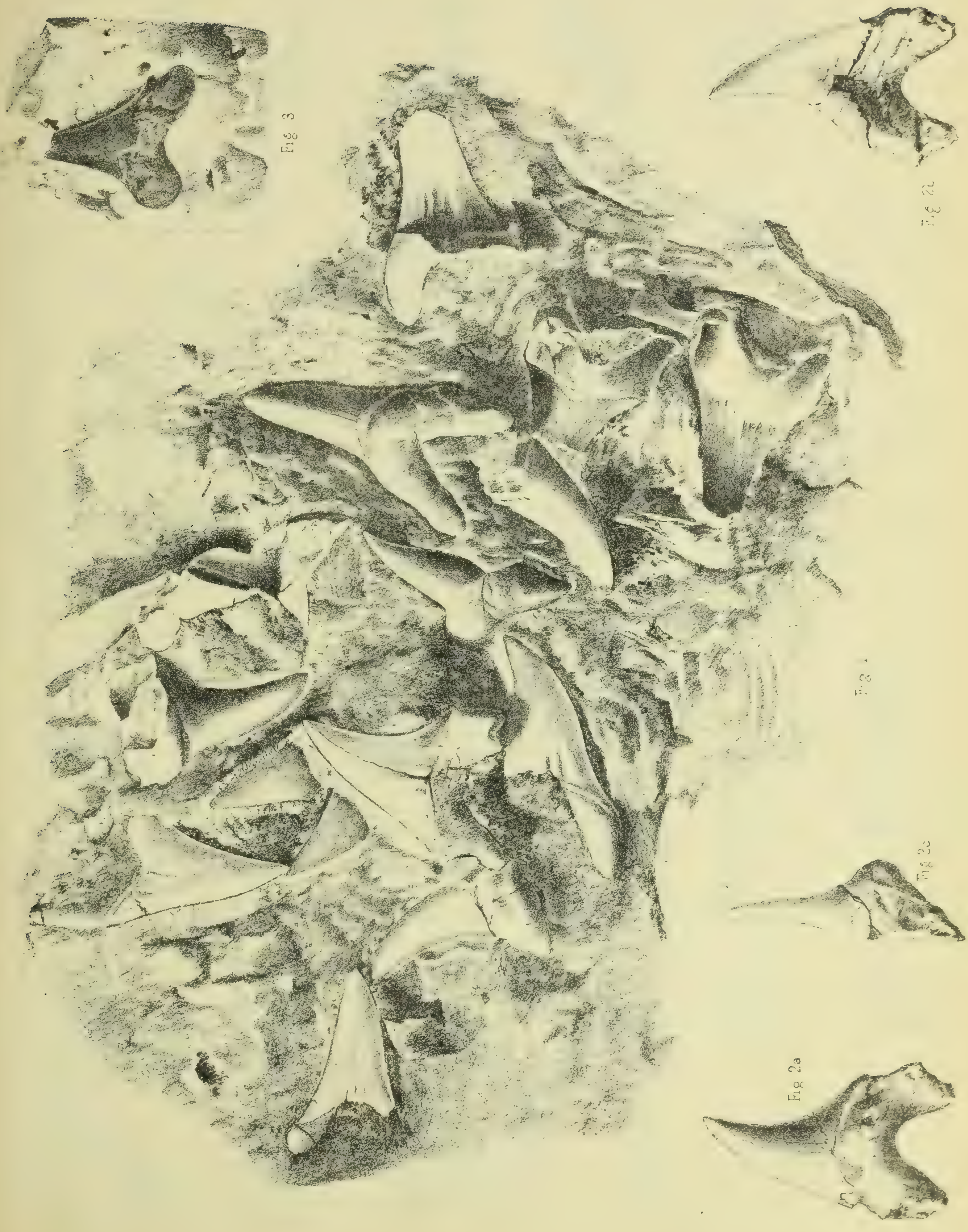
Fig 3
Fig 2b
Fig 1
Fig 2c
Fig 2a

Plate V.

Figs. 1, 2. *Lamna bronni* Agassiz.

1a, external aspect; *1b*, lateral aspect. Curiosity Shop beds. Ex coll. Canterbury Museum, Christchurch.

2a, external aspect; *2b*, internal aspect; *2c*, lateral aspect. Trelissick Basin, Canterbury. Ex coll. Geological Survey, Dominion Museum, Wellington.

Figs. 3–5. *Odontaspis exigua* Davis.

3a, external aspect; *3b*, lateral aspect. Castle Hill Station, Trelissick Basin, Canterbury. Ex coll. J. Davies Enys.

4, posterior tooth, and an enlargement of the same, magnified 2 diameters. Broken River. Ex coll. Canterbury Museum, Christchurch.

5, anterior tooth, and enlargement, magnified 2 diameters. Broken River. Ex coll. Canterbury Museum, Christchurch.

Figs 6–10. *Scapanorhynchus subulatus* Agassiz sp.

6a, internal aspect; *6b*, lateral aspect. Kaikoura. Ex coll. Canterbury Museum, Christchurch.

7–9, external aspects. East Wing, Amuri Bluff. Ex coll. Geological Survey, Dominion Museum, Wellington.

10, internal aspect. East Wing, Amuri Bluff. Ex coll. Geological Survey, Dominion Museum, Wellington.

Figs. 11, 13. *Synechodus sulcatus* Davis sp.

11, from dentition series II or III, anterior region of jaw; 13, from a more posterior series. Amuri Bluff. Ex coll. Geological Survey, Dominion Museum, Wellington.

Fig. 12. *Synechodus validus* sp. nov.

Anterior tooth. Amuri Bluff. Ex coll. Geological Survey, Dominion Museum, Wellington.

Fig. 14. *Isurus retroflexus* Agassiz sp.

14a, external aspect; *14b*, internal aspect; *14c*, lateral aspect. Castle Hill Station, Canterbury. Ex coll. J. Davies Enys, Canterbury Museum, Christchurch.

Figs. 15, 16. *Isurus desori* Agassiz sp.

15a, external aspect; *15b*, internal aspect; *15c*, lateral aspect.

16a, external aspect; *16b*, internal aspect; *16c*, lateral aspect.

Broken River. Ex coll. Canterbury Museum, Christchurch.

Figs. 17–20. *Lamna apiculata* Agassiz sp.

17a, external aspect; *17b*, internal aspect; *17c*, lateral aspect.

18, external aspect.

19 and 20, internal aspects.

Waipara. Ex coll. Canterbury Museum, Christchurch.

Fig. 21 *Isurus hastalis* Agassiz sp.

21a, external aspect; *21b*, internal aspect; *21c*, lateral aspect. Castle Hill Station, Canterbury. Ex coll. J. Davies Enys, Canterbury Museum, Christchurch.

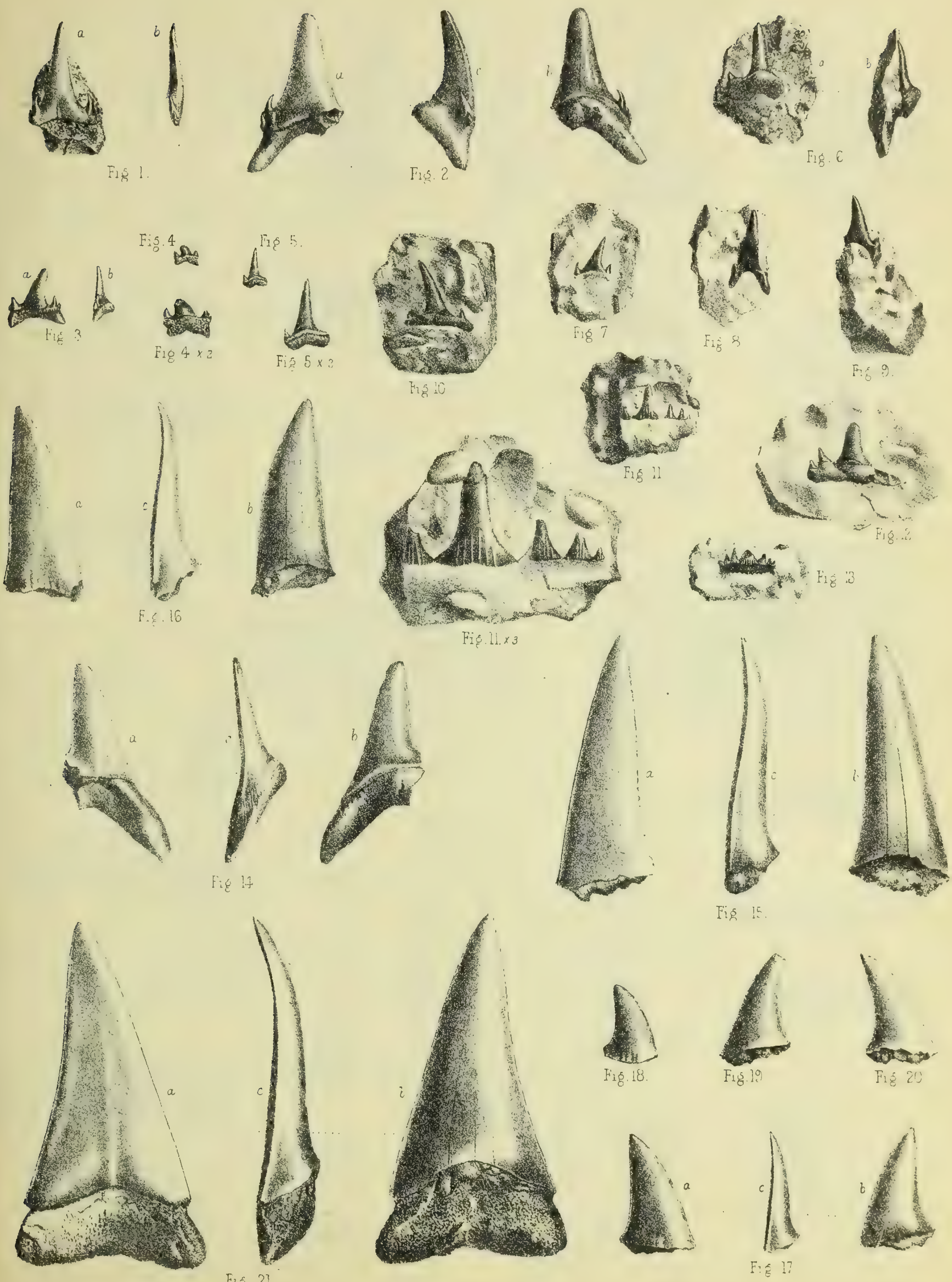
Fig 1.
Fig. 2
Fig. 6
Fig. 4
Fig 5.
Fig 3
Fig 4 x 2
Fig 5 x 3
Fig 10
Fig 7
Fig 8
Fig 9.
Fig 11
Fig. 12
Fig 13
Fig. 16
Fig. 11. x 3
Fig 14
Fig 15.
Fig. 18.
Fig. 19
Fig 20
Fig. 21.
Fig 17

Plate VI.

Figs. 1–3 *Isurus minutus* Agassiz sp.

1*a*, external aspect; 1*b*, internal aspect; 1*c*, lateral aspect.
2, anterior tooth, internal aspect.
3, posterior tooth, internal aspect.
Coleridge Gully, Trelissick Basin. Ex coll. Canterbury Museum, Christchurch.

Fig. 4 *Lamna apiculata* Agassiz sp.

4*a*, external aspect; 4*b*, internal aspect; 4*c*, lateral aspect. Oamaru. Ex coll. J. Davies Enys, Canterbury Museum, Christchurch.

Fig. 5 *Isurus hastalis* Agassiz sp.

External aspect. Kakahu River, South Canterbury. Ex coll. Professor T. J. Parker, Otago University Museum, Dunedin.

Fig. 6. *Notidanus primigenius* Agassiz.

From upper jaw. Cave Valley, Oamaru. Ex coll. Professor F. W. Hutton, Canterbury Museum, Christchurch.

Fig. 7. *Galeocerdo davisi* Chapman and Pritchard.

Holotype. 7*a*, internal aspect; 7*b*, external aspect; 7*c*, lateral aspect. Castle Hill Station. Ex coll. J. Davies Enys, Canterbury Museum, Christchurch.

Fig. 8. *Notidanus marginalis* Davis.

8*a*, external aspect; 8*b*, internal aspect; 8*c*, edge view. Castle Hill Station. Ex coll. J. Davies Enys, Canterbury Museum, Christchurch. This specimen has now to be regarded as the holotype of *N. marginalis*, the tooth (a cotype), represented by fig. 7, having been taken as the holotype of *Galeocerdo davisi* Chapman and Pritchard.

Figs. 9–12. *Notidanus dentatus* A. S. Woodward.

9, tooth from upper jaw; 10, tooth from lower jaw. Amuri Bluff. Ex coll. Geological Department, Natural History Museum, South Kensington..
11, 12, teeth of lower jaw. Amuri Bluff. Ex coll. Geological Survey, Dominion Museum, Wellington.

Fig. 13. *Labrodon depressus* Chapman and Pritchard.

a and *b*, enlarged surface of pavement teeth; × 3. Coleridge Gully, Trelissick Basin. Ex coll. Canterbury Museum, Christchurch.

Figs. 14, 15. *Trygon ensifer* Davis.

14, spine and enlarged figure; × 3. Waipara. Ex coll. Canterbury Museum, Christchurch.
15, spine and enlarged figure; × 3. Amuri limestone, Amuri Bluff. Ex coll. Geological Survey, Dominion Museum, Wellington.

Figs. 16–19. *Myliobatis plicatilis* Davis.

16*a*, upper surface; 16*b*, lower surface; 16*c*, edge view.
17, upper surface. Castle Hill Station. Ex coll. J. Davies Enys.
18, 19, *a*, upper surface; *b*, lower surface; *c*, edge view. Broken River, Trelissick Basin. Ex coll. Canterbury Museum, Christchurch.

Figs. 20, 21. *Myliobatis arcuatus* Davis.

20*a*, upper surface, 20*b*, lower surface; 20*c*, edge view. Broken River, Trelissick Basin. Ex coll. Canterbury Museum, Christchurch.
21, upper surface. Castle Hill Station. Ex coll. J. Davies Enys, Canterbury Museum, Christchurch.

Fig. 22. *Carcharodon rondeletii* Müller and Henle.

Posterior lateral tooth. Napier Series. Esk River, Hawke's Bay. Ex coll. Geological Survey, Dominion Museum, Wellington.

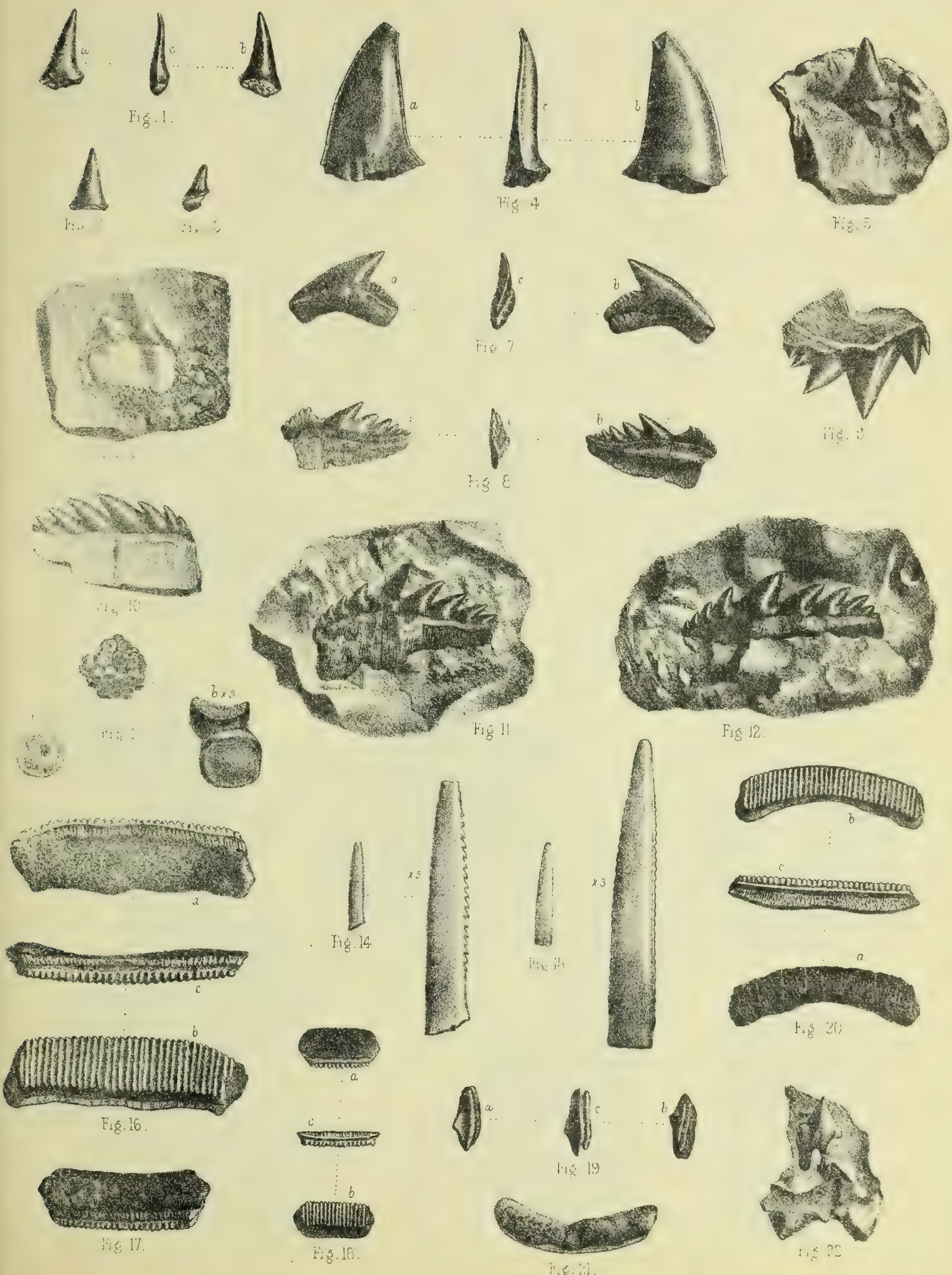
Fig. 1.
Fig. 4
Fig. 5
Fig. 7
Fig. 8
Fig 11
Fig 12.
Fig. 14
Fig. 16.
Fig. 17.
Fig. 18.
Fig. 19
Fig. 20

Plate VII.

Figs. 1, 2. *Myliobatis altus* Davis.

1*a*, upper surface ; 1*b*, lower surface ; 1*c*, side view.

2, median part of another tooth.

Broken River, Trelissick Basin. Ex coll. Canterbury Museum, Christchurch.

Figs. 3–7. *Sargus laticonus* Davis.

Anterior cutting-teeth. Coleridge Gully. Ex coll. Canterbury Museum, Christchurch.

Fig. 8. *Cestracion novo-zelandicus* sp. nov.

Mid-lateral tooth. 8*a*, upper surface ; 8*b*, lower surface ; 8*c*, edge view. Coleridge Gully. Ex coll. Canterbury Museum, Christchurch.

Fig. 9. *Parasqualodon serratus* Davis sp.

Molar tooth. Oamaru Series. White Rock River Quarry, Okuku River, Ashley County, Canterbury. Ex coll. Canterbury Museum, Christchurch.

(N.B.—This is a cetacean tooth of the Odontocetian type, belonging to the family Squalodontidæ. It falls into Hall's genus ***Parasqualodon***, but appears to differ from *P. wilkinsoni* McCoy sp. in having more pronounced denticles. It may belong to the same species as ***P. harwoodi*** Sanger sp., from the Miocene of South Australia, as was suggested by Dr. T. S. Hall (*Proc. Roy. Soc. Vict.*, vol. xxiii (n.s.), pt. ii, 1911, p. 258).

Fig. 10. *Ischyodus thurmanni* Pictet and Campiche.

Right mandibular tooth. Amuri Bluff. Ex coll. Geological Survey, Dominion Museum, Wellington.

Figs. 11–13. *Ischyodus thurmanni* Pictet and Campiche.

11 and 12, under surface of jaw ; 13, upper surface of jaw. Amuri Bluff. Ex coll. Geological Survey, Dominion Museum, Wellington.

Fig. 14. *Callorhynchus hectori* Newton.

Right hinder upper tooth. Amuri Bluff. Ex coll. Geological Department, Natural History Museum, South Kensington.

Fig. 15. *Callorhynchus hectori* Newton.

Upper and under surface of jaw. East Wing, Amuri Bluff. Ex coll. Geological Survey, Dominion Museum, Wellington.

Fig. 16. *Lamna crassa* Agassiz sp.

Internal aspect. Ex coll. Geological Survey, Dominion Museum, Wellington.

Fig 1

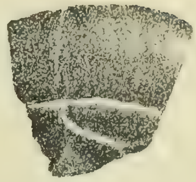

Fig 2

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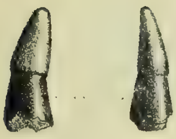

Fig 4

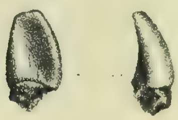

Fig 5

Fig 6.

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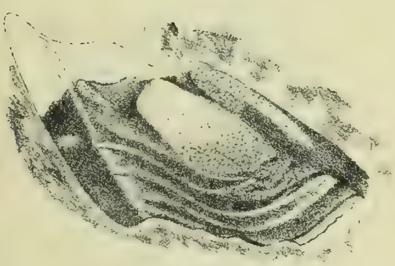
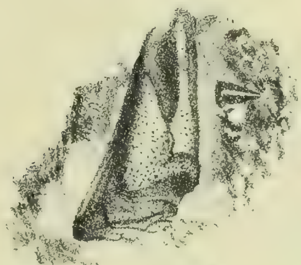


Fig. 10.



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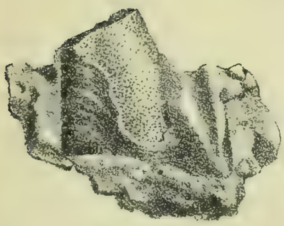

Fig. 13.

Fig 12

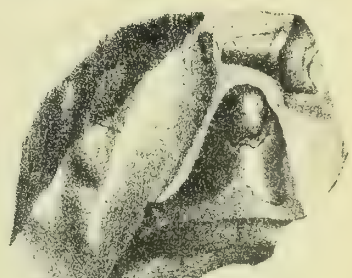

Fig 16

Fig. 11.

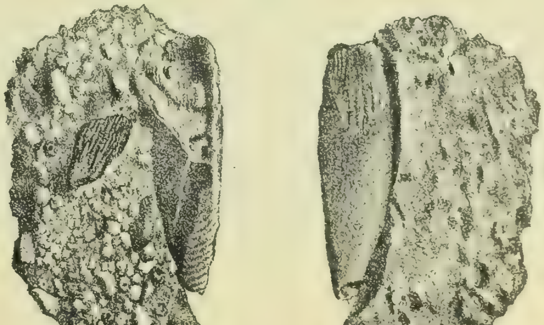

Fig 15

PLATE VIII.

Fig. 1. *Carcharodon rondeletii* Müller and Henle.
External aspect. ? Caversham. Ex. coll. Canterbury Museum, Christchurch.

Fig. 2. *Carcharodon rondeletii* Müller and Henle.
Internal aspect. Greta beds, Awatere Series. Ex coll. Canterbury Museum, Christchurch.

Fig. 3. *Lamna bronni* Agassiz.
External aspect. Milburn, Otago. Ex coll. Canterbury Museum, Christchurch.

Fig. 4. *Diplomystus coverhamensis* sp. nov.
A nearly complete fish in a concretionary nodule. Holotype. A quarter of a mile above whare, Cover Creek, Coverham, Clarence Valley, Marlborough. Ex coll. Geological Survey, Dominion Museum, Wellington.

Fig. 5. Scales of fish probably allied to *Thrissopater*.
Sawpit Gully, about 150 ft. below flints (left-hand figure from Amuri Bluff). Ex coll. Geological Survey, Dominion Museum, Wellington.

Fig. 6. *Scombroclupea* cf. *macrophthalma* Heckel sp.
Anterior portion of fish in chalky greensand. Weka Pass, Waipara district. Ex coll. Geological Survey, Dominion Museum, Wellington.

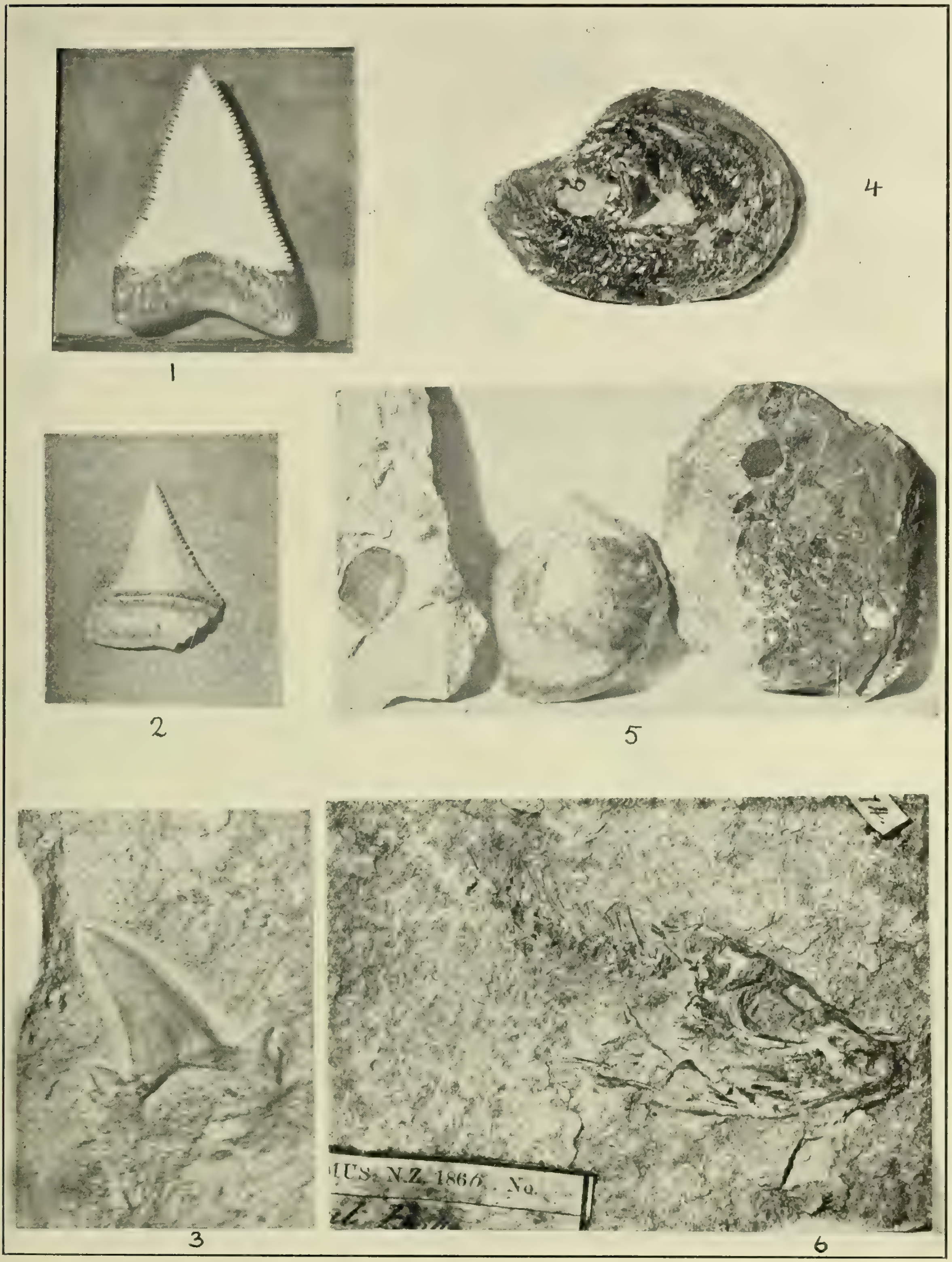
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Plate IX.

Fig. 1. *Notidanus* cf. *marginalis* Davis.
Tertiary; Awatere Series. Mohaka Crossing, Napier–Taupo Road. × 4½ Ex coll. Geological Survey, Dominion Museum, Wellington.

Fig. 2. *Synechodus validus* sp. nov.
Inner aspect of tooth. Holotype. From Belemnite beds, East Wing, Amuri Bluff. Specimen refigured (see also Plate V, fig. 12). × 2. Ex coll. Geological Survey, Dominion Museum, Wellington.

Fig. 3. *Cestracion coleridgensis* sp. nov.
Holotype. *a*, upper surface; *b*, edge view. Tertiary. Broken River, Trelissick Basin. × 2. Ex col'. Canterbury Museum, Christchurch.

Fig. 4. *Cestracion novo-zelandicus* sp. nov.
Holotype. *a*, upper surface; *b*, edge view. Tertiary. Broken River, Trelissick Basin. × 2. Ex coll. Canterbury Museum, Christchurch.

Fig. 5. *Cestracion novo-zelandicus* sp. nov.
Paratype. *a*, upper surface; *b*, edge view. Broken River, Trelissick Basin. × 2. Ex coll. Canterbury Museum, Christchurch.

Fig. 6. *Lamna compressa* Agassiz.
a, outer aspect of tooth; *b*, inner aspect. Tertiary. Coleridge Gully. × 2. Ex coll. Geological Survey, Dominion Museum, Wellington.

Fig. 7. *Lamna compressa* Agassiz sp.
Inner aspect of tooth. Tertiary. Coleridge Gully. × 2. Ex coll. Geological Survey, Dominion Museum, Wellington.

Fig. 8. *Pristiophorus lanceolatus* Davis sp.
Tertiary. Curiosity Shop beds, Canterbury. × 2. Ex coll. Geological Survey, Dominion Museum, Wellington.

Fig. 9. *Pristiophorus napierensis* sp. nov.
Rostral tooth. Cotype. *a*, upper surface; *b*, edge view. Tertiary. Limestone beds, Napier. × 2. Ex coll. Canterbury Museum, Christchurch.

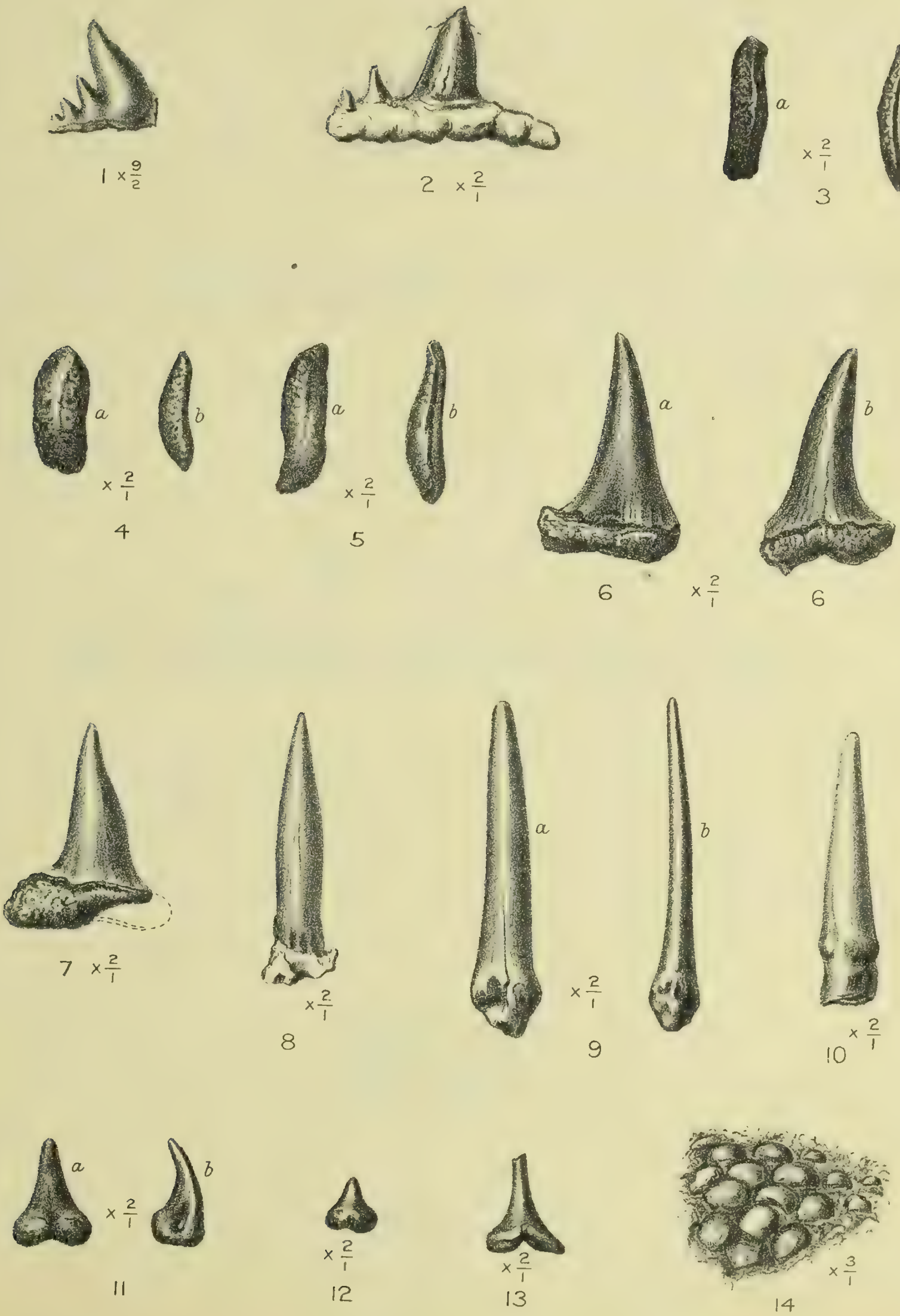
Fig. 10. *Pristiophorus napierensis* sp. nov.
Rostral tooth. Lower surface. Tertiary. Limestone beds, Napier. × 2. Ex coll. Canterbury Museum, Christchurch.

Fig. 11. *Pristiophorus napierensis* sp. nov.
Oral tooth, anterior series. Cotype. *a*, inner aspect; *b*, edge view. Tertiary. Limestone beds, Napier. × 2. Ex coll. Canterbury Museum, Christchurch.

Fig. 12. *Pristiophorus napierensis* sp. nov.
Oral tooth from posterior series, inner aspect. Tertiary. Limestone beds, Napier. × 2. Ex coll. Canterbury Museum, Christchurch.

Fig. 13. *Pristiophorus napierensis* sp. nov.
Oral tooth, anterior series, inner aspect. Tertiary. Limestone beds, Napier. × 2. Ex coll. Canterbury Museum, Christchurch.

Fig. 14. *Labrodon confertidens* Chapman and Pritchard.
Pharyngeal teeth. Tertiary. Broken River, Trelissick Basin. × 3. Ex coll. Geological Survey, Dominion Museum, Wellington.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NEW ZEALAND.

Department of Mines.

GEOLOGICAL SURVEY BRANCH.

(P. G. MORGAN, Director.)

PALÆONTOLOGICAL BULLETIN No. 8.

LISTS OF NEW ZEALAND TERTIARY MOLLUSCA

FROM VARIOUS LOCALITIES EXAMINED AND NAMED FROM 1913 TO THE END OF 1917.

(A FEW EMENDED LISTS, PREVIOUSLY PUBLISHED ELSEWHERE, ARE ADDED.)

BY

HENRY SUTER.

WITH NOTES AND A REVIEW OF RESULTS, ETC.,

BY

P. G. MORGAN.

ISSUED UNDER THE AUTHORITY OF THE HON. G. J. ANDERSON, MINISTER OF MINES.

WELLINGTON.
BY AUTHORITY: MARCUS F. MARKS, GOVERNMENT PRINTER.

1921.

LETTER OF TRANSMITTAL.

Geological Survey Office,
Wellington, 3rd May, 1921.

Sir,—

I have the honour to transmit herewith Palæontological Bulletin No. 8, entitled "Lists of New Zealand Tertiary Mollusca . . . with Notes and a Review of Results, &c." These lists were compiled by the late Mr. Henry Suter, Consulting Palæontologist to the Geological Survey, and were transmitted by him to the Geological Survey shortly before his death in 1918. I have added various notes and have written the final chapter. Mr. J. Marwick, Assistant Geologist, has helped in reading the proofs.

The Bulletin contains 107 pages of letterpress, and two maps showing fossil localities, &c., in the North and South Islands respectively. Although the information given is necessarily of such a nature as not to appeal to the general public, its circulation among scientific workers is desirable in order to advance our knowledge of the geology of New Zealand. It is perhaps not necessary to point out that the science of geology is as yet only in its infancy, and that every addition to the sum of his knowledge will aid the economic geologist in the solution of those problems connected with mineral deposits which are by universal consent assigned to him. Among these problems may here be mentioned the discovery of new coalfields and, possibly, of oilfields. Both these objects are of the highest importance, and both will be greatly assisted by a full knowledge of our Tertiary fossils.

I have the honour to be,
Sir,
Your obedient servant,
P. G. MORGAN,
Director, New Zealand Geological Survey.

The Hon. G. J. Anderson,
Minister of Mines, Wellington.

PREFACE.

The great collections of fossils from all parts of New Zealand made during the earlier years of the New Zealand Geological Survey attest the importance attached by Sir James Hector, the first Director, to palæontological research. Unfortunately, he was prevented from carrying to completion his plans for preparing and publishing a number of palæontological reports. Had this been done not only would our general knowledge of the geology of this country have been much advanced, but those economic researches towards which the attention of the Geological Survey has been rightly, but too exclusively, directed would have been greatly benefited. Prior to 1911, however, except for the early labours of the late Captain F. W. Hutton, very little had been done towards the classification and description of the fossil collections, notwithstanding the urgent need for this work, as was emphatically pointed out in 1904 by the Australasian Association for the Advancement of Science, and by the late Mr. Augustus Hamilton, at that time Director of the Dominion Museum.*

In 1911, with the appointment of Dr. J. A. Thomson (now Director of the Dominion Museum) as Palæontologist to the Geological Survey, a period of progress began, and the present bulletin is the eighth of a series dealing with the fossil collections. In 1913 the late Mr. Henry Suter, the author of that monumental work the *Manual of the New Zealand Mollusca,* was engaged as Consulting Palæontologist, and during the next five years, except for two periods of six months each, was employed wholly on work connected with Tertiary Mollusca. Having examined Hutton's types (so far as these were available) and revised his descriptions (*Palæontological Bulletins Nos. 2 and 3*), Mr. Suter took in hand the identification of the Tertiary Mollusca in the Geological Survey collections. For this work, on account of his unrivalled knowledge of the Recent New Zealand Mollusca, he was well equipped; and as the result of his labours many thousand determinations were made, and a large number of new species distinguished. Not quite two-thirds of the latter are described in *Palæontological Bulletin No. 5*. The present bulletin contains lists of most of the identifications made prior to the end of 1917, but those made during 1918 will be published elsewhere.

One cannot too strongly emphasize the value of the spade-work done by Mr. Suter in the almost uncultivated field assigned to him. Even where some work had been done in that field it had, one might say, almost reverted to its original state; so that in most respects Mr. Suter's work was that of a pioneer, preparing the ground for his successors, and some of the refinements of modern palæontology had necessarily to be dispensed with. Thus an inspection of the suites of specimens determined by him shows that wide limits were given to most of the species, many of which therefore correspond to the "aggregate species" of the botanist. Mr. Suter's familiar acquaintance with the Recent Mollusca no doubt led to many fossils which closely resemble living species being identified with those species, but in a number of cases close examination of well-preserved suites will certainly show that varietal and even specific differences exist. Thus, until the aggregate species are split up and the finest possible distinctions made, close zoning of the New Zealand Tertiary strata cannot be expected; but, as stated on page 98, broad divisions can now be made with

* See *Trans. N.Z. Inst.*, vol. 42, 1910, pp. 52–54. It should be observed that, as stated by Mr. Hamilton, the late Mr. Alexander McKay spent some years from 1904 onwards in re-sorting, relabelling, and cataloguing the mineral and fossil collections of the Geological Survey, a work which has greatly facilitated their description.

a considerable degree of confidence, very largely as the result of Mr. Suter's work. No doubt, too, the percentages of Recent species in the lists now published will be reduced by future workers. This statement applies especially to the pre-Awamoan faunas.

Although the contention of most latter-day biologists that a species ought to be defined as narrowly as possible is a sound one, yet in the early stages of palæontological research one may best proceed on a somewhat different principle. The geological survey of a new country requires a rapid, if imperfect, clearing of the palæontological ground, so that the field-geologist, wherever he goes, may not have to depend for his correlations wholly on stratigraphical and lithological considerations. As geological survey advances, the need for refinement in palæontological methods becomes ever and ever greater. Largely on account of Mr. Suter's work the time has arrived when narrow definitions and exact identifications of fossil species are necessary. Of even greater importance is the collection of large fossil suites from well-defined stratigraphical horizons, a work in which the field-geologist may well be expected to take the greater part. There is room, however, for many workers other than the officers of the official Geological Survey. The present publication, it is believed, will be of material assistance to all these in indicating numerous places where fossils may be found, and the fauna that may be expected to occur. So far as can be foreseen, it will not be necessary in the near future to publish such extensive fossil lists as those given in this bulletin. It is intended, however, whenever important fossil collections have been examined and the determinations cannot conveniently be published in one of the ordinary geological bulletins of the Geological Survey, to make copies of the lists, which will be communicated, on request, to those who are actively engaged in research connected with the geology of New Zealand.

P. G. MORGAN.

CONTENTS.

LISTS

OF

NEW ZEALAND TERTIARY MOLLUSCA.

INTRODUCTORY NOTE.

During the past few years many thousand specimens of Tertiary Mollusca have been identified by the late Mr. Suter, and the need for publishing the results in a form convenient for reference has become increasingly apparent. Accordingly Mr. Suter, in 1918, shortly before his death, prepared the following lists, with the names arranged alphabetically, and the localities in approximate order from north to south. An asterisk prefixed to the name of the species indicates that it is also found Recent. The writer of this note, except in the case of the Oamaru fossils collected by Professor Park and Mr. G. H. Uttley, and of some of Dr. J. A. Thomson's collections, has added the supposed age of the fossils, and as a rule the horizon or formation from which they were collected. In many cases additional remarks, some of them from the late Mr. Alex. McKay's manuscript lists of localities, of which two are in existence, together with references to the literature, are also given. Some of the lists have been previously published, but in a few instances with slight alterations or additions not made by Mr. Suter. The various lists are now all brought together, and published in the same form as supplied by Mr. Suter in July, 1918, except that some of the headings are modified so as to define the localities more exactly, or to bring them into accordance with McKay's manuscript lists. In one case (Loc. No. 637)† a brachiopod named by Dr. Thomson has been added by the writer to the list. There are also two lists in which Mr. Suter has named a brachiopod.‡ Any other alterations or additions are of a trifling nature. Mr. Suter's carefully compiled lists are almost free from slips of the pen, and hardly a letter had to be changed.

In many cases only one or two isolated specimens from a large or fairly large collection have been identified by Mr. Suter. Most of these came either from the Dominion Museum show-cases, or from the collection of pectens sent to Professor Ralph Tate, of Adelaide, many years ago, and

† See p. 34. ‡ Pohokura tunnel collection, p. 24; Oaro Creek, p. 33.

returned only within the last few years through the good offices of the Rev. W. Howchin, F.G.S. Again, some fairly large collections have been dispersed, and others consist mainly of poor material.

The fossils identified by Mr. Suter during the first half of 1918 were mostly comprised in recent collections from the North Taranaki and South-west Auckland districts. Lists of these will be published in forthcoming bulletins dealing with the geology of the areas in which the collections were made.

Most of the fossils identified by Mr. Suter have either been packed away again or at the time of writing had not been unpacked, and hence have not been seen by the writer or other members of the Geological Survey staff. For this reason, and for others that need not be mentioned, the writer has not always been able to give as much additional information concerning the collections as is desirable.

During the period of Mr. Suter's engagement with the Geological Survey, collections were submitted to him for identification by Dr. J. A. Thomson, Dr. P. Marshall, Messrs. M. C. Gudex, A. Purchas, and J. A. Bartrum, the understanding being that lists of identifications and topotypes of new species (when possible) were to be supplied to the Geological Survey. Some of these lists, as indicated above, have been previously published, but were included by Mr. Suter in his manuscript, and for the sake of convenient reference are now reprinted. The various changes in nomenclature that will be observed were, of course, made by Mr. Suter, and represent his final views.

P. G. Morgan.

CHAPTER 1

NORTH ISLAND.

Hokianga South Head : Orbitolite Limestone. Geol. Surv. Loc. 733. McKay; 1888.

Ancilla (Alocospira) papillata (Tate).
Architectonica n. sp.
**Argobuccinum australasia* (Perry). New as a fossil.
Cardium aff. *spatiosum* Hutt.
Corbula kaiparaensis Sut.
**Crepidula monoxyla* (Less.).
Leda semiteres Hutt.
Lima aff. *huttoni* Sut. (*non* Woods).†
**Murex octogonus espinosus* Hutt.
Pecten (Pallium) polymorphoides Zitt.
**Placunanomia zelandica* (Gray).
Polinices (Neverita) huttoni Iher.
Turritella (Torcula) semiconcava Sut.

Thirteen species, of which four also Recent = 31 per cent.

Age: Miocene (McKay). McKay in MS. assigned this collection, which originally contained 67 specimens, to the Awatere Series. He states that "the peculiar fossil of this locality" (the "*Orbitoides*" = *Miogypsina* probably) "is found also at Kawakawa immediately above the shell-bed forming in places the roof of the coal. The Hokianga beds, however, must be of a different age." See *Rep. of Geol. Explor. during 1887–88*, No. 19, 1888, p. 50, and *Rep. of Geol. Explor. during 1885*, No. 17, 1886, p. 166. See also references quoted under next list.

Pakaurangi Point, Kaipara Harbour : Grey Mudstone. Dr. P. Marshall, up to 1917 (Mr. J. A. Bartrum assisted Dr. Marshall in making collections in 1912 and in 1916).

**Acteon craticulatus* Murd. & Sut. New as a fossil.
,, *ovalis* (Hutt.).
Alectrion socialis (Hutt.).
Ampullina (Megatylotus) suturalis (Hutt.).
**Ancilla (Baryspira) australis* (Sow.).
,, *(Alocospira) papillata* (Tate).
,, n. sp.
,, n. sp.
Anomia n. sp.
**Arca novæ-zealandiæ* E. A. Smith.
,, *subvelata* Sut.
Architectonica n. sp.
Astræa subfimbriata Sut.
Bathytoma haasti (Hutt.).
,, *sulcata excavata* Sut.
Borsonia (Cordieria) n. sp.
**Cadulus delicatulus* Sut. New as a fossil.
Calliostoma n. sp.
**Cardita calyculata* (L.).
,, *(Glans)* n. sp.
Cerithiella fidicula Sut.
Chama huttoni Hect.
Chione meridionalis (Sow.).
Cominella carinata (Hutt.).
Conus armoricus Sut.
,, n. sp.
,, n. sp.
,, n. sp.
Coptochetus n. sp. Genus new to fauna.
Corbula canaliculata Hutt.
,, *kaiparaensis* Sut.
* ,, *macilenta* Hutt.
,, n. sp.
Crenilabium n. sp. Genus new to fauna.
Crepidula gregaria Sow.
**Crossea labiata* T.-Woods. New as a fossil.
Cucullæa australis (Hutt.).
Cylichnella enysi (Hutt.).
Cymatium minimum (Hutt.).
Cytherea chariessa Sut.
**Dentalium ecostatum* T. W. Kirk.
,, *pareorense* Pils. & Sharp.
,, *solidum* Hutt.‡
Dentilucina n. sp. Genus new to fauna.
Dolicholatirus n. sp. Genus new to fauna.
**Dosinia greyi* Zitt.
,, n. sp.
Drillia awamoaensis (Hutt.).
,, *imperfecta* Sut.

† Under date of 18th June, 1918, Mr. Henry Suter wrote: "The name *Lima huttoni* H. Woods, *N.Z. Geol. Surv. Pal. Bull. No. 4*, 1917, p. 27, is preoccupied by *Lima huttoni* Suter, *N.Z. Geol. Surv. Pal. Bull. No. 2*, 1914, p. 45, and I now propose the name of *Lima (Limatula) woodsi* for the former species."

‡ There is also a *Dentalium solidum* Verrill, but at the time of writing it is not known whether Hutton's or Verrill's name has priority. Hutton's name dates from 1873.

Drillia n. sp.
**Emarginula striatula* Q. & G
Fusinus kaiparaensis Sut.
,, *morgani* Sut.
,, n. sp.
Galeodea muricata (Hect.).
,, *senex* (Hutt.).
,, *sulcata* (Hutt.).
Glycymeris subglobosa Sut.
Heliacus n. sp.
**Leda fastidiosa* A. Ad.
,, *semiteres* Hutt.
Leucosyrinx alta transenna (Sut.).
Lima colorata Hutt.
Macrocallista assimilis (?) (Hutt.).
,, *pareoraensis* Sut.
**Mangilia dictyota* (Hutt.).
,, n. sp.
Marginella (Eratoidea) conica Harris.
,, ,, *harrisi* Cossm.
Miomelon corrugata (Hutt.).
,, n. sp.
,, n. sp.
,, n. sp.
Mitrella n. sp.
**Murex angasi* (Crosse).
* ,, *zelandicus* Q. & G.
,, ,, *komiticus* Sut.
Mytilus n. sp.
**Natica zelandica* Q. & G.
Ostrea (s. str.) *wuellerstorfi* Zitt.
**Panope zelandica* Q. & G.
Paphia curta (Hutt.).
Pecten (Chlamys) aldingensis Tate.
Pecten (Pallium) burnetti Zitt.
,, *(Chlamys) chathamensis* Hutt.
,, n. sp.
,, n. sp.
,, n. sp.
,, n. sp.
Polinices gibbosus (Hutt.).
**Protocardia (Nemocardium) pulchella* (Gray).
Ptychatractus pukeuriensis Sut.
,, *tenuiliratus* (?) Sut.
**Sarepta obolella* (Tate).
Siphonalia n. sp.
Solariella stoliczkai (Zitt.).
Spondylus n. sp. Genus new to fauna.
Struthiolaria cincta Hutt.
Surcula climacota Sut.
,, *fusiformis* (Hutt.).
,, n. sp.
,, n. sp.
,, n. sp.
,, n. sp.
**Tellina eugonia* Sut.
* ,, *glabrella* Desh.
,, *(Arcopagia)* n. sp.
Terebra orycta Sut.
**Thyasira flexuosa* (Mont.).
**Trivia avellanoides* (McCoy).
Turbo aff. *etheridgei* T.-Woods.
Turris n. sp.
,, n. sp.
Turritella (Torcula) semiconcava Sut.
Vaginella n. sp.
Venericardia subintermedia Sut.

One hundred and sixteen species, of which twenty-two also Recent = 19 per cent.

Age: Miocene. *Horizon:* Probably above supposed unconformity.

References: P. Marshall, *Trans. N.Z. Inst.*, vol. 49, 1917, pp. 433–50 (see pp. 446–48), and vol. 50, 1918, pp. 263–78 (many of above-mentioned new species described and figured).

The name "Komiti Bluff" applied in old Geological Survey reports to the locality where Dr. Marshall made this collection is somewhat in error, Komiti Bluff being several miles to the westward. (See P. Marshall, *Trans. N.Z. Inst.*, vol. 49, 1917, pp. 435–37.) According to Cox, Hector made a collection here in 1874. Cox himself collected a considerable number of fossils in January, 1880, and a further collection was made by Park in March, 1885. These collections have not been examined in detail, but Cox (*Rep. of Geol. Explor. during 1879–80*, No. 13, 1881, p. 33), and Park (*Rep. of Geol. Explor. during 1885*, No. 17, 1886, p. 167) give imperfect lists, and seven species collected by Park from the lower beds are listed below.

South-west Side of Pakaurangi Point, near Batley, Kaipara. J. A. Bartrum; 1916.

Ampullina (Megatylotus) suturalis (Hutt.).
**Anomia* aff. *trigonopsis* Hutt. Young shells.
Cardita (Glans) n. sp.
Chama huttoni Hector.
Chione aff. *meridionalis* (Sow.). Young shells.
Glycymeris aff. *subglobosa* Sut. Young shell.
Mesalia striolata (Hutt.).
**Siphonalia* aff. *mandarina* (Duclos). Young shell.
**Spisula ordinaria* (E. A. Smith).
Surcula climacota Sut.
,, *fusiformis* (Hutt.).
Turris n. sp.
,, n. sp.

Thirteen species, of which three most likely also Recent = 23 per cent.

Age: Miocene. The above fossils were collected from sandy beds south-west of the spot where a possible unconformity (not admitted by Mr. Bartrum) is visible, and, so far as was determined, at a higher horizon than the supposed unconformity.

Pakaurangi Point, Kaipara: Lower "Komiti Point" Beds. Geol. Surv. Loc. 542. J. Park; 1885.

Bathytoma sulcata excavata Sut.
Corbula kaiparaensis Sut.
Fusinus morgani Sut.
Pecten (Pallium) burnetti Zitt.
Pecten (Pseudamusium) huttoni (Park).
Siphonalia costata (Hutt.).
Struthiolaria cingulata (?) Zitt.

Age: Miocene (?). *Horizon:* Below supposed unconformity The collection originally contained 194 specimens, and apparently only a part has been examined by Mr. Suter.

Reference: Park, *Rep. of Geol. Explor. during 1885*, No. 17, 1886, pp. 165–67; *Rep. of Geol. Explor. during 1886–87*, No. 18, 1887, pp. 220–21.

Pahi Township, Kaipara: Pahi Greensands. Geol. Surv. Loc. 732. McKay; 1887.

Atrina distans (Hutt.).
Cardium gracile (?) Hect. (MS.).
**Mytilus canaliculus* Mart.
**Panope zelandica* Q. & G.
**Siphonalia* aff. *nodosa* (Mart.).

Age: Probably Miocene.

Reference: McKay, *Rep. of Geol. Explor. during 1887–88*, No. 19, 1888, pp. 53–54.

Coast near Takapuna, Auckland: Volcanic Breccia. Geol. Surv. Loc. 539. J. Park; 1885.

Pecten (Pallium) burnetti Zitt.

Age: Miocene. *Horizon:* Waitematan. The specimen identified is an isolated example from a large collection of 280 to 290 specimens.

Reference: Park, *loc. cit.*, 1886, p. 154.

Waikato: Mercer Marls. Geol. Surv. Loc. 101. McKay; 1875.

**Murex octogonus espinosus* Hutt.
Pecten (Chlamys) aldingensis Tate.
,, *(Patinopecten) hutchinsoni* Hutt.

Age: Miocene. *Horizon:* Below Raglan limestone and above coal-measures proper. McKay states in MS. that the beds are the same as at Whangape Lake, Whaingaroa or Raglan Harbour, and Miranda.

Reference: S. H. Cox, *Rep. of Geol. Explor. during 1874–76*, No. 9, 1877, pp. 11, 13. (See also *Rep. of Geol. Explor. during 1874–76*, No. 10, 1877, p. 22, &c.).

Kupakupa, Waikato: Aotea Sandstone (Calcareous) between Raglan and Kupakupa. Geol. Surv. Loc. 268. Cox; 1876.

**Epitonium (Cirsotrema) zelebori* (Dkr.).
Mytilus sp.
Pecten (Pseudamusium) huttoni (Park).

Age: Miocene (Oamaruian). Kupakupa is on the west bank of the Waikato, near Huntly. The fossils were apparently collected near the Huntly–Raglan Road, at a spot six miles or more west of the Waikato River, and probably not very far from Pukemiro.

Reference: S. H. Cox, *loc. cit.*, 1877, pp. 10, 13.

Coast Four or Five Miles North of Raglan: Limestone. Geol. Surv. Loc. 97. Cox and McKay; 1875.

Pecten (Patinopecten) marshalli Sut.

Age: Miocene. *Horizon:* Ototaran (?). The specimen identified is an isolated example from a collection of eighty specimens.

Reference: S. H. Cox, *loc. cit.*, 1877, pp. 10, 14; and also *Rep. of Geol. Explor. during 1876–77*, No. 10, 1877, p. 25.

Raglan: Coralline Limestone. Geol. Surv. Loc. 112. Cox and McKay; 1875.

Cardium (Fragum) maorinum Sut.

Age: Miocene. *Horizon:* Ototaran (?). The specimen identified is from a collection of sixty specimens.

Reference: S. H. Cox, *Rep. of Geol. Explor. during 1876–77*, No. 10, 1877, pp. 15, 23.

Raukokore River, Bay of Plenty: Shelly Limestone. Geol. Surv. Loc. 682. McKay; 1887.

Corbula canaliculata Hutt.
**Modiolus australis* (Gray).
Ostrea wuellerstorfi (?) Zitt. Fragment.

According to McKay's MS. the age of the material is Pliocene. The fossiliferous beds occur on the north bank of the river, several miles inland.

Reference: McKay, *Rep. of Geol. Explor. during 1886–87*, No. 18, 1887, pp. 184, 209.

Hicks Bay, East Cape District. Geol. Surv. Loc. 263. Hector; 1874.

Pecten (Patinopecten) sectus Hutt.

According to McKay's MS. the age is Miocene (Pareora Series). He adds that the collection contains twenty-four specimens, in addition to Hutton's type of *Ostrea corrugata* and Echinodermata. The type of *O. corrugata*, however, seems to have come from Shakespeare Cliff, Wanganui (Hutton, *Cat. Tert. Moll. and Echin. of N.Z.*, 1873, p. 35). It is now in the Dominion Museum.

Reference: Hector, *Rep. of Geol. Explor. during 1873–74*, No. 8, 1877, p. xvii.

"Duncan's," between Tolaga and Tokomaru Bays: Sands with Bands of Cementstone and Greensands. Geol. Surv. Loc. 249. McKay; 1874.

Ampullina (Megatylotus) suturalis (?) (Hutt.).
**Anomia huttoni* (?) Sut.
* ,, *trigonopsis* Hutt.
Atrina distans (Hutt.). Plentiful; all juv.
* ,, *zelandica* (Gray). Several young shells.
Calliostoma hodgei (?) (Hutt.).
Calyptræa (Sigapatella) maccoyi (?) Sut.
* ,, ,, *maculata* (Q. & G.).
* ,, (s. str.) *tenuis* (Gray).
Cardium brachytonum Sut.
,, aff. *huttoni* Iher.
,, *(Fragum) maorinum* Sut.
,, aff. *patulum* Hutt.
,, aff. *subcordatum* Sut.
**Chione meridionalis* (Sow.). Cast.
,, *spissa* (?) (Desh.). Cast.
* ,, *(Salacia) yatei* (?) (Gray).
**Cochlodesma angasi* (C. & F.).
Cominella carinata (?) (Hutt.).
Corbula canaliculata Hutt. Plentiful.
,, *humerosa* Hutt.
**Corbula macilenta* Hutt.
Crassatellites amplus (Zitt.).
,, *attenuatus* (Hutt.)
* ,, *obesus* (A. Ad.)
**Crepidula costata* (Sow.).
* ,, *monoxyla* (Less.).
Cucullæa alta Sow.
,, ,, var. B Hutt.
,, *australis* (Hutt.).
Cylichnella enysi (Hutt.).
**Cytherea oblonga* (?) (Hanley).
Dentalium mantelli Zitt.
* ,, *nanum* Hutt. Common
,, *solidum* Hutt. Common
**Diplodonta zelandica* (Gray).
**Divaricella cumingi* (Ad. & Ang.).
**Dosinia greyi* Zitt.
* ,, *lambata* (Gould).
**Euthria* aff. *striata* (Hutt.).
**Fulgoraria arabica* (Mart.).
* ,, *gracilis* (Swains.).

Glycymeris cordata (Hutt.).
,, *globosa* (Hutt.).
* ,, *laticostata* (Q. & G.). Plentiful.
Hemiconus ornatus (Hutt.). Fragment.
Hinnites trailli (?) Hutt.
**Leda bellula* A. Ad. Plentiful.
,, *semiteres* Hutt. Plentiful.
**Lima angulata* Sow.
**Macrocallista multistriata* (Sow.).
**Mactra discors* Gray
* ,, *ovata* (Gray).
* ,, ,, *rudis* Hutt.
* ,, *scalpellum* Reeve.
**Mesodesma australe* (Gmel.).
Miomelon corrugata (Hutt.).
Modiolus dolichus Sut.
**Myllita stowei* (Hutt.). New as a fossil.
**Myodora antipodum* Smith.
* ,, *pandoriformis* (Stutchb.). Plentiful
Olivella neozelanica (Hutt.). Many juv.
**Ostrea (Anodontostrea) angasi* (?) Sow.
* ,, (s. str.) *corrugata* (?) Hutt.
,, aff. *incurva* Hutt
,, aff. *manubriata* Tate.
,, (s. str.) *subdentata* Hutt.
Panope orbita Hutt.
,, *worthingtoni* Hutt.
Paphia curta (Hutt.) var.
**Pecten (Pallium) convexus* Q. & G. Juv.
,, *(Patinopecten) crawfordi* Hutt. Plentiful.
,, *(Pallium) polymorphoides* Zitt.
,, *(Chlamys) williamsoni* Zitt.
* ,, ,, *zelandiæ* (?) Gray.
**Polinices amphialus* (Wats.).
Polinices gibbosus (Hutt.). Plentiful.
,, *(Neverita) ovatus* (Hutt.).
**Protocardia (Nemocardium) pulchella* (Gray). Very abundant.
**Psammobia lineolata* Gray
* ,, *zelandica* Desh.
**Saxicava arctica* (L.).
**Siphonalia dilatata* (Q. & G.).
,, *subnodosa* (Hutt.).
,, *turrita* Sut. Plentiful.
Solariella stoliczkai (?) (Zitt.).
,, *sulcatina* (?) Sut.
**Spisula ordinaria* (E. A. Smith).
Struthiolaria canaliculata Zitt.
,, *cincta* Hutt.
,, *frazeri* Hutt.
* ,, *papulosa* (Mart.). Impression.
,, *spinosa* Hect. Fragment.
* ,, *vermis tricarinata* Less. Fragments.
**Tellina deltoidalis* Lamk.
* ,, *eugonia* Sut.
* ,, *glabrella* Desh.
Terebra orycta Sut. Impression.
Teredo heaphyi Zitt.
**Thracia vitrea* (Hutt.).
Trochus sp. indet.
**Turritella (Peyrotia) carlottæ* Wats.
,, *(Torcula) concava* (?) Hutt.
,, *(Archimediella) huttoni* Cossm.
* ,, *(Peyrotia) rosea* Q. & G.
* ,, (s. str.) *symmetrica* Hutt. Plentiful.
**Venericardia difficilis* (Desh.). Juv.
* ,, *lutea* (Hutt.).
**Zenatia acinaces* (Q. & G.).

One hundred and nine species and varieties, of which fifty-six also Recent = 51 per cent.

This locality seems to be a former "shelly beach," washed-up shells accumulating and being buried in sand and mud. There are comparatively few Gastropods, the majority of specimens consisting of single valves of Pelecypods.

Age: Probably late Miocene and Lower Pliocene horizons are represented. In MS. McKay places the beds at Duncan's in the Awatere Series, a correlation that seems to be correct.

Reference: McKay in *Rep. of Geol. Explor. during 1873–74*, No. 8, 1877, pp. 149, 150, 151, &c.†

Spring near Track above Komomona-te-wai Stream, near North Boundary of Uawa Survey District, Tolaga Bay District. Geol. Surv. Loc. 868. M. Ongley; December, 1915.

**Barnea similis* (Gray).
Dentalium solidum Hutt.
Polinices gibbosus (Hutt.). Plentiful.
**Protocardia (Nemocardium) pulchella* (Gray).
Siphonalia subnodosa (?) (Hutt.).
,, sp.
**Spisula ordinaria* (E. A. Smith). Plentiful.

Age: Upper Miocene. Tawhiti Series. *Matrix of fossils:* Calcareous argillaceous sandstone.

Road-cutting beside Mangatokerau Stream, below Fitzgerald's, Tolaga Bay District. Geol. Surv. Loc. 866. M. Ongley; December, 1915.

Ancilla aff. *waikopiroensis* Sut.
Clio (Styliola) rangiana (Tate).
Crepidula gregaria Sow.
* ,, *monoxyla* (Less.).
Dentalium sp.?
**Fulgoraria arabica* (Mart.).
Glycymeris subglobosa Sut.
Polinices gibbosus (Hutt.).
**Siphonalia dilatata* (Q. & G.).
,, aff. *turrita* Sut.
Struthiolaria tuberculata (?) Hutt.

Age: Upper Miocene. Tawhiti Series. *Matrix:* Calcareous argillaceous sandstone.

† See also *N.Z.G.S. Bull. No. 21*, 1920, pp. 46–47, &c., which contains also various succeeding lists.

Track from Hikurangi Trig. to Fitzgerald's, Tolaga Bay District. Geol. Surv. Loc. 869. M. Ongley; December, 1915.

Miomelon corrugata (Hutt.) (*Lapparia* of *Hand-list*).
**Protocardia (Nemocardium) pulchella* (Gray) var. Also Loc. 864.
Siphonalia aff. *costata* (Hutt.).
Solariella sulcatina Sut.
**Venericardia difficilis* (?) (Desh.).

Age: Upper Miocene. Tawhiti Series. *Matrix:* Calcareous argillaceous sandstone.

Boland's Corner, Hikuwai Stream, Tolaga Bay District. Geol. Surv. Loc. 864. L. Teychenné December, 1915.

Anomia sp.
Astræa sp.
Atrina distans (Hutt.). Fragments.
**Calyptræa* (s. str.) *tenuis* (Gray).
Cardium facetum Sut.
Chione meridionalis (Sow.).
Conus aff. *fusellinus* Sut. Cast.
Corbula n. sp. ?
Crepidula gregaria Sow.
* ,, *monoxyla* (Less.). Plentiful.
,, *striata* (Hutt.).
Cucullæa sp.
Cymatium minimum (?) (Hutt.).
Dentalium solidum Hutt.
Glycymeris subglobosa (?) Sut.
Lima aff. *colorata* Hutt.
Mitra sp.
**Modiolus australis* (?) (Gray).
**Mytilus (Aulacomya) magellanicus* Lamk.
Olivella neozelanica (Hutt.).
Polinices sp.
**Protocardia (Nemocardium) pulchella* (Gray) var.
Rapana aff. *waihaoensis* Sut. Cast.
Sinum sp. ?
Siphonalia sp.
Struthiolaria cincta Hutt.
,, *tuberculata* Hutt.
Teredo heaphyi Zitt.
Turritella sp.

Twenty-nine species, of which five also Recent = 17 per cent.

Age: Upper Miocene. Tawhiti Series. *Matrix:* Calcareous argillaceous sandstone.

Marau Point, Eight Miles North of Tolaga Bay. Geol. Surv. Loc. 865. M. Ongley; December, 1915.

**Alcira varians* (?) (Hutt.).
Cardium brachytonum (?) Sut.
,, *waitakiense* Sut. var.
,, n. sp. ?
**Cominella zealandica* (Reeve).
**Crepidula monoxyla* (Less.).
Dentalium solidum Hutt. Fragment.
Fusinus sp.
Limopsis zitteli Iher.
Polinices gibbosus (?) (Hutt.).
Rapana aff. *waihaoensis* Sut. Cast.
**Siphonalia dilatata* (Q. & G.). Fragments.
,, *turrita* (?) Sut.
Surcula fusiformis (?) (Hutt.).
Turris aff. *complicatus* Sut.

Fifteen species, of which four also Recent = 27 per cent.

Age: Upper Miocene. Tawhiti Series. *Matrix:* Calcareous argillaceous sandstone.

Hikuwai, Tolaga Bay District: Road-quarry. Geol. Surv. Loc. 867. M. Ongley; January, 1916.

**Anomia undata* Hutt.
**Calyptræa (Sigapatella) maculata* (Q. & G.).
Cardium brachytonum Sut.
Corbula canaliculata Hutt.
Cucullæa alta Sow.
,, *attenuata* Hutt.
Dentalium solidum Hutt.
Dosinia sp. ?
Lima colorata (?) Hutt. Juv.
Ostrea (Anodontostrea) incurva (?) Hutt.
,, (s. str.) *subdentata* Hutt.
**Panope zelandica* Q. & G.
Paphia curta (?) (Hutt.) var. The same occurs at Loc. 871 (Ormond).
Pecten (Patinopecten) crawfordi (?) Hutt.
Polinices, operculum of ?
**Protocardia (Nemocardium) pulchella* (Gray).
**Siphonalia dilatata* (Q. & G.).
,, sp. Fragment.
Struthiolaria aff. *cingulata* Zitt. Juv.
Turritella (Torcula) semiconcava Sut.

Twenty species, of which five also Recent = 25 per cent.

Age: Upper Miocene. Tawhiti Series. *Matrix:* Calcareous argillaceous sandstone.

Cook's Cove, Tolaga Bay. Geo. Surv. Loc. 328. McKay; 1874.

Cucullæa alta Sow.
,, ,, var. B Hutt.
Cucullæa attenuata Hutt.
,, *worthingtoni* Hutt.

Age: Upper Miocene. Pareora Series (McKay) = Tawhiti Series.

The following determinations, marked "A" to "H," represent various small collections made during the recent survey of the Gisborne district by Dr. J. Henderson and Mr. M. Ongley.

A. Conglomerate composed of Pebbles of Igneous Rocks, Waipaoa River, 20 Chains below Waipaoa Station, Mangatu Survey District, Gisborne District. M. Ongley; April, 1916.

Panope worthingtoni Hutt.
Teredo heaphyi Zitt. Two tubes.
Turritella (Archimediella) huttoni Cossm.

Age: Upper Miocene. Tawhiti Series.

B. Sandstone near Spring on Waikura Valley Road, Six Miles West of Waerengaokuri, Patutahi Survey District. J. Henderson; March, 1915.

**Bathytoma nodilirata* (Murd. & Sut.).

Age: Miocene. Te Arai Series.

C. Argillaceous Sandstone, Wharekopae River, Three Miles South-west of Gardiner's Homestead, Waikohu Survey District.

Bathytoma haasti (Hutt.).
Siphonalia turrita (?) Sut. Fragment.

Age: Miocene. Te Arai Series.

D. Marshall's Road, near Head of Mangaehu Stream, Waimata Survey District. J. Henderson; February, 1916.

Ancilla (Alocospira) papillata (Tate).
Polinices gibbosus (Hutt.).

Age: Upper Miocene. Tawhiti Series.

E. Sandy Mudstone at Mouth of Urukokomoko Stream, Mangatu Survey District. J. Henderson; April, 1916.

Astræa n. sp.
Dentalium solidum Hutt.
Mytilus huttoni Cossm.

Age: Upper Miocene. Tawhiti Series.

F. Mangatu Road, near Wairere, Mangatu Survey District. J. Henderson; April, 1916.

Cominella sp.
Conus n. sp. Cast.
Cymatium minimum (Hutt.).

Age: Upper Miocene. Tawhiti Series. *Matrix:* Argillaceous sandstone.

G. Mudstone at Road-cutting near Junction of Waimata and Te Arai Streams, Patutahi Survey District. J. Henderson; April, 1915.

**Polinices* aff. *amphialus* (Wats.). Broken specimen.

Age: Miocene. Te Arai Series.

H. Quarry near Road, Two Miles and a Half West of Waerengaokuri, Patutahi Survey District. J. Henderson; March, 1915.

Pecten (Pallium) burnetti Zitt.

Age: Pliocene. Ormond Series. *Matrix:* Shell limestone. Mr. Suter adds: "There is also a large subfossil shell of the Recent snail-slug *Schizoglossa novoseelandica* (Pfr.). This has also been found in caves together with moa-bones. (See *Man. N.Z. Moll.* 1913, p. 787.)"

Cuff's, Oil-spring District, Whatatutu, Poverty Bay: Grey Marls. Geol. Surv. Loc. 307. McKay; 1874.

Lima jeffreysiana Tate.
Pecten (Chlamys) williamsoni (?) Zitt.
**Placunanomia zelandica* (Gray).

Also the hydroid *Cylindropora areolata* T.-Woods, and brachiopods.

Age: Upper Miocene. Tawhiti Series. McKay states in MS. that the locality is some miles to the north-east of the oil-springs.

Waimata River, near Head, Quarter of a Mile below Thomas's Whare. Geol. Surv. Loc. 862. M. Ongley; February, 1916.

Ampullina (Megatylotus) suturalis (Hutt.).
Ancilla (Alocospira) papillata (Tate).
**Anomia trigonopsis* Hutt.
Atrina distans (Hutt.).
Chione meridionalis (Sow.).
**Crepidula costata* (Sow.).
**Cytherea oblonga* (Hanley).
Dentalium mantelli Zitt.
,, *solidum* Hutt.
**Diplodonta zelandica* (Gray).
Glycymeris subglobosa Sut.
Hemifusus goniodes Sut.
Miomelon corrugata var. B (Hutt.).
**Ostrea* (s. str.) *corrugata* Hutt.
,, ,, *subdentata* Hutt.
Pecten (Pallium) burnetti Zitt. Juv.
Polinices gibbosus (Hutt.).
**Protocardia (Nemocardium) pulchella* (Gray). Plentiful.
**Siphonalia dilatata* (Q. & G.).
,, *subnodosa* (Hutt.).
,, *turrita* (?) Sut. Juv.
Struthiolaria tuberculata Hutt.
Turritella (Torcula) semiconcava Sut. Fragment.

Twenty-three species, of which seven also Recent = 30 per cent.

Age: Miocene (Upper). Tawhiti Series. *Matrix:* Argillaceous sandstone.

Gisborne-Opotiki Road, Twelve Miles North of Ormond: Limestone. Geol. Surv. Loc. 710 McKay; 1887.

**Leda bellula* A. Ad.
**Lima lima* (L.).
**Trochus tiaratus* (?) Q. & G.

Age: Pliocene. Ormond Series.

Gisborne-Opotiki Road, Two Miles West of the Waipaoa River: Pumice Sands. Geol. Surv. Loc. 711. McKay; 1887.

**Pecten (Pallium) convexus* Q. & G.
**Poroleda lanceolata* (Hutt.).
**Protocardia (Nemocardium) pulchella* (Gray).

Age: Pleistocene.

Waihora River, Two Miles from Te Karaka, Poverty Bay: Sandstone above Unconformity.

Geol. Surv. Loc. 870. M. Ongley; December, 1914.

Ampullina (Megatylotus) suturalis (Hutt.).
**Anomia undata* Hutt.
Atrina distans (Hutt.).
Cardium spatiosum Hutt. Fragment.
**Cochlodesma angasi* (C. & F.).
**Crepidula monoxyla* (Less.).
Dentalium solidum Hutt.
**Dosinia greyi* Zitt.
Drillia æquistriata Hutt.
Galeodea sulcata (?) (Hutt.).
**Leptomya lintea* (Hutt.).
**Macrocallista multistriata* (Sow.).
**Mactra scalpellum* Reeve.
Miomelon corrugata (Hutt.).
**Ostrea (Anodontostrea) angasi* Sow.
* ,, (s. str.) *corrugata* Hutt.
,, ,, *subdentata* Hutt.
Pecten (Chlamys) chathamensis Hutt. Impression.
**Pecten (Pallium) convexus* Q. & G. Fragments.
,, *(Patinopecten) triphooki* Zitt. Juv.
* ,, *(Chlamys) zelandiæ* Gray.
Polinices (Neverita) huttoni Iher.
**Protocardia (Nemocardium) pulchella* (Gray).
**Psammobia lineolata* Gray.
Sinum n. sp.
**Siphonalia dilatata* (Q. & G.). Fragments.
Struthiolaria canaliculata Zitt. Juv.
**Tellina eugonia* Sut.
Teredo heaphyi Zitt.
Trochus conicus (Hutt.).
Turritella (Archimediella) ambulacrum Sow.
,, ,, *huttoni* Cossm.
,, *(Torcula) semiconcava* Sut.
* ,, (s. str.) *symmetrica* Hutt.
**Venericardia lutea* (Hutt.).

Thirty-five species, of which seventeen also Recent = 48·6 per cent.

Age: Pliocene. Ormond Series. *Matrix:* Soft rather coarse sandstone.

Ormond, Poverty Bay: Calcareous Glauconitic Sandstone, overlying Clays with Concretions.

Geol. Surv. Loc. 212. McKay; 1874.

**Anomia trigonopsis* Hutt.
Cardium greyi Hutt.
,, *brachytonum* Sut.
,, *patulum* (?) Hutt.
,, *spatiosum* Hutt.
**Glycymeris laticostata* (Q. & G.).
**Modiolus australis* (Gray).
**Ostrea (Anodontostrea) angasi* Sow.
Paphia curta (Hutt.).
Pecten (Patinopecten) triphooki Zitt.
**Venericardia purpurata* (Desh.).

Eleven species, of which five also Recent = 45 per cent.

Age: Pliocene. McKay in MS. describes the matrix as sandy glauconitic limestone.

Waihirere Stream, Waimata Survey District, Gisborne Subdivision: Ormond Limestone.

Geol. Surv. Loc. 871. M. Ongley; January, 1915.

**Anomia undata* Hutt.
* ,, *trigonopsis* Hutt.
**Atrina zelandica* (Gray).
Cardium brachytonum Sut.
**Glycymeris laticostata* (Q. & G.).
**Modiolus australis* (Gray).
Ostrea (Anodontostrea) arenicola Tate.
Paphia curta (?) (Hutt.) var. (Occurs also at Loc. 867, p. 8.)
Pecten (Patinopecten) crawfordi Hutt.
,, ,, *triphooki* Zitt.
,, aff. *williamsoni* Zitt. or *aldingensis* Tate.
**Protocardia (Nemocardium) pulchella* (Gray).

Age: Pliocene. Ormond Series. *Matrix:* Somewhat sandy limestone.

Near Trig. B, North-east Part of Patutahi Survey District, Gisborne Subdivision.

**Glycymeris laticostata* (Q. & G.).
Modiolus dolichus Sut.
**Protocardia (Nemocardium) pulchella* (Gray). Plentiful.

Age: Pliocene. Ormond Series. *Matrix:* Calcareous sandstone or allied rock.

Trig. 122a, North-west Part of Patutahi Survey District. Geol. Surv. Loc. 863. J. Henderson ; April, 1915.

**Anomia trigonopsis* Hutt.
Cardium facetum Sut.
**Crepidula monoxyla* (?) (Less.).
Cucullæa attenuata Hutt.
**Glycymeris laticostata* (Q. & G.).
Ostrea aff. *nelsoniana* Zitt.
Pecten (Patinopecten) crawfordi (?) Hutt.
,, *(Pallium) polymorphoides* Zitt.
**Siphonalia dilatata* (Q. & G.).
**Tellina eugonia* Sut.

Ten species, of which five also Recent = 50 per cent

Age : Pliocene. Ormond Series. *Matrix :* Impure shelly limestone.

Trig. 101, North-east Part of Patutahi Survey District. Geol. Surv. Loc. 872. J. Henderson ; April, 1915.

**Anomia undata* Hutt.

Age : Pliocene. Ormond Series. *Matrix :* Impure shelly limestone.

McDonald's Section, North-east Shore of Poverty Bay, towards the Headland. Geol. Surv. Loc. 90. McKay ; 1874.

Acmæa sp. Nearest to the Recent *A. parviconoidea* Sut.
Leda semiteres Hutt.
Limopsis aff. *zitteli* Iher.

Age : Tertiary (?). One of McKay's MS. lists states that "the southern end of the section shows what are undoubtedly Cretaceous beds. The northern end towards the mouth of the Turanganui River may be Tertiary." In another MS. list and in his report of 1877 (*Rep. of Geol. Explor. during 1873–74*, No. 8, 1877, pp. 162–64) McKay mentions the presence of *Inoceramus* in the section.

Poverty Bay : Hill East of the Mouth of the Turanganui River. Geol. Surv. Loc. 203. McKay ; 1874.

Acteon sulcatus (Hutt.).
**Arca novæ-zealandiæ* E. A. Smith.
Bathytoma gemmea (Murd.).
**Calyptræa* (s. str.) *tenuis* Gray.
**Cerithidea bicarinata* (Gray).
**Chione stutchburyi* (Gray).
**Cominella lurida* Phil.
* ,, *virgata* A. Ad.
**Cytherea oblonga* (Hanley).
**Dosinia subrosea* (Gray).
Drillia buchanani (Hutt.).
* ,, *lævis* (Hutt.).
,, *wanganuiensis* (Hutt.).
**Emarginula striatula* Q. & G.
**Epitonium (Cirsotrema) zelebori* (Dkr.).
**Euthria striata* (Hutt.).
**Kellia suborbicularis* (Montagu).
**Macrocallista multistriata* (Sow.).
**Mesodesma australe* (Gmel.).
* ,, *ventricosum* (?) Gray.
**Myodora striata* (Q. & G.).
**Natica zelandica* Q. & G.
**Phalium achatinum pyrum* (Lamk.).
**Psammobia stangeri* Gray.
**Serpulorbis sipho* (Lamk.).
**Tellina deltoidalis* (Lamk.).
* ,, *glabrella* Desh.
**Tugalia intermedia* (Reeve).
**Turritella (Peyrotia) carlottæ* Wats.

Twenty-nine species, of which twenty-five also Recent = 86 per cent.

Age : Pleistocene (?). In MS. McKay states that the collection was made from raised beaches and estuarine deposits, which he regarded as of Pleistocene and Recent age.

Bryant's Farm, near Gisborne. Geol. Surv. Loc. 65. McKay ; 1874.

Amusium zitteli (Hutt.).
**Crassatellites obesus* (?) (A. Ad.).
Siliquaria sp. ?
**Trochus tiaratus* (?) Q. & G. Impression.

Age : Miocene (probably).

Reference : McKay in *Rep. of Geol. Explor. during 1874–76*, No. 8, 1877, pp. 119–20, 156-57.

Poverty Bay: Shells collected prior to 1874. Geol. Surv. Loc. 60. (Mostly casts only).

Cardium sp.
Chione meridionalis (Sow.).
,, sp.
Conus n. sp.
Corbula humerosa (?) Hutt.
**Crassatellites obesus* (?) (A. Ad.). Juv.
**Cytherea oblonga* (?) (Hanley).
**Diplodonta zelandica* (?) (Gray).
**Dosinia greyi* Zitt.
Epitonium (Cirsotrema) lyratum (Zitt.).
,, n. sp. ?
**Mactra discors* (?) Gray. Fragment.
**Modiolus australis* (Gray).
Pecten aff. *chathamensis* Hutt.
**Polinices amphialus* (Wats.).
,, aff. *huttoni* Iher.
,, sp.
**Psammobia lineolata* Gray.
**Sinum (Eunaticina) undulatum* (Hutt.).
Siphonalia sp.
**Spisula æquilateralis* (?) (Desh.). Juv.
Struthiolaria cincta Hutt.
**Tellina eugonia* Sut.
* ,, *glabrella* Desh.
* ,, *spenceri* Sut. New as a fossil.
Teredo heaphyi (?) Zitt.
Turris duplex Sut.
Turritella (Torcula) semiconcava Sut.

Twenty-eight species, of which thirteen also Recent = 46 per cent.

McKay states in his MS.: "This is a general collection contributed to the Colonial Museum prior to 1873, of which the localities are uncertain. The immediate vicinity of Poverty Bay exhibits formations of different ages, so that no particular age can be assigned to this collection, which contains 182 specimens."

Gisborne District: Whatatutu Series. P. Marshall, *N.Z. Geol. Surv. Bull. No. 9 (n.s.)*, 1911, p. 22. (Revised list of names.)

**Anomia huttoni* Sut.
Astræa sp. Cast.
**Calyptræa (Sigapatella) maculata* (Q. & G.).
Conus sp. ind.
**Crassatellites obesus* (A. Ad.).
Crepidula gregaria Sow.
**Cymatium spengleri* (?) (Chemn.). [? not *Septa costata* (Born) = *Lotorium olearium* (L.).]
Dentalium pareorense Pils. & Sharp.
,, *solidum* Hutt.
**Dosinia subrosea* (Gray).
**Ethalia zelandica* (H. & J.).
**Fulgoraria arabica elongata* (Swains.).
* ,, *gracilis* (Swains.).
**Fusinus spiralis* (A. Ad.).
Galeodea senex (Hutt.).
,, *sulcata* (Hutt.).
Genota robusta (Hutt.).
Glycymeris globosa (Hutt.).
,, *traversi* (Hutt.).
Latirus (Leucozonia) brevirostris (Hutt.).
Lima paleata Hutt.
**Limopsis aurita* (Brocchi).
,, *zitteli* (?) Iher. (not *L. insolita*).
**Lithophaga truncata* (Gray).
**Mactra ovata* (Gray).
Maculopeplum attenuatum (Hutt.).
**Modiolus australis* (Gray).
Olivella neozelanica (Hutt.).
Panope orbita Hutt. (There is no *P. sulcata.*)
Pecten (Pseudamusium) huttoni (Park).
,, *(Pallium) polymorphoides* Zitt.
Plejona huttoni (Sut.).
Polinices callosus (Hutt.).
,, *gibbosus* (Hutt.).
,, *ovatus* (Hutt.).
Siphonalia conoidea (Zitt.).
Struthiolaria calcar Hutt.
**Tellina eugonia* Sut.
**Trophon plebejus* (Hutt.).
**Turritella (Peyrotia) rosea* Q. & G.
**Venericardia purpurata* (Desh.).

Thirty-nine identified species, of which seventeen also Recent = 43 per cent.

This list gives the revised names of the fossils from the Whatatutu Subdivision identified by Dr. P. Marshall. The collection was a general one, but probably every specimen came from Miocene strata. The usual matrix was argillaceous calcareous sandstone with shelly bands. The collection was carefully packed away in 1911, but is not now in existence. Its fate is indicated on page 5 of *11th Ann. Rep. of Geol. Surv.*, Parl. Paper C.–2B, 1917.

Raised Beach, North Shore of Mahia Peninsula. Geol. Surv. Loc. 689. McKay; 1887.

**Hipponix hexagonus* Sut.

Age: Recent. This is an isolated specimen from a large collection, said by McKay to contain over one hundred species of Mollusca, in addition to Foraminifera. (See *Rep. of Geol. Explor. during 1886–87*, No. 18, 1887, pp. 198–99.)

Te Purutu Creek, near Mohaka Crossing, Napier–Taupo Road, Hawke's Bay. Geol. Surv. Loc. 680. McKay; 1887.

Crepidula gregaria Sow.

Age: Pliocene (?). This is an isolated specimen from a large collection.

Reference: McKay, *Rep. of Geol. Explor. during 1886–87*, No. 18, 1887, pp. 183, 207, 208, 209.

Kiwi Range, North Side of Mohaka River, Napier–Taupo Road, Hawke's Bay. Geol. Surv. Loc. 573. McKay; 1885.

Crepidula gregaria Sow.

Age: Miocene (McKay). A collection of 160 specimens was made from the northern slope of the range in a creek where the strata are vertical.

Te Waka Range, North-west of Pohui, Twenty-six Miles North-west of Napier. Geol. Surv. Loc. 703. McKay; 1887.

**Atrina zelandica* (Gray).
**Calyptræa (Sigapatella) maculata* (Q. & G.).
* ,, ,, ,, *inflata* (Hutt.).
Cardium greyi Hutt.
,, *spatiosum* Hutt.
**Diplodonta zelandica* (Gray).
**Glycymeris laticostata* (Q. & G.).
**Lima bullata* (Born).
**Macrocallista multistriata* (Sow.).
**Modiolus australis* (Gray).
**Myodora boltoni* E. A. Smith.
**Mytilus canaliculus* Mart.
**Ostrea (Anodontostrea) angasi* Sow.
**Ostrea* (s. str.) *corrugata* Hutt.
* ,, *(Anodontostrea) tatei* Sut.
**Panope zelandica* Q. & G.
**Pecten (Pallium) convexus* Q. & G.
,, *(Patinopecten) crawfordi* Hutt.
* ,, *(Chlamys) radiatus* Hutt.
,, *(Patinopecten) triphooki* Zitt.
* ,, *(Chlamys) zelandiæ* Gray.
Polinices lævis (?) (Hutt.).
**Protocardia (Nemocardium) pulchella* (Gray).
**Serpulorbis sipho* (Lamk.).
**Struthiolaria vermis tricarinata* Less.

Twenty-five species, of which twenty also Recent = 80 per cent.

Age: Pliocene. Correlated by McKay in MS. with Te Aute, Scinde Island, and Waitotara limestones. (See also McKay, *Rep. of Geol. Explor. during 1886–87*, No. 18, 1887, p. 206, &c.)

Reference: McKay, *loc. cit.*, 1887, pp. 183, 209, &c. On p. 209 McKay states that the collection made by him contained thirty-five species, of which eight were extinct.

Petane: Upper Band of Limestone, Lower Esk River to Petane Hotel. Geol. Surv. Loc. 720. McKay; 1886.

**Alcira varians* (Hutt.).
**Ancilla (Baryspira) australis pyramidalis* (Reeve).
* ,, ,, *depressa* (Sow.).
* ,, *(Amalda) novæ-zelandiæ* (Sow.).
**Anomia huttoni* Sut.
Bezanconia (Ataxocerithium) n. sp.
**Calyptræa (Sigapatella) maculata* (Q. & G.).
* ,, (s. str.) *tenuis* (Gray).
**Cerithidea bicarinata* (Gray).
**Chione mesodesma* (Q. & G.).
**Chiton pellisserpentis* Q. & G.
**Cominella adspersa* (Brug.).
* ,, *virgata* A. Ad.
**Crepidula costata* (Sow.).
* ,, *monoxyla* (Less.).
,, *striata* (Hutt.).
**Dentalium nanum* Hutt.
,, *solidum* Hutt.
**Divaricella cumingi* (Ad. & Ang.).
Drillia n. sp.

Drillia wanganuiensis (Hutt.).
**Epitonium (Cirsotrema) zelebori* (Dkr.).
**Ethalia zelandica* (H. & J.).
Euthria drewi (Hutt.).
* ,, *striata* (Hutt.).
**Fulgoraria arabica* (Mart.).
**Fusinus spiralis* (A. Ad.).
**Glycymeris laticostata* (Q. & G.).
* ,, *modesta* Ang.
**Loripes concinna* Hutt.
,, *laminata* Hutt.
**Mangilia sinclairi* (E. A. Smith).
**Marginella pygmæa* Sow.
**Mesodesma australe* (Gmel.).
**Mitrella choava* (Reeve).
**Murex octogonus espinosus* Hutt.
**Natica australis* (Hutt.).
* ,, *zelandica* Q. & G.
**Ostrea (Anodontostrea) angasi* Sow.
,, ,, *arenicola* Tate.
,, (s. str.) *subdentata* Hutt.
**Pecten (Pallium) convexus* Q. & G.
* ,, *(Chlamys) zelandiæ* Gray.
**Seila chathamensis* Sut.
**Siphonalia mandarina* (Duclos).
Struthiolaria cingulata Zitt.
**Terebra tristis* Desh.
Tritonidea n. sp.
**Trochus tiaratus* Q. & G.
**Trophon ambiguus* (Phil.).
* ,, *rugosus* (Q. & G.).
**Tugalia bascauda* Hedley.
**Turbonilla zealandica* (Hutt.).
**Turritella (Peyrotia) carlottæ* Wats.
* ,, *(Archimediella) fulminata* Hutt.
* ,, *(Peyrotia) rosea* Q. & G.
* ,, (s. str.) *symmetrica* Hutt.
,, ,, *waikopiroensis* Sut.
**Venericardia corbis* (Phil.).
* ,, *difficilis* (Desh.).
* ,, *lutea* (Hutt.).

Sixty-one species, of which forty-nine also Recent = 80 per cent.

Age: Pliocene.

Reference: McKay, *loc. cit.*, 1887, p. 201, &c.

Petane, Hawke's Bay: Sandy Clays below Limestone. Geol. Surv. Loc. 221. Cox; 1876.

Anachis pisaniopsis (Hutt.).
**Ancilla (Baryspira) mucronata* (Sow.).
**Bathytoma albula* (Hutt.).
* ,, *nodilirata* (Murd. & Sut.).
**Calyptræa (Sigapatella) maculata* (Q. & G.).
* ,, ,, ,, *inflata* (Hutt.).
Chione meridionalis (Sow.). Very abundant.
* ,, *mesodesma* (Q. & G.).
**Cochlodesma angasi* (C. & F.).
Cominella acuminata Hutt.
* ,, *zealandica* (Reeve).
**Crepidula monoxyla* (Less.).
**Cuspidaria trailli* (Hutt.). New as a fossil.
**Dentalium nanum* Hutt.
**Dosinia lambata* (?) (Gould).
Drillia æquistriata Hutt.
,, *buchanani* (Hutt.).
,, *wanganuiensis* (Hutt.).
**Epitonium (Cirsotrema) zelebori* (Dkr.).
Eulima obliqua (?) (Hutt.). Juv.
**Fulgoraria gracilis* (Swains.).
**Leda bellula* A. Ad.
**Leptomya lintea* (Hutt.).
Leucosyrinx alta (Harris).
**Mactra scalpellum* Reeve. Abundant.
**Malletia australis* (Q. & G.). Fragment.
**Mangilia sinclairi* (E. A. Smith).
**Megalatractus maximus* (Tryon). Juv.
**Mesodesma australe* (Gmel.). Abundant.
**Modiolus australis* (Gray).
**Murex zelandicus* Q. & G.
**Myodora striata* (Q. & G.).
**Natica australis* (Hutt.).
**Pecten (Chlamys) radiatus* Hutt.
* ,, ,, *zelandiæ* Gray.
* ,, ,, ,, *gemmulatus* Reeve. Fragments.
**Poroleda lanceolata* (Hutt.). Fragment.
**Protocardia (Nemocardium) pulchella* (Gray). Abundant.
**Psammobia stangeri* Gray.
**Siphonalia mandarina* (Duclos). Juv.
* ,, *nodosa* (Mart.). Juv.
**Spisula ordinaria* (E. A. Smith).
**Tellina glabrella* Desh.
**Trochus tiaratus* Q. & G.
Trophon expansus Hutt.
* ,, *plebejus* (Hutt.).
**Tugalia intermedia* (Reeve).
**Turritella* (s. str.) *symmetrica* Hutt.
**Zenatia acinaces* (Q. & G.).

Forty-nine species, of which forty also Recent = 82 per cent.

Age: Pliocene.

Reference: Cox in *Rep. of Geol. Explor. during 1874–76*, No. 9, 1877, pp. 97, 101–2.

Petane, Seven Miles North-west of Napier: Clays under Limestone. Geol. Surv. Loc. 690. McKay; 1887.

Admete lacunosa (Hutt.).
Anachis cancellaria (Hutt.).
**Ancilla (Baryspira) australis* (Sow.).
* ,, ,, *depressa* (Sow.).
* ,, ,, *mucronata* (Sow.).
* ,, *(Amalda) novæ-zelandiæ* (Sow.).
**Anomia huttoni* Sut.
**Bathytoma cheesemani* (Hutt.).
* ,, *nodilirata* (Murd. & Sut.).
**Calyptræa (Sigapatella) maculata* (Q. & G.).
,, (s. str.) *tenuis* (Gray).
**Cardita calyculata* (L.).
**Cominella adspersa* (Brug.).
* ,, *zealandica* (Reeve).
**Corbula macilenta* Hutt.
* ,, *zelandica* Q. & G.
Crepidula gregaria Sow.
* ,, *monoxyla* (Less.).
**Dentalium nanum* Hutt.
Drillia buchanani (Hutt.).
,, *wanganuiensis* (Hutt.).
**Epitonium (Cirsotrema) zelebori* (Dkr.).
**Fulgoraria* sp. Pullus.
**Fusinus spiralis* (A. Ad.).
**Mangilia protensa* (Hutt.).
**Mesodesma australe* (Gmel.).
**Murex zelandicus* Q. & G.
**Natica australis* (Hutt.).
* ,, *zelandica* Q. & G.
**Ostrea (Anodontostrea) angasi* Sow.
Pecten (Patinopecten) triphooki Zitt.
**Protocardia (Nemocardium) pulchella* (Gray).
**Serpulorbis sipho* (Lamk.).
**Siphonalia caudata* (Q. & G.).
* ,, *dilatata* (Q. & G.).
* ,, *mandarina* (Duclos).
* ,, *nodosa* (Mart.).
**Struthiolaria vermis tricarinata* Less.
**Trichotropis clathrata* Sow.
**Trochus tiaratus* Q. & G.
**Trophon ambiguus* (Phil.).
* ,, *bonneti* Cossm.
**Tugalia bascauda* Hedley.
**Turritella (Peyrotia) carlottæ* Wats.
* ,, *(Archimediella) fulminata* Hutt.
* ,, *(Peyrotia) rosea* Q. & G.
* ,, (s. str.) *symmetrica* Hutt.
**Venericardia bollonsi* Sut.
* ,, *difficilis* (Desh.).

Forty-nine species, of which forty-three also Recent = 88 per cent.

Age: Pliocene. From McKay's MS. it appears that this collection includes material from the same locality collected at other dates than 1887. He places the beds from which the collection was made in the "Putiki and Petane series."

Reference: McKay, *loc. cit.*, 1887, p. 201, &c. It may apparently be assumed that the collection was made from sandy clays, &c., under the upper limestone. The term "Putiki series" (Wanganui) is used by Hutton in *Trans. N.Z. Inst.*, vol. 18, 1886, p. 339.

Petane, Seven Miles North-west of Napier: Limestone. Geol. Surv. Loc. 691. McKay; 1887.

**Ancilla (Baryspira) australis* (Sow.).
* ,, ,, ,, *pyramidalis* (Reeve).
* ,, ,, *depressa* (Sow.).
**Anomia huttoni* Sut.
**Calyptræa (Sigapatella) maculata* (Q. & G.).
* ,, (s. str.) *tenuis* (Gray).
**Cantharidus tenebrosus* A. Ad.
* ,, ,, *huttoni* (E. A. Smith).
**Cardita calyculata* (?) (L.).
**Cerithidea bicarinata* (Gray).
**Chione mesodesma* (Q. & G.).
**Cominella huttoni* Kobelt.
**Crepidula monoxyla* (Less.).
**Dentalium nanum* Hutt.
**Epitonium (Cirsotrema) zelebori* (Dkr.).
**Ethalia zelandica* (H. & J.).
Euthria drewi (Hutt.).
* ,, *littorinoides costulata* (?) Sut.
* ,, *martensiana* (?) Hutt.
**Fulgoraria arabica* (Mart.).
**Fulgoraria gracilis* (Swains.).
**Glycymeris laticostata* (Q. & G.).
**Mangilia dictyota* (Hutt.).
Marginella (s. str.) *hectori* (?) T. W. Kirk.
**Mesodesma australe* (Gmel.).
**Natica australis* (Hutt.).
**Ostrea (Anodontostrea) angasi* Sow.
**Pecten (Chlamys) radiatus* Hutt. Fragments.
**Siphonalia caudata* (Q. & G.).
* ,, *mandarina* (Duclos).
* ,, *nodosa* (Mart.). Juv.
Terebra costata (?) Hutt. Much worn.
**Trochus tiaratus* Q. & G.
**Trophon ambiguus* (Phil.). Juv.
,, *gouldi* Cossm.
* ,, *plebejus* (Hutt.). Juv.
**Turritella (Peyrotia) carlottæ* Wats.
* ,, *(Archimediella) fulminata* Hutt.
* ,, (s. str.) *symmetrica* Hutt.
**Venericardia difficilis* (Desh.).

Forty species, of which thirty-six also Recent = 90 per cent.

Age: Pliocene.

Reference: McKay, *loc. cit.*, 1887, p. 201, &c.

Petane and Scinde Island. Geol. Surv. Loc. 736. A. Hamilton; 1884.

Anachis pisaniopsis (Hutt.).
**Ancilla (Baryspira) mucronata* (Sow.).
**Bathytoma nodilirata* (Murd. & Sut.).
Calliostoma hodgei (Hutt.).
**Calyptræa* (s. str.) *alta* (Hutt.).
* ,, *(Sigapatella) maculata inflata* (Hutt.).
Chione meridionalis (Sow.).
* ,, *mesodesma* (Q. & G.).
**Cominella huttoni* Kobelt.
* ,, *virgata* A. Ad.
* ,, *zealandica* (Reeve).
**Crepidula costata* (Sow.).
* ,, *monoxyla* (Less.).
**Cylichnella striata* (Hutt.).
**Dentalium nanum* Hutt.
,, *solidum* Hutt.
Drillia buchanani (Hutt.).
* ,, *chordata* Sut.
* ,, *lævis* (Hutt.).
,, *wanganuiensis* (Hutt.).
**Epitonium (Cirsotrema) zelebori* (Dkr.).
**Ethalia zelandica* (H. & J.).
**Fulgoraria arabica elongata* (Swains.).
* ,, *gracilis* (Swains.).
**Glycymeris laticostata* (Q. & G.).
**Leptomya lintea* (Hutt.).
Lutraria solida Hutt.
Mangilia abnormis (Hutt.).
**Mesodesma australe* (Gmel.).
* ,, *ventricosum* Gray.
Miomelon corrugata (Hutt.).
**Modiolaria impacta* (Hermann).
**Modiolus australis* (Gray).
**Nucula strangei* A. Ad.
**Ostrea* (s. str.) *corrugata* Hutt.
* ,, *(Anodontostrea) tatei* Sut.
**Panope zelandica* Q. & G.
**Pecten (Pallium) convexus* Q. & G.
* ,, *(Chlamys) zelandiæ* Gray.
**Protocardia (Nemocardium) pulchella* (Gray).
**Psammobia lineolata* Gray.
Rissoa (Alvania) rugosa Hutt.
Siphonalia elegans (?) Sut.
Struthiolaria cingulata Zitt.
,, *parva* Sut.
Surcula n. sp.
**Therasia decidua* (Pfr.).
**Trichotropis clathrata* Sow.
Trigonia neozelanica (?) Sut.
Trochus conicus (Hutt.).
* ,, *tiaratus* Q. & G.
Trophon gouldi Cossm.
**Tugalia bascauda* Hedley.
Turris duplex Sut. New for the Pliocene.
**Turritella (Peyrotia) carlottæ* Wats.
* ,, (s. str.) *symmetrica* Hutt.
**Venericardia difficilis* (Desh.).
* ,, *lutea* Hutt.
**Zenatia acinaces* (Q. & G.).

Fifty-nine species, of which forty-one also Recent = 69 per cent.

Age: Pliocene. Mr. Hamilton collected from more than one locality, and apparently at lower horizons than Cox and McKay. (See *Rep. of Geol. Explor. during 1886–87*, No. 18, 1887, p. 202, where McKay states that Hamilton collected from the Petane clays, &c., below the limestones.) Yet the fossil collections by Cox (Loc. 221) and by McKay (Loc. 690) from the clays under the limestone contain 82 and 88 per cent. respectively of Recent species.

Scinde Island (Bluff Hill), Napier: Lower Limestone. Geol. Surv. Loc. 194. McKay; 1877.

**Anomia* sp.
**Atrina zelandica* (Gray).
**Calyptræa* (s. str.) *alta* (Hutt.).
* ,, *(Sigapatella) maculata* (Q. & G.).
* ,, ,, ,, *inflata* (Hutt.). Common.
* ,, (s. str.) *tenuis* (Gray).
Chione meridionalis (Sow.).
* ,, *spissa* (Desh.).
* ,, *stutchburyi* (Gray).
**Crepidula monoxyla* (Less.). Common.
**Cytherea oblonga* (Hanley).
**Diplodonta zelandica* (Gray).
**Dosinia subrosea* (?) (Gray).
**Epitonium (Cirsotrema) zelebori* (Dkr.).
**Fulgoraria gracilis* (?) (Swains.).
**Glycymeris laticostata* (Q. & G.).
**Leptomya lintea* (?) (Hutt.).
**Lima bullata* (Born).
* ,, *lima* (L.).
Lutraria solida Hutt.
**Mactra elongata* Q. & G.
* ,, *ovata* (Gray). Common.
* ,, *scalpellum* Reeve.
**Mesodesma australe* (Gmel.).
* ,, *subtriangulatum* (Gray).
**Modiolus australis* (Gray).
**Mytilus canaliculus* Mart.
* ,, *edulis* L.
* ,, *magellanicus* Lamk.
**Ostrea (Anodontostrea) angasi* Sow.
* ,, ,, *tatei* Sut.
**Paphia intermedia* (Q. & G.).
**Pecten (Pallium) convexus* Q. & G.

Pecten (Euvola) medius (Lamk.).
* ,, *(Chlamys) radiatus* Hutt.
,, ,, *semiplicatus* Hutt.
,, *(Patinopecten) triphooki* Zitt.
* ,, *(Chlamys) zelandiæ* Gray.
**Protocardia (Nemocardium) pulchella* (Gray).
**Psammobia lineolata* Gray.
**Siphonalia mandarina* (Duclos).
**Tellina eugonia* Sut.
**Tugalia intermedia* (Reeve).
**Turbo smaragdus* (Mart.). Cast.
**Zenatia acinaces* (Q. & G.).

Forty-five species, of which forty-one also Recent = 91 per cent.

Age: Upper Pliocene. With few exceptions the specimens are casts only, the identification therefore is difficult, and in many cases somewhat doubtful.

McKay states in MS. that the collection was made from the lower limestone on the seaward side of Scinde Island (which is not an island, but an isolated hill, now commonly known as Bluff Hill). Cox appears to have made a considerable collection at Scinde Island in 1876. (See *Rep. of Geol. Explor. during 1874–76*, No. 9, 1877, pp. 100–1.)

Reference: McKay, *Rep. of Geol. Explor. during 1876–77*, No. 10, 1877, p. 68, &c. (no specific reference of any consequence bearing on the collection).

Scinde Island, Napier: Lower Limestone. Geol. Surv. Loc. 702. McKay; 1887.

**Anomia huttoni* (?) Sut.
**Atrina zelandica* (Gray). Fragments.
**Calyptræa (Sigapatella) maculata* (Q. & G.).
* ,, (s. str.) *tenuis* (Gray).
Cardium spatiosum Hutt. Casts.
**Crepidula monoxyla* (Less.).
**Cytherea oblonga* (Hanley). Casts.
* ,, *subsulcata* (?) (Sut.).
**Divaricella cumingi* (Ad. & Ang.).
**Fulgoraria arabica elongata* (Swains.). Fragment.
**Glycymeris laticostata* (Q. & G.).
**Lima lima* (?) (L.). Impression.
**Mactra elongata* (Q. & G.).
**Mesodesma australe* (?) (Gmel.). Casts.
**Mytilus canaliculus* Mart.
* ,, *magellanicus* Lamk.
**Ostrea (Anodontostrea) angasi* Sow.
**Panope zelandica* Q. & G. Fragments.
Pecten (Chlamys) semiplicatus Hutt. Fragment.
,, *(Patinopecten) triphooki* Zitt.
* ,, *(Chlamys) zelandiæ* Gray.
**Protocardia (Nemocardium) pulchella* (Gray). Casts.
**Siphonalia mandarina* (Duclos). Fragments.
**Struthiolaria* sp. Fragments.
**Trochus* sp. Casts.

Twenty-five species, of which twenty-two also Recent = 88 per cent.

Age: Pliocene.

Reference: McKay, *loc. cit.*, 1887, p. 193, &c.

The list given above, and preceding lists, prove McKay's contention that all the beds at Scinde Island are of Pliocene age. Hutton (*Trans. N.Z. Inst.*, vol. 18, 1886, pp. 329–30) found 61 per cent. of Recent species in the lower limestone at Scinde Island, but considered it to be of Pareora age. He evidently thought that further collecting would reduce the percentage of Recent species, rather than increase it.

Watchman's Island, Napier Harbour. Geol. Surv. Loc. 222. Williams (probably Archdeacon Williams); 1878.

Acteon sulcatus (Hutt.).
**Ancilla (Baryspira) mucronata* (Sow.).
**Calliostoma selectum* (Chemn.).
**Cardita calyculata* (L.).
**Corbula zelandica* Q. & G.
**Crepidula costata* (Sow.).
**Daphnella striata* (Hutt.).
**Dosinia lambata* (Gould).
**Epitonium (Cirsotrema) zelebori* (Dkr.).
**Lima bullata* (Born).
Lithophaga striata (Hutt.).
**Modiolus australis* (Gray).
**Placunanomia zelandica* (Gray).
**Venericardia difficilis* (Desh.).
**Zenatia acinaces* (Q. & G.).

Fifteen species, of which thirteen also Recent = 87 per cent.

Age: Pliocene.

Reference: Watchman's Island is mentioned by McKay in *Rep. of Geol. Explor. during 1876–77*, No. 10, 1877, pp. 84, 88, and a further reference to islands in Napier Harbour is made by him in *Rep. of Geol. Explor. during 1886–87*, No. 18, 1887, p. 203.

Napier. Geol. Surv. Collection.

Pecten (Patinopecten) sectus Hutt.

Apparently an isolated unnumbered specimen, either from the Museum show-cases or from the collections sent to Professor Ralph Tate (Adelaide) in 1885 and 1890. During the past few years, owing to the good offices of the Rev. W. Howchin, F.G.S., most of the latter specimens have been returned.

Shrimpton's, Ngaruroro River, Hawke's Bay: Upper Shelly Beds. Geol. Surv. Loc. 191. McKay; 1877.

**Anomia huttoni* Sut. Common.
* ,, *undata* Hutt.
**Atrina zelandica* (Gray).
Bezanconia (Ataxocerithium) huttoni (Cossm.).
**Calyptræa (Sigapatella) maculata* (Q. & G.).
* ,, (s. str.) *tenuis* (Gray).
**Cerithidea bicarinata* (Gray).
Chione meridionalis (Sow.). Common.
* ,, *mesodesma* (Q. & G.). Abundant.
**Cominella adspersa* (Brug.).
* ,, *huttoni* Kobelt.
* ,, *lurida* (Phil.).
* ,, *nassoides* (Reeve).
* ,, *zealandica* (Reeve).
**Crepidula monoxyla* (Less.).
,, *striata* (Hutt.).
**Cytherea oblonga* (Hanley).
* ,, *subsulcata* Sut. Abundant.
**Dentalium nanum* Hutt.
**Diplodonta globularis* (Lamk.).
* ,, *zelandica* (Gray).
**Dosinia anus* (Phil.).
* ,, *greyi* Zitt.
* ,, *lambata* (Gould).
* ,, *subrosea* (Gray).
Drillia æquistriata Hutt.
,, *buchanani* (Hutt.).
**Ethalia zelandica* (H. & J.).
**Euthria striata* (Hutt.).
**Fissuridea monilifera* (Hutt.).
**Fulgoraria arabica* (Mart.).
* ,, ,, *elongata* (Swains.).
* ,, *hedleyi* Murd. & Sut. var. New as a fossil.
**Glycymeris laticostata* (Q. & G.).
* ,, *modesta* (Ang.). Common.
* ,, *striatularis* (Lamk.). New to fauna.
**Leptomya lintea* (Hutt.).
**Lima bullata* (?) (Born). Cast.
* ,, *lima* (L.).
**Loripes concinna* Hutt.
Lutraria solida Hutt.
**Malletia australis* (Q. & G.).
Melina zealandica Sut. Fragment.
**Mesodesma australe* (Gmel.). Common.
**Modiolaria impacta* (Hermann).
**Modiolus australis* (Gray).
**Monodonta nigerrima* (Gmel.). New as a fossil.
**Myodora striata* (Q. & G.).
**Mytilus canaliculus* Mart.
**Nucula hartvigiana* Pfr. New as a fossil.
* ,, *nitidula* A. Ad.
**Ostrea (Anodontostrea) angasi* Sow.
* ,, ,, *hyotis* L.
**Panope zelandica* Q. & G.
**Paphia intermedia* (?) (Q. & G.).
**Pecten (Chlamys) radiatus* Hutt.
* ,, ,, *zelandiæ* Gray. Common.
**Poroleda lanceolata* (Hutt.).
**Protocardia (Nemocardium) pulchella* (Gray).
**Sinum (Eunaticina) undulatum* (?) (Hutt.).
**Siphonalia caudata* (Q. & G.).
,, aff. *conoidea* Zitt.
,, *costata* Hutt.
* ,, *dilatata* (Q. & G.).
* ,, *nodosa* (Mart.).
* ,, *mandarina* (Duclos).
**Solariella egena* (Gould).
**Spisula ordinaria* (E. A. Smith).
Struthiolaria frazeri Hutt.
* ,, *vermis* (Mart.).
**Thais striata* (Mart.).
**Trophon ambiguus* (Phil.).
* ,, *hanleyi* (Ang.). New as a fossil.
* ,, *plebejus* (Hutt.).
**Tugalia bascauda* Hedley.
**Turritella (Peyrotia) carlottæ* Wats.
* ,, *(Archimediella) fulminata* Hutt.
* ,, *(Peyrotia) rosea* Q. & G.
* ,, (s. str.) *symmetrica* Hutt.
**Venericardia difficilis* (Desh.).
* ,, *lutea* (Hutt.).
* ,, *purpurata* (Desh.). Common.
**Zenatia acinaces* (Q. & G.).

Eighty-three species, of which seventy-three also Recent = 88 per cent.

Age: Pliocene. According to McKay's MS. the fossiliferous beds are formed of calcareous sands and shells but little consolidated, and consequently the fossils can be extracted in an excellent state of preservation.

Reference: McKay in *Rep. of Geol. Explor. during 1876–77*, No. 10, 1877, pp. 68, 84, 93 (Kikowhero Creek), &c. The collection was probably made near the junction of Kikowhero Creek with the Ngaruroro River.

Cape Kidnappers, South End of Hawke Bay: Scinde Island Limestone. Geol. Surv. Loc. 78. McKay; 1875.

**Chione stutchburyi* (Gray).
**Crepidula monoxyla* (Less.).
**Cytherea oblonga* (Hanley).
**Glycymeris laticostata* (Q. & G.).
**Lima bullata* (Born).
**Mytilus edulis* L.
Ostrea (Anodontostrea) ingens Zitt.
,, ,, *nelsoniana* Zitt.
Ostrea (s. str.) *wuellerstorfi* Zitt.
**Pecten (Pallium) convexus* Q. & G.
,, *(Chlamys) hilli* Hutt.
* ,, *(Euvola) medius* Lamk. Fragment.
,, *(Patinopecten) triphooki* Zitt.
* ,, *(Chlamys) zelandiæ* Gray.
**Placunanomia zelandica* (?) (Gray).

Fifteen species, of which ten also Recent = 67 per cent.

Age: Pliocene. The correlation with the Scinde Island limestone seems doubtful.
Reference: McKay in *Rep. of Geol. Explor. during 1874–76*, No. 9, 1877, pp. 49–50.

Kereru, Forty-one Miles South-west of Napier: Lower Beds. Geol. Surv. Loc. 190. McKay; 1877

**Ancilla (Baryspira) australis pyramidalis* (Reeve).
**Anomia huttoni* Sut.
**Atrina zelandica* (Gray).
**Calliostoma selectum* (Chemn.).
**Calyptræa (Sigapatella) maculata* (Q. & G.).
Chione meridionalis (Sow.).
**Corbula zelandica* Q. & G.
**Crepidula monoxyla* (Less.).
,, *striata* Hutt.
**Diplodonta zelandica* (Gray).
**Dosinia lambata* (Gould).
* ,, *subrosea* (Gray).
**Ethalia zelandica* (H. & J.).
**Fulgoraria gracilis* Swains.
**Leptomya lintea* (Hutt.).
**Lima bullata* (Born).
Lutraria solida Hutt.
Melina zealandica Sut. Fragment.
**Modiolaria impacta* (Hermann).
**Modiolus australis* (Gray).
**Mytilus canaliculus* Mart.
**Ostrea (Anodontostrea) angasi* Sow.
**Panope zelandica* Q. & G.
**Paphia intermedia* (Q. & G.).
**Pecten (Chlamys) zelandiæ* Gray.
**Protocardia (Nemocardium) pulchella* (Gray). Common.
**Siphonalia dilatata* (Q. & G.).
* ,, *mandarina* (Duclos).
**Struthiolaria vermis* (Mart.).
**Trophon hanleyi* (Ang.).
**Tugalia intermedia* (Reeve).
**Venericardia purpurata* (Desh.).

Thirty-two species, of which twenty-eight also Recent = 88 per cent.

Age: Pliocene.
Reference: McKay in *Rep. of Geol. Explor. during 1876–77*, No. 10, 1877, pp. 68, 81, 82, 93.

Waitomo Valley, One to Three Miles West of Waitomo Caves Hostel, along Hauturu Road: Argillaceous Sandstone overlying Limestone. Geol. Surv. Loc. 882. J. Henderson; April, 1917.

Alectrion (Hima) socialis (Hutt.).
Ampullina (Megatylotus) suturalis (Hutt.).
Cardium (Trachycardium) greyi (?) Hutt.
Crassatellites amplus (?) (Zitt.). Juv.
**Dosinia lambata* (?) (Gould).
Polinices gibbosus (Hutt.).
**Spisula æquilateralis* (Desh.). Juvenile casts.
Turritella (Torcula) semiconcava Sut.

Age: Miocene (Oamaruian).

Four Miles West of Hangatiki, on Waihohonu Road: Weathered Mudstone overlying Limestone. Geol. Surv. Loc. 880. J. Henderson; March, 1917.

Pholadomya neozelanica (?) Hutt. Juv.

Age: Miocene.

Four Miles West of Otorohanga, on Honikiwi Road, near Junction with Te Raumauku Road: Arenaceous Limestone, in places passing into Fine Conglomerate. Geol. Surv. Loc. 881. J. Henderson; March, 1917.

Cucullæa attenuata Hutt.
Lima n. sp. ?
Miomelon corrugata (Hutt.). (*Lapparia* of *Hand-list*).
Panope worthingtoni Hutt.
Pecten (Pseudamusium) hochstetteri Zitt.
,, ,, *huttoni* (Park).
Siphonalia aff. *costata* (Hutt.).
Stomatella n. sp. Genus new to fauna.
Venericardia pseutes Sut.

Age: Miocene. *Horizon:* Ototaran (?).

One Mile West of Te Kuiti, along Road to Awakino: Calcareous Argillaceous Sandstone. Geol. Surv. Loc. 877. J. Henderson; February, 1917.

Astræa sp. (perhaps n. sp.). Juv.
**Mactra scalpellum* (?) Reeve.
Pecten (Pseudamusium) huttoni (Park). Juv.
Siphonalia sp.

Age: Miocene. The beds collected from overlie the Te Kuiti limestone, perhaps unconformably.

Half a Mile East of Te Kuiti, between Mangarino and Rangitoto Roads: Pumiceous Slightly Calcareous Sandstone. (Same series as Loc. 877.) Geol. Surv. Loc. 878. J. Henderson; March, 1917.

Amusium zitteli (Hutt.).
Capulus sp. ?

Age: Miocene.

Railway-ballast Quarries, One Mile and a Half South-south-east of Te Kuiti: Lower Arenaceous Limestone. Geol. Surv. Loc. 883. J. Henderson; February, 1917.

**Anomia huttoni* (?) Sut.
Pecten (Pseudamusium) hochstetteri Zitt.
Pecten (Pseudamusium) huttoni (Park).
Teredo heaphyi Zitt.

Age: Miocene.

Five Miles East of Te Kuiti, on Road joining Puketawai and Otewa Roads: Calcareous Sandstone. Geol. Surv. Loc. 884. J. Henderson; February, 1917.

Pecten (Pseudamusium) huttoni (Park).
Terèdo heaphyi Zitt.

Age: Miocene. Horizon nearly the same as that of Loc. 883.

One Mile South of Oparure, along Road to Mairoa: Argillaceous Sandstone. (Same series as Loc. 877.) Geol. Surv. Loc. 879. J. Henderson; March, 1917.

Chione chiloensis truncata (?) Sut. Juv.
Pecten (Chlamys) williamsoni Zitt.
Siphonalia sp. ?
Surcula aff. *huttoni* Sut.

Age: Miocene.

Mangaotaki Gorge, Six Miles South-west of Piopio, on Road to Mahoenui: Calcareous Sandstone at Base of Limestone. Geol. Surv. Loc. 886. J. Henderson; February, 1917.

Pecten (Pseudamusium) huttoni (Park).

Age: Miocene.

Four Miles East of Awakino, along the Road to Te Kuiti, One Mile from the River-flats : Argillaceous Sandstone. Geol. Surv. Loc. 885. J. Henderson ; February, 1917.

Lima colorata Hutt.
Limopsis zitteli Iher.
**Tellina glabrella* (?) Desh.
**Xenophora corrugata* (Reeve).
Fry of *Phalium* ?

Age : Miocene. The beds collected from overlie the limestone horizon.

Top of Taumatamaire Hill, Awakino-Mahoenui Road, Awakino County. J. Henderson ; 1917.

Polinices gibbosus (Hutt.).

Age : Miocene. *Horizon :* Above limestone (?). See also E. de C. Clarke in *N.Z. Geol. Surv. Bull. No. 14*, 1912, p. 19.

Patokatoka Creek, Mokau River : Greensands underlying Limestone. J. Park, *Rep. of Geol. Explor. during 1886–87*, No. 18, 1887, p. 44. (Revised list of names.)

**Ancilla (Baryspira) australis* (?) (Sow.).
,, (s. str.) *hebera* (Hutt.).
Bathytoma sulcata (Hutt.).
Chione acuminata Hutt.
Glycymeris globosa (Hutt.).
Lima colorata Hutt.
Ostrea sp. ind.
Pecten (Pseudamusium) huttoni (Park).

Age : Miocene.

This list consists of the revised names of the species listed by Park. The collection made by him at Patokatoka Creek is presumably that from Loc. No. 584, and has not yet been re-examined, so that the correctness of the above list depends on the accuracy of the identifications made in 1887.

White Cliffs, Taranaki. J. Park, *loc. cit.*, p. 43. (Revised list of names.)

**Bathytoma nodilirata* (Murd. & Sut.).
Dentalium solidum Hutt.
Galeodea sulcata (Hutt.).
**Malletia australis* (Q. & G.).
**Nucula nitidula* A. Ad.
**Protocardia (Nemocardium) pulchella* (Gray).
Siphonalia nodosa robinsoni (Zitt.).

Age : Upper Miocene or Lower Pliocene.

White Cliffs, North of Urenui, Taranaki. Geol. Surv. Loc. 52. J. Hector; 1874.

**Anomia huttoni* (?) Sut. Juv.
Bathytoma haasti (Hutt.).
Clio (Creseis) urenuiensis Sut.
**Leptomya lintea* (?) (Hutt.). Impression.
Miomelon corrugata (Hutt.).
,, var. B (Hutt.).

Age : Upper Miocene or Lower Pliocene.

Urenui, Taranaki : Blue Clay. Geol. Surv. Loc. 582. J. Park ; 1886.

Bathytoma haasti (Hutt.).
Drillia buchanani (Hutt.).
Euthria media (?) (Hutt.).
**Fulgoraria arabica* (?) (Mart.). Fragment.
**Leptomya lintea* (Hutt.).
**Malletia australis* (Q. & G.).
**Nucula hartvigiana* Pfr.
**Protocardia (Nemocardium) pulchella* (Gray).
Siphonalia costata (Hutt.).
,, *subnodosa* (Hutt.).

Age : Lower Pliocene (probably). Onairo Series of E. de C. Clarke (*N.Z. Geol. Surv Bull. No. 14*, 1912).

Onairo, near Waitara, Taranaki : Pareora Beds.† Geol. Surv. Loc. 583. J. Park; 1886.

Ancilla (Baryspira) mucronata (Sow.).
**Chione mesodesma* (Q. & G.).
**Cominella zealandica* (Reeve).
Crassatellites sp. ?
Crepidula gregaria Sow.
Cytherea sulcata (Hutt.).
Dentalium solidum Hutt.
**Divaricella cumingi* (Ad. & Ang.).
Dosinia sp.
Glycymeris globosa (Hutt.). Common.
Miomelon corrugata (Hutt.).
Polinices (Neverita) huttoni Iher.
**Protocardia (Nemocardium) pulchella* (Gray).
**Siphonalia caudata* (Q. & G.).
* ,, *nodosa* (Mart.).
Struthiolaria cincta Hutt.
* ,, *papulosa* (?) (Mart.).
* ,, *vermis tricarinata* Less.
Turritella (Torcula) semiconcava Sut.
**Zenatia acinaces* (Q. & G.).

Eighteen identified species, of which ten also Recent = 55·6 per cent.

Age: Lower Pliocene (probably). Onairo Series of E. de C. Clarke.

Onairo, Taranaki. J. Park, *Rep. of Geol. Explor. during 1886–87*, No. 18, 1887, p. 13. (Revised list of names.)

**Ancilla (Baryspira) australis* (Sow.).
**Cardita calyculata* (L.).
**Chione mesodesma* (Q. & G.).
* ,, *stutchburyi* (Gray).
**Cominella adspersa* (Brug.).
Crepidula gregaria Sow.
**Dentalium ecostatum* T. W. Kirk.
* ,, *nanum* Hutt.
,, *solidum* Hutt.
**Divaricella cumingi* (Ad. & Ang.).
**Dosinia greyi* Zitt.
* ,, *subrosea* (Gray).
Galeodea sulcata (Hutt.).
**Glycymeris laticostata* (Q. & G.).
**Malletia australis* (Q. & G.).
Ostrea sp. ind.
**Polinices amphialus* (Wats.).
Siphonalia nodosa robinsoni (Zitt.).
**Spisula æquilateralis* (Desh.).
Struthiolaria tuberculata Hutt.
**Tellina deltoidalis* Lamk.
**Turritella (Peyrotia) rosea* Q. & G.
* ,, (s. str.) *symmetrica* Hutt
**Zenatia acinaces* (Q. & G.).

Twenty-three identified species, of which eighteen Recent = 78 per cent.

Age: Lower Pliocene (probably). Onairo Series of Clarke. The matrix of the fossils is argillaceous pebbly conglomerate (more or less calcareous).

New Plymouth Subdivision. E. de C. Clarke, *N.Z. Geol. Surv. Bull. No. 14 (n.s.)*, 1912, p. 20 (Revised list.)

**Ancilla (Baryspira) australis* (Sow.).
**Bathytoma nodilirata* (Murd. & Sut.).
**Cardita calyculata* (L.).
Chione acuminata Hutt.
* ,, *mesodesma* (Q. & G.).
* ,, *stutchburyi* (Gray).
**Cominella adspersa* (Brug.).
Crepidula gregaria Sow.
Cucullæa alta Sow.
**Dentalium ecostatum* T. W. Kirk.
* ,, *nanum* Hutt.
,, *solidum* Hutt.
**Divaricella cumingi* (Ad. & Ang.).
**Dosinia greyi* Zitt.
* ,, *subrosea* (Gray).
Galeodea sulcata (Hutt.).
Glycymeris globosa (Hutt.).
* ,, *laticostata* (Q. & G.).
Limopsis zitteli (?) Iher.
**Malletia australis* (Q. & G.).
**Nucula nitidula* A. Ad.
Pecten fischeri Zitt.
,, *(Pseudamusium) hochstetteri* (?) Zitt. [Perhaps *P. huttoni* (Park).]
**Polinices amphialus* (Wats.).
,, *ovatus* (Hutt.).
**Protocardia (Nemocardium) pulchella* (Gray).
**Siphonalia nodosa* (Mart.).
,, ,, *robinsoni* (Zitt.).
**Spisula æquilateralis* (Desh.).
Struthiolaria tuberculata Hutt.
**Tellina deltoidalis* Lamk.
Teredo heaphyi Zitt.
**Turritella* (s. str.) *symmetrica* Hutt.
**Zenatia acinaces* (Q. & G.).

Thirty-four species, of which twenty-one also Recent = 62 per cent.

This list embodies a revision of Mr. Clarke's nomenclature. His list was partly compiled, and the fossil localities are not specifically mentioned. Various horizons (Pliocene and Miocene) are represented.

† So entitled in McKay's manuscript list of fossiliferous localities.

Pohokura Tunnel, Stratford-Whangamomona Railway. P. G. Morgan and W. Gibson; October. 1914.

**Anomia huttoni* Sut.
**Ancilla bicolor* (?) (Gray).
**Cerithidea bicarinata* (?) (Gray).
**Chione mesodesma* (Q. & G.).
**Crepidula monoxyla* (Less.).
Diplodonta ampla (Hutt.).
**Dosinia anus* (Phil.).
**Glycymeris laticostata* (Q. & G.).
* ,, *modesta* (Ang.).
**Magellania lenticularis* (Desh.).
**Ostrea tatei* Sut.
Pecten triphooki Zitt.

Age: Pliocene. The collection was made from calcareous sandy claystones on the dumps at the south-western end of the tunnel.

Nolan's Quarry, on Hilltop near Te Wera, Ngatimaru Survey District. W. Gibson; 1914.

**Cytherea oblonga* (?) (Hanley).
**Glycymeris laticostata* (Q. & G.).
**Struthiolaria vermis* (?) (Mart.).

Age: Pliocene. The matrix is a calcareous sandstone.

Shell-bed, Railway-cutting, One Mile and a Half South-west of Huiroa Railway-station. W. Gibson; 1914 (or early in 1915).

Anomia sp. Juv. Very likely *A. huttoni* Sut.
Ostrea angasi Sow. Juv.

Age: Pliocene.

Beach, North-east of Tapuae Stream, South-west of New Plymouth, Taranaki. P. G. Morgan; 1916.

Mactra chrydœa Sut.

This specimen is from an immense block of fine calcareous sandstone embedded in volcanic agglomerate. This block is mentioned by Clarke (*N.Z. Geol. Surv. Bull. No. 14*, p. 15), who speaks of it as limestone. He collected a number of fossil specimens, but unfortunately these were lost, and the writer of this paragraph could find nothing identifiable except casts of the fossil mentioned above. The interest attaching to the block of sandstone containing the fossils lies not only in its size and mode of occurrence, but also in the fact that it belongs to a lower horizon than any sedimentary rock known to exist *in situ* near the surface in the New Plymouth Subdivision. (See, however, the following list.)

West of Salisbury Road, and Two Miles and a Half East of Tariki, Taranaki: Fossiliferous Tuff. W. Gibson; 1915.

Chione meridionalis (?) (Sow.). Cast.
Mactra chrydœa Sut.
Pecten (Patinopecten) triphooki Zitt.
Pecten n. sp.
Typhis maccoyi (?) T.-Woods. Impression.

Age: Probably Lower Pliocene, though the list as it stands suggests a Miocene age. The determination of the exact horizon is a matter of great importance from an oil-boring point of view.

Oil-bore, at Depth of 4,550 ft. to 4,760 ft., Huiroa, Taranaki. J. Henchman; 1916.

Siphonalia n. sp. Nearest to *S. orbita* Hutt.
Struthiolaria n. sp. With short, broadly angled spire.
Turritella (Torcula) semiconcava Sut.

These specimens were forwarded to the Geological Survey in November, 1916, by Mr. J. Henchman, manager at the Huiroa oil-bore (fifteen miles north-east of Stratford). It is fairly certain that their horizon is well down in the Miocene. The exact determination of that horizon is obviously important.

Manaia Beach, at Foot of Rainie Road : Sandy Mudstone (Papa) which forms the Lower Part of the Sea-cliff of South Taranaki, and is overlain by Volcanic Material. Geol. Surv. Loc. 875. M. Ongley ; March, 1917.

Anomia trigonopsis Hutt.
**Calyptræa* (s. str.) *alta* (Hutt.).
Cardium spatiosum Hutt. Fragment.
Crepidula gregaria Sow.
,, *striata* (Hutt.).
**Cytherea oblonga* (Hanley).
Dentalium mantelli Zitt.
**Dosinia greyi* Zitt.
**Glycymeris laticostata* (Q. & G.).
Loripes n. sp. (The same Loc. 876.)
Miomelon corrugata (Hutt.).
Miomelon corrugata var. B (Hutt.).
**Ostrea (Anodontostrea) hyotis* (L.).
Pecten (Patinopecten) crawfordi Hutt.
* ,, *(Chlamys) zelandiæ* Gray.
Polinices (Neverita) sagenus Sut.
**Protocardia (Nemocardium) pulchella* (Gray).
Siphonalia sp. (Near *S. plicatilis*, but twice its size.)
Struthiolaria cingulata Zitt.
Turbo n. sp. Fragments.

Twenty species, eight of which also Recent = 40 per cent.

Age : Uppermost Miocene (probably).

Hawera Beach, at Mouth of Waihi Stream : Sandy Mudstone (Papa) which forms the Lower Part of the Sea-cliff of South Taranaki, overlain by Volcanic Material. Geol. Surv. Loc. 876. M. Ongley ; March, 1917.

**Ancilla (Baryspira) mucronata* (Sow.).
**Chione mesodesma* (Q. & G.).
**Crepidula monoxyla* (Less.).
**Cytherea oblonga* (Hanley). Fragments.
Dentalium mantelli Zitt.
**Divaricella cumingi* (Ad. & Ang.).
**Dosinia (Dosinidia) greyi* Zitt.
Epitonium aff. *(Confusiscala) nympha* (Hutt.).
Loripes n. sp. (The same Loc. 875.)
**Ostrea (Anodontostrea) hyotis* (L.).
Pecten (Patinopecten) triphooki Zitt. Fragment.
Polinices (Neverita) ovatus (Hutt.).
,, ,, *sagenus* Sut.
Struthiolaria canaliculata Zitt.
**Turritella (Peyrotia) carlottæ* Wats.

Fifteen species, eight of which also Recent = 53 per cent.

Age : Lower Pliocene or uppermost Miocene.

Waitotara, Puketapu, North-west Wellington. Geol. Surv. Loc. 588. Hector ; 1866.

**Ostrea (Anodontostrea) tatei* Sut.

Age : Pliocene. *Horizon :* Waitotaran. An isolated specimen from a small collection of sixteen specimens. There is some doubt about the locality.

Wanganui : Shakespeare Cliff (Upper Part). Geol. Surv. Loc. 206. T. W. Kirk ; 1875.

**Ancilla (Baryspira) australis* (Sow.).
* ,, ,, ,, *pyramidalis* (Reeve).
* ,, ,, *depressa* (Sow.).
**Astræa heliotropium* (Mart.).
**Calyptræa (Sigapatella) maculata* (Q. & G.).
* ,, ,, ,, *inflata* (Hutt.).
* ,, (s. str.) *tenuis* (Gray).
**Cardita calyculata* (L.).
**Chione mesodesma* (Q. & G.). Common.
* ,, *spissa* (Desh.).
**Cominella lurida* (Phil.).
**Corbula zelandica* Q. & G.
Crepidula gregaria Sow.
* ,, *monoxyla* (Less.).
**Diplodonta zelandica* (Gray).
**Divaricella cumingi* (Ad. & Ang.).
**Dosinia greyi* Zitt.
* ,, *subrosea* (Gray).
**Ethalia zelandica* (H. & J.).
**Euthria* sp.
**Fusinus spiralis* (A. Ad.).
**Glycymeris laticostata* (Q. & G.). Common.
* ,, *modesta* (Ang.).
**Mactra elongata* Q. & G.
* ,, *scalpellum* Reeve.
**Mesodesma australe* (Gmel.).
* ,, *subtriangulatum* (Gray).
**Mesodesma ventricosum* Gray.
**Murex zelandicus* Q. & G.
**Myodora striata* (Q. & G.). Common.
**Nucula nitidula* A. Ad.
**Ostrea (Anodontostrea) angasi* Sow. Common.
* ,, ,, *arenicola* Tate. New to fauna.
* ,, (s. str.) *corrugata* Hutt.
* ,, *(Anodontostrea) hyotis* (L.). Common.
**Pecten (Euvola) medius* Lamk.
* ,, *(Chlamys) radiatus* Hutt.
**Polinices amphialus* (Wats.).
**Protocardia (Nemocardium) pulchella* (Gray).

**Psammobia lineolata* Gray.
**Siphonalia mandarina* (Duclos).
* ,, *nodosa* (Mart.).
**Solariella egena* (Gould).
**Struthiolaria papulosa* (?) (Mart.). Casts.
* ,, *vermis* (Mart.).
Trochus conicus (Hutt.).
**Trochus tiaratus* Q. & G.
**Trophon ambiguus* (Phil.).
* ,, *plebejus* (Hutt.).
**Turritella (Peyrotia) carlottæ* Wats.
* ,, ,, *rosea* Q. & G.
* ,, (s. str.) *symmetrica* Hutt.
**Venericardia difficilis* (Desh.).

Fifty-three species, of which fifty are also Recent = 94 per cent.

Age: Highest Pliocene or Early Pleistocene. *Horizon:* Castlecliffian (?).

The collection may contain some of the material collected by John Buchanan in 1866 (Loc. 92).

Wanganui Fossils: Shakespeare Cliff and Elsewhere.

**Ancilla (Baryspira) australis* (Sow.).
* ,, ,, ,, *pyramidalis* (Reeve).
* ,, ,, *depressa* (Sow.).
* ,, ,, *mucronata* (Sow.).
**Arca novæ-zealandiæ* E. A. Smith.
**Astræa heliotropium* (Mart.).
**Atrina zelandica* (Gray).
**Barnea similis* (Gray).
**Bathytoma nodilirata* (Murd. & Sut.).
**Calliostoma punctulatum* (Mart.).
**Calyptræa (Sigapatella) maculata* (Q. & G.).
* ,, (s. str.) *tenuis* (Gray).
**Cardita calyculata* (L.).
**Chione mesodesma* (Q. & G.).
* ,, *spissa* (Desh.).
* ,, *stutchburyi* (Gray).
* ,, *yatei* (Gray).
**Cominella costata* (Q. & G.).
* ,, *lurida* (Phil.).
* ,, *virgata* A. Ad.
**Corbula zelandica* (Q. & G.).
**Crepidula costata* (Sow.).
,, *gregaria* Sow.
* ,, *monoxyla* (Less.).
**Cymatium spengleri* (Chemn.).
**Cytherea oblonga* (Hanley).
**Dentalium nanum* Hutt.
**Diplodonta zelandica* (Gray).
**Divaricella cumingi* (Ad. & Ang.).
**Dosinia greyi* Zitt.
* ,, *subrosea* (Gray).
Drillia æquistriata Hutt.
,, *buchanani* (Hutt.).
,, *wanganuiensis* (Hutt.).
**Emarginula striatula* Q. & G.
**Epitonium (Cirsotrema) zelebori* (Dkr.).
**Ethalia zelandica* (H. & J.).
**Fulgoraria arabica elongata* (Swains.).
* ,, *gracilis* (Swains.).
**Fusinus spiralis* (A. Ad.).
**Glycymeris laticostata* (Q. & G.).
* ,, *modesta* (Ang.).
**Leda bellula* A. Ad.
**Lima angulata* Sow.
* ,, *bullata* (Born).
Lithophaga striata (Hutt.).
Macrocallista assimilis (Hutt.).
**Mactra ovata rudis* Hutt.
* ,, *scalpellum* (Reeve).
**Megalatractus maximus* (Tryon).
**Mesodesma australe* (Gmel.).
* ,, *subtriangulatum* (Gray).
* ,, *ventricosum* Gray.
**Modiolaria impacta* (Hermann).
**Modiolus australis* (Gray).
**Murex octogonus umbilicatus* (T.-Woods).
* ,, *zelandicus* Q. & G.
**Myodora striata* (Q. & G.).
**Natica zelandica* Q. & G.
**Nucula nitidula* A. Ad.
**Ostrea (Anodontostrea) angasi* Sow.
,, ,, *arenicola* Tate.
* ,, (s. str.) *corrugata* Hutt.
* ,, *(Anodontostrea) hyotis* (L.).
**Paphia intermedia* (Q. & G.).
**Pecten (Pallium) convexus* Q. & G.
* ,, *(Euvola) medius* Lamk.
* ,, *(Chlamys) radiatus* Hutt.
**Phalium achatinum pyrum* (Lamk.).
**Polinices amphialus* (Wats.).
**Protocardia (Nemocardium) pulchella* (Gray).
**Psammobia lineolata* Gray.
* ,, *stangeri* Gray.
* ,, *zelandica* Desh.
**Siphonalia mandarina* (Duclos).
* ,, *nodosa* (Mart.).
,, *subnodosa* (Hutt.).
**Solariella egena* (Gould).
**Spisula ordinaria* (E. A. Smith).
**Struthiolaria papulosa* (Mart.).
* ,, *vermis* (Mart.).
**Tellina deltoidalis* Lamk.
Thracia neozelanica Sut.
Trochus conicus (Hutt.).
* ,, *tiaratus* Q. & G.
**Trophon ambiguus* (Phil.).
,, *gouldi* Cossm.
* ,, *plebejus* (Hutt.).
**Tugalia intermedia* (Reeve).
**Turritella (Peyrotia) carlottæ* Wats.
* ,, ,, *rosea* Q. & G.
* ,, (s. str.) *symmetrica* Hutt.
**Venericardia difficilis* (Desh.).
**Zenatia acinaces* (Q. & G.).

Ninety-four species, of which eighty-three also Recent = 88 per cent.

This list appears to represent a somewhat miscellaneous collection of Wanganui fossils sent to Mr. Suter several years ago. Portions of the collections made by John Buchanan in 1866 (Locs. 91 and 92) are probably included in the material.

Manawatu Gorge (East End) : Limestone. J. Henderson, 1915.

Ostrea tatei Suter (= *O. hippopus* Tate, *non* Lamarck).

Age : Pliocene.

Mauriceville, Wellington : Limestone. J. Henderson ; 1915.

**Astræa sulcata* (Mart.). Casts. New as a fossil.
**Calliostoma pellucidum* (Val.).
* ,, *selectum* (Chemn.).
**Lithophaga truncata* (Gray). New as a fossil.
**Mytilus canaliculus* Mart.
**Panope zelandica* Q. & G.
**Siphonalia mandarina* (?) (Duclos).

Age : Pliocene (Upper).

Mangapakeha Valley, East of Masterton, Wairarapa District. Geol. Surv. Loc. 117. Hector ; 1866.

Struthiolaria tuberculata Hutt.

Age : McKay remarks in MS. that *S. tuberculata* indicates a Miocene age. This statement is confirmed to some extent by McKay's brief list of shells from beds underlying the shell limestone, Taueru (*Rep. of Geol. Explor. during 1874–76*, No. 9, 1877, p. 53), and Morgan's list of species from shelly conglomerate and limestone published in " Petroleum and other Minerals in Eastern Wairarapa District," *Parl. Paper C.–16*, 1910, p. 2. The proofs of this paper were not submitted to the writer, and consequently it contains many typographical errors. The list of fossils, corrected according to Suter's nomenclature, is as follows :—

Dentalium solidum Hutt.
Turritella cavershamensis Harris.
,, 2 spp.
**Struthiolaria papulosa* (Mart.).
Glycymeris sp.
Cucullæa alta var. B Hutt.
,, sp.

Taipos, Masterton County (near Tenui). Geol. Surv. Loc. 93. Hector ; 1866.

Pecten (Chlamys) semiplicatus Hutt.

This is an isolated example from a collection of sixty-one specimens, besides types described by Hutton (McKay, MS.). The fossils themselves indicate a Miocene age, as will be seen by reference to McKay's lists (*loc. cit.*, p. 53). The rugged hills known as the Taipos, however, are formed mainly of a thick-bedded, hard sandstone, apparently non-fossiliferous, and probably of pre-Tertiary (certainly pre-Miocene) age. (See Morgan in Parl. Paper C.–16, 1910, p. 2, and also Thomson in *8th Ann. Rep. of N.Z. Geol. Surv.*, part of Parl. Paper C.–2, 1914, p. 164.)

Castle Point, East Coast of Wellington. Geol. Surv. Loc. 81. McKay ; 1875.

Pecten (Chlamys) semiplicatus Hutt.

Age : Pliocene (McKay). This is an isolated example from a large collection.

Cliffs at Mouth of Ruamahanga River, Palliser Bay. Geol. Surv. Loc. 749. McKay ; 1882.

**Terebra tristis* Desh.

Age : Pliocene (McKay). This is an isolated specimen from a collection which originally contained ninety-two specimens, or by a later count seventy-five.

CHAPTER II.

SOUTH ISLAND.

Cave Hill, East of Bainham, Aorere Valley: Limestone. Geol. Surv. Loc. 746. J. Park; 1888.

Anomia sp.
**Calyptræa (Sigapatella) maculata* (Q. & G.).
Cardium patulum (?) Hutt.
Crassatellites amplus (?) (Zitt.).
Dentalium sp. ?
Glycymeris sp. ?
Lima aff. *colorata* Hutt.
,, sp. ?
**Mactra elongata* Q. & G.
**Mesodesma australe* (?) (Gmel.).
**Mytilus edulis* L.
Ostrea sp.
Paphia curta (?) (Hutt.).
Pecten (Patinopecten) palmipes Tate.
**Placunanomia zelandica* (?) (Gray).

All specimens in a bad condition for identification. The collection contains fifteen species, of which five are Recent = 33 per cent.

Age: Miocene (Oamaruian). *Horizon:* Ototaran (?).

The locality from which Park collected is near Doctor's Creek, a small tributary of the Aorere. See *Rep. of Geol. Explor. during 1888-89*, No. 20, pp. 213, 239. For a brief description of the caves see *N.Z. Geol. Surv. Bull. No. 3, 1907*, p. 31, para. 7.

Coast between Anatori and Big Rivers, Collingwood County: Greensands. Geol. Surv. Loc. 739. J. Park; 1887.

Pecten (Patinopecten) hutchinsoni Hutt.

Age: Miocene (Oamaruian).

Tata Island, Takaka County: Limestone. Geol. Surv. Loc. 662. Hector; 1887.

Pecten (Patinopecten) hutchinsoni Hutt.

Age: Miocene. *Horizon:* Ototaran (probably).

Port Hills, near Town of Nelson. Geol. Surv. Loc. 319. McKay; 1874.

Cardium (Fragum) maorinum Sut.
Lithophaga nelsoniana Sut.

Age: Upper Miocene. Kanieri Series (McKay) = Pareoran.

These are fossils from a considerable collection, containing specimens collected prior to 1874 (McKay in MS.).

Awatere Valley. Shells collected by J. von Haast (for F. von Hochstetter), F. W. Hutton, and J. Park. (Revised lists.)

	Recorded by
Ampullina suturalis (Hutt.)	Hutton.
**Ancilla (Baryspira) australis* (Sow.)	Park.
**Anomia trigonopsis* Hutt.	Park.
**Atrina zelandica* (Gray)	Hutton, Park.
**Calliostoma selectum* (Chemn.).	Park.
**Calyptræa maculata* (Q. & G.)	Hochstetter.

	Recorded by
* *Cantharidus purpuratus* (Mart.)	Park.
* ,, *tenebrosus* A. Ad.	Hutton.
Cardium spatiosum Hutt.	Park.
* *Chione stutchburyi* (Gray)	Park.
Crepidula gregaria Sow.	Hutton.
,, *striata* Hutt. "Novara," pl. xv, fig. 10	Hochstetter, Hutton.
* *Cylichnella striata* (Hutt.)	Park.
* *Cytherea oblonga* (Hanley)	Park.
Dentalium mantelli Zitt.	Hutton.
,, *solidum* Hutt.	Park.
* *Diplodonta zelandica* (Gray)	Park.
* *Dosinia greyi* Zitt.	Hochstetter, Park.
,, *magna* Hutt.	Park.
* *Epitonium zelebori* (Dkr.)	Park.
* *Fulgoraria arabica* (Mart.)	Hochstetter, Park.
* ,, *gracilis* (Swains.)	Hutton.
* *Fusinus spiralis* (A. Ad.)	Hutton.
* *Glycymeris laticostata* (Q. & G.)	Hochstetter, Park.
Hipponix radiatus (Hutt.)	Hutton.
Leda semiteres Hutt. "Novara," pl. xv, fig. 12	Hochstetter.
Lutraria sulcata Hutt.	Hutton.
Mactra chrydæa Sut.	Park, Hutton.
* ,, *elongata* Q. & G.	Hutton.
Miomelon corrugata (Hutt.)	Park, Hutton.
* *Mytilus magellanicus* Lamk. (? *striatus* Hutt.)	Park.
* *Natica zelandica* Q. & G.	Park.
* *Ostrea angasi* Sow.	Park.
,, *nelsoniana* Zitt.	Hutton.
Panope orbita Hutt.	Park.
* *Paphia intermedia* (Q. & G.)	Hutton.
,, n. sp.	Park.
* *Pecten convexus* Q. & G.	Park.
,, *triphooki* Zitt.	Park.
Polinices huttoni Iher. "Novara," pl. xv, fig. 6	Hochstetter.
* *Protocardia pulchella* (Gray)	Park.
* *Siphonalia caudata* (Q. & G.)	Park.
,, *conoidea* (Zitt.)	Hochstetter.
* ,, *dilatata* (Q. & G.)	Park.
,, *subnodosa* (Hutt.)	Park.
* *Solariella egena* (Gould)	Park.
,, *stoliczkai* (Zitt.)	Hochstetter.
* *Soletellina siliqua* Reeve	Hutton.
Struthiolaria canaliculata Zitt.	Hochstetter.
,, *cincta* Hutt.	Hutton, Park.
,, *cingulata* Zitt.	Hochstetter
* ,, *papulosa* (Mart.)	Park.
* ,, *vermis* (Mart.)	Hutton, Park.
,, sp. "Novara," pl. xv, fig. 3	Hochstetter.
Trochus circinatus Hutt.	Hutton.
Turritella ambulacrum Sow. (? *huttoni* Cossm.)	Hutton.
* ,, *rosea* Q. & G.	Park, Hutton.
* ,, *symmetrica* Hutt.	Park, Hutton.
* *Zenatia acinaces* (Q. & G.)	Park.

Fifty-nine species, of which thirty-three also Recent = 56 per cent.

Age : Miocene to Pliocene. Awatere Series.

For the original lists or records see—Hochstetter, F. von, and others, "Paläontologie von Neuseeland," *Reise der österr. Fregatte Novara*, Geol. Theil., 1 Bd., 2 Abt., 1864 ; Hutton, F. W., *Catalogue of the Tertiary Mollusca and Echinodermata of New Zealand*, 1873 ; Park, J., "On the Marine Tertiaries of Otago and Canterbury," *Trans. N.Z. Inst.*, vol. 37, 1905, pp. 547–48.

Lower Awatere River. Geol. Surv. Loc. 126. Buchanan; 1867.

T = also collected by J. A. Thomson (see following lists).

Ampullina (Megatylotus) suturalis (Hutt.).
**Ancilla (Baryspira) depressa* (Sow.). T.
**Calyptræa* (s. str.) *alta* (Hutt.).
Chione meridionalis (?) (Sow.). T.
* ,, *mesodesma* (Q. & G.). T.
Crepidula gregaria Sow. T.
* ,, *monoxyla* (Less.). T.
,, *striata* (Hutt.). T.
Cucullæa alta Sow.
**Dosinia greyi* Zitt.
**Ethalia zelandica* (H. & J.). T.
**Glycymeris laticostata* (Q. & G.). T.
Heliacus imperfectus Sut.
Lutraria sulcata (?) Hutt. T.
**Macrocallista multistriata* (?) (Sow.).
**Mactra ovata* (Grey).
Maculopeplum elegantissimum (Sut.). T.
Miomelon corrugata (Hutt.). T.
**Natica zelandica* Q. & G.
**Ostrea (Anodontostrea) angasi* Sow. T.
,, ,, *nelsoniana* Zitt.
Polinices (Neverita) huttoni Iher. T.
,, ,, *ovatus* (?) (Hutt.).
**Solariella egena* (Gould).
Struthiolaria cincta Hutt. T.
,, *cingulata monilifera* Sut.

Twenty-six species, of which twelve also Recent = 46 per cent. Fourteen of these have also been collected by J. A. Thomson.

Age: Upper Miocene and Lower Pliocene (?). Awatere Series.

The exact locality or localities from which Buchanan collected cannot now be identified, but it is probable that his material came from a considerable thickness of strata, and from more than one locality.

Mudstone Cliffs, Awatere River, Left Bank, above Seddon Railway-bridge. J. A. Thomson; 1914.

B in this and following lists = also collected by Buchanan (loc. No. 126).

**Ancilla (Baryspira) depressa* (Sow.). B.
* ,, *(Amalda) novæ-zelandiæ* (Sow.).
,, *(Alocospira) papillata* (Tate).
Awateria streptophora Sut. 22 specimens.
,, ,, *evanida* Sut. 4 specimens.
**Bathytoma nodilirata* (Murd. & Sut.).
**Drillia chordata* Sut.
Lutraria sulcata (?) Hutt. B.
**Murex zelandicus* Q. & G.
**Protocardia (Nemocardium) pulchella* (Gray).
Siphonalia conoidea (Zitt.).
* ,, *mandarina* (Duclos).
**Turritella (Peyrotia) carlottæ* Wats.

Thirteen species, of which eight also Recent = 61·5 per cent.

Age: Lower Pliocene (?). Awatere Series.

Awatere Valley, Starborough Creek, above Waterfall. J. A. Thomson; 1914.

**Anomia trigonopsis* Hutt.
**Chione yatei* (Gray).
**Corbula zelandica* (?) Q. & G.
Crepidula gregaria Sow. B.
,, *striata* (Hutt.). B.
**Dentalium nanum* Hutt.
,, *solidum* Hutt.
**Dosinia lambata* (Gould).
**Nucula nitidula* A. Ad.
Polinices (Neverita) huttoni Iher. B.
Siphonalia conoidea (Zitt.).
,, *turrita* Sut.
**Soletellina siliqua* Reeve.
**Spisula ordinaria* (E. A. Smith).
Struthiolaria canaliculata Zitt.
**Tellina glabrella* Desh.
Trophon pulcherrimus Sut.
**Turritella (Peyrotia) carlottæ* Wats.

Eighteen species, of which ten also Recent = 56 per cent.

Age: Lower Pliocene or Uppermost Miocene. Awatere Series.

Awatere Valley, Lower End of Starborough Creek. J. A. Thomson; 1914.

Ampullina (Megatylotus) suturalis (Hutt.).
**Ancilla (Baryspira) depressa* (Sow.). B.
**Anomia trigonopsis* Hutt.
Bathytoma sulcata excavata Sut.
Cardium spatiosum Hutt.
**Chione mesodesma* (Q. & G.). B.
**Crepidula monoxyla* (Less.). B.
Dentalium solidum Hutt.
**Dosinia lambata* (Gould).
,, *magna* Hutt.
**Drillia chordata* Sut.
**Epitonium (Cirsotrema) zelebori* (Dkr.).
**Ethalia zelandica* (H. & J.). B.
**Glycymeris laticostata* (Q. & G.). B.
Mactra chrydœa Sut.
Miomelon corrugata (Hutt.). B.
Olivella neozelanica (Hutt.).
**Ostrea (Anodontostrea) hyotis* (L.).
**Ostrea (Anodontostrea) tatei* Sut.
Panope orbita Hutt.
Pecten (Patinopecten) crawfordi Hutt.
,, ,, *triphooki* Zitt.
Polinices (Neverita) huttoni Iher. B.
Siphonalia conoidea (Zitt).
* ,, *mandarina* (Duclos).
,, *turrita* Sut.
Solariella stoliczkai (Zitt). Common.
**Soletellina siliqua* Reeve.
Struthiolaria canaliculata Zitt.
,, *cingulata* Zitt.
* ,, *papulosa* (Mart).
* ,, *vermis tricarinata* Less.
Turritella (Archimediella) huttoni Cossm.
* ,, *(Peyrotia) rosea* Q. & G.
**Zenatia acinaces* (Q. & G.).

Thirty-five species, of which seventeen also Recent = 49 per cent. Seven were also collected by Buchanan in 1867.

Age: Uppermost Miocene or Lowest Pliocene. Awatere Series.

Starborough Creek is a small stream which flows through Seddon and enters the Awatere below the railway-bridge.

Railway-cutting South-east of Seddon. J. A. Thomson; 1912.

Alectrion socialis (Hutt.).
Cominella sp.?
**Cuspidaria fairchildi* Sut. New as a fossil.
Dentalium mantelli Zitt.
**Malletia australis* (Q. & G.).
Marginella (Eratoidea) harrisi (?) Cossm.
Miomelon corrugata (Hutt.). B.
Mitra sp.?
**Nucula strangei* A. Ad.
**Verticipronus mytilus* Hedley. New as a fossil.

Age: Miocene (Upper) or Pliocene (Lower). Awatere Series.

East Shore of Lake Grassmere, Half a Mile from Bar: Awatere Beds. J. A. Thomson; 1914.

Awateria streptophora Sut.
**Bathytoma nodilirata* (Murd. & Sut.).
,, *sulcata excavata* Sut.
Drillia wanganuiensis (Hutt.) var.
Miomelon corrugata (Hutt.) B.
Surcula fusiformis (Hutt.)

Age: Miocene (Upper) or Pliocene (Lower). Awatere Series.

Tatchell's† Creek Tributary of Flaxbourne River), West of Ward. J. A. Thomson; 1914.

**Ancilla (Baryspira) australis* (Sow.).
Cardium maorinum (?) Sut.
,, *spatiosum* Hutt.
Chione meridionalis (?) (Sow.). B.
**Cominella lurida* (Phil.).
Dentalium solidum Hutt.
Leda semiteres Hutt.
**Limopsis aurita* (Brocchi).
,, *catenata* Sut.
Maculopeplum elegantissimum (Sut.). B
Miomelon corrugata (Hutt.). B.
**Ostrea (Anodontostrea) angasi* Sow. B.
Panope orbita Hutt.
Pecten (Pseudamusium) huttoni (Park).
**Siphonalia dilatata* (?) (Q. & G.).
Struthiolaria cincta Hutt. B.
,, *tuberculata* Hutt.
**Turritella* (s. str.) *symmetrica* (?) Hutt.

Eighteen species, of which six also Recent = 33 per cent.

Age: Miocene. Awatere Series (presumably).

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† Spelt "Tachall" on Lands and Survey Department's map of Marlborough County.

Waipapa Point and Clarence Valley, Marlborough : Grey Marls. J. A. Thomson ; 1912.

(1.) Grey Marls, Waipapa Point.

**Emarginula striatula* Q. & G.
**Malletia australis* (Q. & G.).
Turritella (Torcula) semiconcava Sut.

(2.) Upper Grey Marls, South Cliff, North Branch Dee.

Cytherea chariessa Sut.
Dentalium mantelli Zitt.
Glycymeris globosa (Hutt.).
Polinices gibbosus (Hutt.).
Siphonalia subnodosa (Hutt.).
Struthiolaria tuberculata Hutt. Juv.
Turritella (Torcula) semiconcava Sut.

(3.) Upper Grey Marls, North Branch Dee.

Acmæa n. sp.

4.) Supposed Lower Grey Marls, South Side, North Branch Dee.

Turritella (Torcula) semiconcava Sut. Many specimens.

(5.) Upper Grey Marls, Mead Gorge, 20 ft. below Conglomerate.

Ancilla (s. str.) *hebera* (Hutt.).
Clio (Styliola) rangiana (Tate). New to fauna (*i.e.*, in 1912).
**Limopsis aurita* (Brocchi).
Turritella (Torcula) semiconcava Sut.

(6.) Grey Marls, Mead Gorge, 25 ft. below Conglomerate.

Ancilla (s. str.) *hebera* (Hutt.). Fragment.
Dosinia magna Hutt.
Glycymeris globosa (Hutt.).
Paphia curta (Hutt.).
Polinices sp. ?
Turritella (Torcula) semiconcava Sut.
**Zenatia acinaces* (Q. & G.).

(7.) Upper Grey Marls, Mead Gorge, 30 ft. below Conglomerate.

Ancilla (s. str.) *hebera* (Hutt.). Fragment.
Chione meridionalis (?) (Sow.).
**Malletia australis* (Q. & G.).
Miomelon corrugata (?) (Hutt.). Juv.
Paphia curta (?) (Hutt.).
Polinices gibbosus (Hutt.).
Siphonalia conoidea (?) (Zitt).
,, n. sp.
Turritella (Torcula) semiconcava Sut.

(8.) Upper Grey Marls, Mead Gorge, 100 ft. below Conglomerate.

Dentalium mantelli Zitt.
**Fulgoraria arabica* (?) (Mart.). Juv.
Paphia curta (Hutt.).

(9.) Upper Grey Marls, Mead Gorge, 130 ft. below Conglomerate.

Cardium patulum (?) Hutt. Fragment.

(10.) Upper Grey Marls, Mead Gorge : Derived Boulder in situ.

Ancilla (s. str.) *hebera* (Hutt.).
**Anomia trigonopsis* (?) Hutt.
**Calyptræa (Sigapatella) maculata* (Q. & G.).
Glycymeris globosa (Hutt.).
**Mactra scalpellum* Reeve.
Paphia curta (Hutt.).
Polinices sp. ?

(11.) Upper Grey Marls, Mead Gorge : Derived Boulder from Slip.

**Anomia trigonopsis* (?) Hutt. (*A. walteri* Hect. is a synonym.)
**Calyptræa (Sigapatella) maculata* (Q. & G.).
Cucullæa alta Sow.
Dentalium mantelli Zitt.
Glycymeris globosa (Hutt.).
**Mactra scalpellum* Reeve.
Paphia curta (Hutt.).
Turritella (Torcula) emiconcava Sut.

(12.) Slip, Upper Grey Marls, Mead Gorge.

Ancilla (s. str.) *hebera* (Hutt.). Fragment.
„ *(Alocospira) papillata* (Tate). Fragment.
**Limopsis aurita* (Brocchi).
Paphia curta (Hutt.).
Polinices gibbosus (Hutt.).
Struthiolaria cincta (?) Hutt.
Turritella (Torcula) semiconcava Sut.

Age: Tertiary. The Grey Marls of Weka Pass, Amuri Bluff, Clarence Valley, &c., were supposed by Hector and McKay to form the closing member of the Cretaceo-Tertiary Formation. It is now certain that they are purely Tertiary in age, but from time to time calcareous mudstones in many localities, and without doubt from varying horizons, have been assigned to the Grey Marl. Some of these rocks are Miocene, others probably pre-Miocene. Thus the term "Grey Marl" is practically without age significance. See J. A. Thomson in *6th Ann. Rep. N.Z Geol. Surv.*, Parl. Paper C.–9, 1912, p. 9; *7th Ann. Rep. N.Z. Geol. Surv.*, part of Parl. Paper C.–2, 1913, p. 123, &c.; and *Trans. N.Z. Inst.*, vol. 48, 1916, p. 50.

Deadman's Creek Beds, Marlborough. J. A. Thomson; 1912.

**Dosinia greyi* (?) Zitt.
**Fulgoraria arabica* (Mart.).
* „ „ *depressa* Sut. New as a fossil.
Glycymeris globosa (Hutt.).
Polinices gibbosus (Hutt.).
Protocardia sera Hutt.
Siphonalia subnodosa (Hutt.).
Struthiolaria tuberculata Hutt.
Turritella (Torcula) concava Hutt.
„ „ *semiconcava* Sut. Many specimens.

Age: Miocene.

Reference: J. A. Thomson, *7th Ann. Rep. N.Z. Geol. Surv.*, part of Parl. Paper C.–2, 1913, p. 123.

Oaro Creek, North of Amuri Bluff (900 ft. above Sea-level): Sandy Beds. C. A. Cotton and J. A. Thomson; 1912.

**Chione mesodesma* (Q. & G.)
**Cominella virgata* A. Ad.
* „ *zealandica* (Reeve).
**Dentalium nanum* Hutt
Drillia æquistriata Hutt.
* „ *chordata* Sut.
**Glycymeris laticostata* (Q. & G.).
**Glycymeris modesta* (Ang.).
Pecten triphooki Zitt.
Siphonalia elegans Sut.
**Terebratella sanguinea* Leach.
**Turritella symmetrica* Hutt.
**Venericardia difficilis* (Desh.).
* „ *lutea* (Hutt.).

Age: Upper Pliocene (probably).

The above list was not among those forwarded by Mr. Suter. The determinations were made in 1912. See *6th Ann. Rep. N.Z. Geol. Surv.*, Parl. Paper C.–9, 1912, p. 8.

Amuri Bluff: Amuri Limestone. Geol. Surv. Loc. 12. McKay, 1873, 1876; J. A. Thomson, 1913.

(M = McKay; T = Thomson.)

Amusium n. sp. ? M, T.
Pecten (Patinopecten) delicatulus (?) Hutt. M, T.
* „ *(Chlamys) zelandiæ* Gray. M.
„ n. sp., near *P. chathamensis*, but distinct. M, T.

Age: Upper Cretaceous (Danian) (?). *Horizon:* Uppermost Waiparan.

J. A. Thomson has collected *Amusium zitteli* in the same locality. See *Trans. N.Z. Inst.*, vol. 48, 1916, p. 50.

Amuri Bluff : Raised Beach (450 ft.). Geol. Surv. Loc. 158. McKay; 1876.

**Cantharidus tenebrosus huttoni* (E. A. Smith).
**Trochus chathamensis* (Hutt.).

Age : Pleistocene.

McKay made a large collection from a bed of fine beach gravel overlain by 8 ft. to 10 ft. or more of fine loam (MS.).

Amuri Bluff Hill : Raised Beach, 450 ft. above Sea-level. Geol. Surv. Loc. 767. McKay; 1876.

Cominella monilifera Hutt.
**Euthria linea traversi* (?) (Hutt.).

Age : Pleistocene.

Loc. 767 is the same as Loc. 158 (McKay, MS.).

Reference : McKay in *Rep. of Geol. Explor. during 1874–76*, No. 9, 1876, p. 173.

Cheviot Hills Estate, Cheviot County : Upper Pareora Beds. Geol. Surv. Loc. 505. McKay ; 1882.

Pecten (Patinopecten) triphooki Zitt.

Age : Upper Miocene (possibly Pliocene). Awatere Series, or Upper Pareora beds (McKay in MS. lists written at different times).

Between West Wanganui and Mokihinui, West Coast of Nelson. Geol. Surv. Loc. 637. Hector ; 1866.

**Glycymeris laticostata* (?) (Q. & G.).
Ostrea (Anodontostrea) nelsoniana Zitt.
Ostrea (s. str.) *wuellerstorfi* Zitt.
Polinices (Neverita) huttoni Iher.

Also *Terebratula magna* (Hamilton) (determined by J. A. Thomson).

Age : Tertiary (Miocene).

References : Hector in *Abstract Rep. on Progress of Geol. Surv. of N.Z. during 1866–67* (= *Rep. of Geol. Explor.* No. 4), 1868, pp. 14, 15 ; *N.Z. Geol. Surv. Bull. No. 17*, 1915, p. 92. So far as can be ascertained, Hector's collection (which originally contained over thirty specimens) was made from at least two distinct localities, one north of Kahaurangi Point and the other near the mouth of the Mokihinui River.

White Rock (Gentle Annie) Point, North of Mokihinui. Geol. Surv. Loc. 55. McKay; 1874.

Ostrea (s. str.) *wuellerstorfi* Zitt.

Age : Middle Miocene (probably). *Horizon :* Ototaran (?).

Inland of White Rock Point, Four Miles (or less) North of Mokihinui River. Geol. Surv. Loc. 34. McKay; 1874.

Amusium zitteli (Hutt.).

Age : Eocene. *Horizon* : Kaiatan.

The description given in McKay's MS. list states that the beds he collected from consist of dark marly mudstone similar to the roof of the coal in Coal or Parenga Creek. *Amusium zitteli* was also collected north of the Mokihinui River by P. G. Morgan in 1911 (*N.Z. Geol. Surv. Bull. No. 17*, 1915, p. 81).

Brewery Creek, Mokihinui River, West Coast of Nelson : Conus Beds. Geol. Surv. Loc. 44. McKay ; 1874.

Ampullina (Megatylotus) suturalis (Hutt.).
**Atrina zelandica* (Gray).
Bathytoma haasti (?) (Hutt.).
Chione meridionalis (Sow.).
Conus deperditus Sut.
,, *fusellinus* Sut.
Corbula canaliculata Hutt.
,, *humerosa* Hutt.
Cytherea sulcata (Hutt.). Fairly common.
Dentalium solidum Hutt.
**Dosinia greyi* Zitt. Fairly common.
Epitonium sp. ?
Galeodea senex (?) (Hutt.).
Mactra aff. *chrydœa* Sut.
Polinices gibbosus (Hutt.).
,, *(Neverita) huttoni* Iher.
**Protocardia (Nemocardium) pulchella* (Gray).
**Psammobia zelandica* Desh.
Sinum (Eunaticina) cinctum (Hutt.).
Siphonalia aff. *costata* (Hutt.).
Struthiolaria cincta Hutt.
**Tellina eugonia* Sut.
Turbo n. sp.
Turritella (Torcula) semiconcava Sut.
**Zenatia acinaces* (Q. & G.).

Twenty-five species, of which six also Recent = 24 per cent.

The collection consists chiefly of fragments and casts.

Age : Upper Miocene. *Horizon :* Pareoran.

Matrix : Fine-grained calcareous sandstone or sandy mudstone.

References : McKay in *Rep. of Geol. Explor. during 1873–74*, No. 8, 1877, p. 113 ; Morgan and Bartrum in *N.Z. Geol. Surv. Bull. No. 17*, 1915, pp. 89 *et seq.* ; G. F. Harris in *Cat. of Tert. Moll. in Dept. of Geology, Brit. Mus.*—Part I, The Australian Tertiary Mollusca, 1897, p. 36, &c.

Between Ngakawau and Mokihinui Rivers. Geol. Surv. Loc. 281. Hector ; 1871.

Ostrea (s. str.) *wuellerstorfi* Zitt.

One specimen is a very large accumulation of left valves.

Age : Eocene or Miocene—probably the former.

Cape Foulwind, Westport. Geol. Surv. Loc. 823.

Miomelon corrugata (Hutt.).

Age : Miocene. *Horizon :* Pareoran (probably).

McKay in one of his MS. lists assigns this locality to the Pareora Series, and mentions that the collection (three specimens) contains a very large tooth described by Davis (*Carcharodon megalodon*).

Buller-Mokihinui Subdivision, Westport Division. P. G. Morgan, J. A. Bartrum, and others ; 1911–1913. *N.Z. Geol. Surv. Bull. No. 17*, 1915.

Mr. Suter's lists are rearranged according to localities.

Karamea Road, near Corbyvale and Fall Creek.

Glycymeris sp. Casts of young, not Recent, shells.

Age : Miocene. *Horizon :* Ototaran. *Matrix :* Argillaceous limestone.

Coast-line near Kongahu Point : Coarse Calcareous Grit.

Ostrea (s. str.) *wuellerstorfi* Zitt.

Age : Miocene. *Horizon :* Ototaran (?).

Mouth of Six-mile Creek, South of Kongahu Point.

Pecten (Pseudamusium) huttoni (Park).

Age: Miocene. *Horizon:* Ototaran.

Near Gentle Annie Point, North of Mokihinui River.

Hinnites trailli (?) Hutt. Neanic part of valve missing.

Age: Miocene. *Horizon:* Ototaran.

Karamea Road, North of Seddonville: Limestone.

Anomia sp.
Lima sp.

Age: Miocene. *Horizon:* Ototaran.

Karamea Road, near Tobin Creek: Kaiata Beds.

Amusium zitteli (Hutt.).
**Lima bullata* (Born).

Age: Eocene. *Horizon:* Kaiatan.

Foraminifera from the calcareous Kaiatan mudstone of this locality have been examined by Mr. F. Chapman. His determinations are—

Cristellaria subalata Reuss.
,, *cultrata* (Montfort).
Haplophragmium incisum Stache.

Yellow Silver-pine Exploration Company's Tramway, South of Mokihinui Mine. P. G. Morgan; 1911.

Melina zealandica Sut. Fragment.
Ostrea (Anodontostrea) nelsoniana Zitt.
,, (s. str.) *wuellerstorfi* Zitt.
Trigonia sp. Fragment.
Turritella (Torcula) concava Hutt. Young shells.

Age: Eocene. *Horizon:* Islandian (below Kaiatan). *Matrix:* Dark sandstone and grit, not far above coal horizon.

Road to Denniston, East of Waimangaroa Junction. P. G. Morgan and J. A. Bartrum; 1912.

Chione meridionalis (Sow.).
* ,, *stutchburyi* (Gray).
,, sp.
Crepidula gregaria Sow.
Dentalium solidum Hutt.
**Fulgoraria gracilis* (?) Swains.
Glycymeris cordata (Hutt.).
Olivella neozelanica (Hutt.).
Polinices gibbosus (Hutt.).

Age: Upper Miocene. *Horizon:* Pareoran. *Matrix:* Calcareous sandy claystone.

East of Denniston, on Road between Burnett's Face and Kiwi Compressor. P. G. Morgan; 1912.

Cardium brunneri Hect.
Pecten hochstetteri Zitt.

Age: Eocene. *Horizon:* Lowest Kaiatan or Islandian. *Matrix:* Dark sandy shelly mudstone just above coal-grits and sandstones.

Upper Mackley River, 35 chains South-east of Trig. J. P. G. Morgan; 1912.

Amusium zitteli (Hutt.).
Chione sp.
Mactra sp. Juv.
Ostrea aff. *wuellerstorfi* Zitt.
Pecten (Chlamys) williamsoni (?) Zitt.
Pholadomya neozelanica Hutt.
Turritella aff. *ambulacrum* Sow.

Age: Eocene. *Horizon:* Lowest Kaiatan or Islandian. *Matrix:* Dark micaceous argillaceous sandstone.

Cape Foulwind, West of Westport. P. G. Morgan; 1912–13.

Dentalium mantelli Zitt. Below limestone.
,, *solidum* Hutt.
Limopsis morgani Sut. Generic position not beyond doubt, as the hinge is unknown. Horizon about 150 ft. above limestone.
Pecten (Pseudamusium) huttoni (Park). Above limestone.

Age: Miocene. *Horizon:* Ototaran to Pareoran.

Omanu (or Back) Creek, South-south-east of Westport. J. A. Bartrum; 1912 or 1913.

Cytherea sp. ? Cast.
Mactra chrydæa Sut.
Trochus sp. Cast of a small species.

Age: Upper Miocene. *Horizon:* Pareoran. *Matrix:* Calcareous sandy claystone.

Totara River, between Addison's Flat and Charleston. J. A. Bartrum; 1913.

Cucullæa ponderosa var. B Hutt.
**Dosinia greyi* Zitt.

Age, &c.: As for Omanu Creek.

One Mile below Lyell, Buller River, West Coast of Nelson. Geol. Surv. Loc. 274. McKay; 1874.

Cardium patulum (?) Hutt. Juv.
Chione meridionalis (Sow.).
Crepidula gregaria Sow.
Cytherea sulcata (?) (Hutt.). Juv.
Panope worthingtoni Hutt.
Pholadomya neozelanica Hutt. Cast.

Age: Miocene. *Horizon:* Ototaran (probably).

This collection was made near the present bridge over the Buller on the main road, but whether from the limestone that there outcrops or underlying calcareous claystone is not known. An examination of the matrix of the fossils (which have not been seen by the writer of this note) would clear up the point.

McKay seems to have made the collection in the latter part of 1874. See *Rep. of Geol. Explor. during 1874–76*, No. 9, 1877, pp. 36 *et seq.* Lyell mentioned on p. 40.

The localities listed below, from Three-channel Flat to Rainy Creek, are in the Reefton Subdivision. See *N.Z. Geol. Surv. Bull. No. 18*, 1917.

Three-channel Flat, North of Inangahua Junction. V. Dellavedova.

Cucullæa alta Sow. Collected from Miocene rocks.

Christie's, Westport–Reefton Road, near Inangahua Junction. Geo. Surv. Loc. 50. McKay; 1874.

Crepidula sp. ?
Dentalium solidum Hutt.

Age: Miocene. *Horizon:* Below Inangahua limestone.

According to McKay in MSS., the beds collected from are dark marly clays with concretions underlying the limestone at the junction of the Inangahua and Buller rivers. In one list he states that the beds overlie the limestone, but this is believed to be a slip of the pen.

Reference: McKay, *Rep. of Geol. Explor. during 1873–74*, No. 8, 1877, pp. 101–2.

Junction of Inangahua and Buller Rivers, West Nelson. Geol. Surv. Loc. 48. McKay; 1874.

Anomia undata Hutt. Juv.
Atrina distans (?) (Hutt.).
Chama huttoni Hect.
Fusinus sp. ?
**Lima angulata* Sow.
* ,, *suteri* Dall. New as a fossil.
Modiolus sp. ?
Ostrea (s. str.) *wuellerstorfi* Zitt.
Pecten (Chlamys) williamsoni (?) Zitt.
**Protocardia (Nemocardium) pulchella* (Gray).
Turbo sp.
Turritella sp.
**Xenophora corrugata* (Reeve).

Very few fossils could be determined; fragments of oyster-shells are numerous in this rock.

Age: Miocene. *Horizon:* Below Inangahua limestone.

Reference: McKay, *Rep. of Geol. Explor. during 1873–74*, No. 8, 1877, pp. 101–2.

Ferry, Inangahua River, Westport–Reefton Road: Limestone Horizon. Geol. Surv. Loc. 49. McKay; 1874.

**Anomia huttoni* Sut.
Cytherea sulcata (?) (Hutt.).
Pecten (Pseudamusium) huttoni (Park).
Pholadomya neozelanica Hutt.

Age: Miocene. *Horizon:* Upper Ototaran (?).

Reference: McKay, *loc. cit.*, p. 101 (Inangahua Crossing). There is some reason for believing that the Inangahua limestone is, on the whole, at a somewhat higher horizon than the Cobden limestone, which may very fairly be assigned to the Ototaran, and thus correlated with the Oamaru or Ototara limestone.

St. Kilda, North of Brighton, West Coast of Nelson. Geol. Surv. Loc. 45. McKay; 1874.

Cardium priscum Sut.
,, *waitakiense* (?) Sut.
Cucullæa alta Sow.
**Dosinia greyi* (?) Zitt.
**Lima angulata* Sow.
* ,, *suteri* Dall.
**Ostrea* (s. str.) *corrugata* (?) Hutt. Juv.
**Panope zelandica* Q. & G.
Pecten (Pseudamusium) hochstetteri Zitt. Common.
,, *(Chlamys) scandula* Hutt.
Pinna (?) *lata* Hutt.
Teredo heaphyi Zitt.
Turritella (Peyrotia) patagonica Sow.
,, *(Torcula) semiconcava* (?) Sut.
* ,, (s. str.) *symmetrica* (?) Hutt.

Fifteen species, of which six are Recent = 40 per cent.

Age: Miocene. *Horizon:* Ototaran (?).

Reference: McKay, *loc. cit.*, p. 108. The collection made by McKay contains numerous Foraminifera embedded in highly calcareous marl or soft limestone which passes upward into the Charleston and Fox River limestone (McKay in MS.).

Welshman's Terrace, Fox River, Brighton, West Coast of Nelson: Roof of Coal. Geol. Surv Loc. 28. McKay; 1873–74.

**Arca novæ-zealandiæ* E. A. Smith.
Cardium sp. ?
Chione chiloensis truncata (?) Sut.
,, *meridionalis* (?) (Sow.).
Cucullæa n. sp. ?
Daphnella aff. *neozelanica* Sut.
Dosinia sp. ?
Leda semiteres Hutt.
Olivella neozelanica (Hutt.). Juv.
Panope orbita (?) Hutt. Juv.
Paphia curta (Hutt.).
Pecten (Chlamys) scandula Hutt.
Polinices sp.
Surcula n. sp. ?

Age: Miocene. *Horizon:* Waiarekan (?).

Woodpecker Bay, near Brighton, West Coast of Nelson: Island Sandstone. Geol. Surv. Loc. 31. McKay; 1874.

Lima colorata Hutt.
Ostrea wuellerstorfi Zitt.
Pecten (Pseudamusium) hochstetteri Zitt. Common.
,, *(Patinopecten) hutchinsoni* Hutt. Juv.
Pecten (Patinopecten) marshalli (?) Sut.
,, ,, *sectus* Hutt.
Teredo heaphyi Zitt.
**Turritella* (s. str.) *symmetrica* Hutt.

Age: Miocene. *Horizon:* Ototaran (?) or Waiarekan (?).

Reference: McKay, *loc. cit.*, pp. 108, 111. "Island sandstone" is undoubtedly a misnomer. Correlation must be made with the lower part of the Greymouth Series, not with the Mawheranui Series.

Woodpecker Bay, near Brighton, West Coast of Nelson: Above Sandstone. Geol. Surv. Loc. 33. McKay; 1874.

Atrina distans (Hutt.).
Chione aff. *elegans* (Hutt.).
**Dosinia greyi* Zitt. Fragment.
Pinna lata (?) Hutt. Fragment.
Teredo heaphyi Zitt.
Trochus sp. ?
Turris sp.

Age: Miocene. *Horizon:* Ototaran (?).
Reference: McKay, *loc. cit.*, pp. 108, 111.

Seal Rock, Woodpecker Bay, near Brighton, West Coast of Nelson. Geol. Surv. Loc. 46. McKay; 1874.

Lima (Plagiostoma) regia Sut. (holotype).

Age: Miocene. *Horizon:* Ototaran (?).

The above-named fossil is figured in *N.Z. Geol. Surv. Pal. Bull. No. 5*, 1917, pl. ix, fig. 1, and is described on pp. 70–71. The collection made by McKay contained at least twenty-six specimens. A specimen of the penguin *Palæudyptes antarcticus* Huxley and the type of the crab *Harpactocarcinus tumidus* Woodward have also been collected on Seal (or Penguin) Island.

References: McKay, *loc. cit.*, p. 111; *N.Z. Geol. Surv. Bull. No. 18*, 1917, pp. 93, 94.

Fox River, above Dilemma Creek, Brighton, West Coast of Nelson: Blue Bottom. Geol. Surv. Loc. 38 (red number). J. Henderson; 1913.

Dentalium solidum Hutt.
**Dosinia greyi* Zitt.
Lima paucisulcata Hutt.
Panope orbita Hutt.
Paphia curta (?) (Hutt.).
Pleurotomaria tertiaria McCoy.
Polinices gibbosus (Hutt.).
**Psammobia lineolata* Gray.
Semele n. sp. ?

Age: Upper Miocene. *Horizon:* Pareoran.

Fox River, Brighton, West Coast of Nelson. Geol. Surv. Loc. 125. McKay; 1874.

Macrocallista pareoraensis (?) Sut.
**Modiolus australis* (Gray).
Sinum (Eunaticina) cinctum (Hutt.).

Age: Upper Miocene. *Horizon:* Pareoran.
Reference: McKay, *loc. cit.* pp. 109–10.

Fox River, West Coast of Nelson: Blue Bottom. P. G. Morgan; March, 1911.

**Dosinia greyi* Zitt.
Olivella neozelanica (Hutt.).

Age: Upper Miocene. *Horizon:* Pareoran. *Matrix:* Calcareous sandy claystone.

The last three localities are one and the same.

South of Brighton, on the Coast. P. G. Morgan; March, 1911.

Pecten (Pseudamusium) hochstetteri Zitt.

Age: Miocene. *Horizon:* Ototaran (probably).

Two Miles and a Half South of Brighton, West Coast of Nelson. Geol. Surv. Loc. 37 (red number). J. Henderson; 1913.

Pecten (Pseudamusium) hochstetteri Zitt.

Age: Miocene. *Horizon:* Ototaran (probably).

Hunt Creek, Reefton: Blue Bottom. Geol. Surv. Loc. 39 (red number). J. Henderson; 1913.

Crepidula gregaria Sow.
Ostrea (Anodontostrea) incurva Hutt.

Age: Upper Miocene. *Horizon:* Pareoran.

Moonlight Creek, Waiwhero Survey District: Blue Bottom. Geol. Surv. Loc. 41 (red number). J. Henderson; 1912.

**Ancilla (Baryspira) australis* (Sow.).
* ,, ,, *mucronata* (Sow.).
**Architectonica (Philippia) lutea* (Lamk.).
Euthria aff. *media* (Hutt.).
**Glycymeris laticostata* (Q. & G.).
Miomelon corrugata (?) (Hutt.).
**Natica zelandica* (?) Q. & G.
Polinices (Neverita) huttoni Iher.
Siphonalia conoidea (Zitt.).

Age: Upper Miocene. *Horizon:* Pareoran.

Rainy Creek, Inangahua Valley, above Reefton: Beds overlying Coal. Geol. Surv. Loc. 38. McKay; 1874.

Cardium sp.
**Dosinia greyi* (?) Zitt.
Panope orbita Hutt.
**Psammobia lineolata* Gray.
Semele n. sp. ?

Age: Miocene. *Horizon:* Ototaran (?).
McKay in MS. list states that the locality is near the Inkerman Mine.

Ten-mile Creek, on Coast North of Grey River, Greymouth : Roof of Coal-seam. Geol. Surv. Loc. 27. McKay ; 1873–74.

Ancilla sp.
Cardium aff. *brunneri* Hector.
Cominella sp.
Struthiolaria tuberculata concinna Sut.
Tellina sp.
Venericardia sp.

All the fossils are in a very unsatisfactory condition for determination.

Age : Eocene. *Horizon :* Islandian.

References : McKay, *loc. cit.*, p. 81 ; *N.Z. Geol. Sur. Bull. No. 13*, 1911, pp. 61, 62, &c.

Nine-mile Bluff, North of Greymouth. Geol. Surv. Loc. 32. McKay ; 1873 (also Hector ; 1866).

Cardium brunneri (?) Hect.
**Crassatellites obesus* (?) (A. Ad.).
Epitonium (Cirsotrema) lyratum (Zitt.).
Galeodea senex (?) (Hutt.).
Pecten (Pseudamusium) hochstetteri Zitt.
,, ,, *huttoni* (Park).
Teredo heaphyi Zitt.
**Turritella* (s. str.) *symmetrica* Hutt.

Age : Eocene. *Horizon :* Islandian.

Reference : McKay, *loc. cit.*, pp. 80, 81, 82, 83. The large oyster mentioned by McKay does not appear to have been in the collection submitted to Mr. Suter.

Bluff, South of Nine-mile Creek (Nine-mile Bluff), Cobden Survey District, Greymouth : Island Sandstone. P. G. Morgan ; 1910.

Pecten (Pseudamusium) hochstetteri (?) Zitt.
Teredo heaphyi (?) Zitt.

Same locality as last.

Reference : *N.Z. Geol. Surv. Bull. No. 13*, 1911, pp. 61, 62, &c.

Point Elizabeth, Greymouth. Geol. Surv. Loc. 58. McKay ; 1873 (also Hector).

Ostrea sp.
Venericardia sp.

Age : Miocene (Oamaruian). *Horizon :* Ototaran.

McKay's manuscript description of the locality implies that he collected from the limestone only.

Reference : McKay, *loc. cit.*, pp. 79–80, 83.

Greymouth : Cobden Limestone. Geol. Surv. Loc. 35. McKay ; 1873.

Amusium zitteli (Hutt.).
Aturia australis McCoy. Fragment.
Gryphæa tarda (?) Hutt.
**Lima angulata* Sow.
Ostrea (s. str.) *subdentata* (?) Hutt.
Siphonalia sp. ?

Age : Miocene (Oamaruian). *Horizon :* Ototaran.

This was originally a large collection.

Reference : McKay, *loc. cit.*, p. 74.

Greymouth : Cobden Limestone-quarries. Geol. Sur. Loc. 757. 1891 (contributed, but name of donor not recorded).

Cardium (Fragum) dolichum Sut.

Same locality as last. The collection originally contained 126 specimens.

Brunner Mine, Grey Valley, Greymouth. Geol. Surv. Loc. 29. Hector, 1870; McKay, 1873.

Cardium brunneri Hect.

Age: Eocene (Mawheranuian). *Horizon:* Islandian.

Callaghan's Hill, Westland. Geol. Surv. Loc. 225. Hector; 1869.

Galeodea sulcata (Hutt.).
Pecten (Pallium) burnetti Zitt.

Age: Miocene (Oamaruian). *Horizon:* Pareoran or Hutchinsonian.

According to McKay's MS. list, the beds collected from consist of dark greensands (lower beds) and blue clays. The collection at one time contained twenty-nine specimens.

Reference: See also *N.Z. Geol. Surv. Bull. No. 13*, 1911, p. 71, &c.

Kanieri River, Westland. Geol. Surv. Loc. 154. McKay; 1875.

Pecten (Patinopecten) sectus Hutt. Juv.

Age: Upper Miocene. *Horizon:* Pareoran.

Two specimens from a fairly large collection of 162 or 163 specimens.

Waikari Valley, North Canterbury, near the Greta Railway-station, right on the Bank of the Stream. A. Purchas; 1913.

Calyptræa (Sigapatella) maculata (Q. & G.).
Cominella purchasi Sut.
Crepidula monoxyla (Less.).
Glycymeris laticostata (Q. & G.).
Modiolus huttoni Sut.
Mytilus canaliculus (?) Mart.
Polinices gibbosus (Hutt.).
Siphonalia dilatata (Q. & G.).
* ,, *nodosa* (Mart.).
,, *turrita* Sut.
Surcula fusiformis (Hutt.).
Turritella (Peyrotia) carlottæ Wats.
,, *(Torcula) concava* Hutt.
,, ,, *semiconcava* Sut.

Fourteen species, of which seven also Recent = 50 per cent.

Age: Miocene (?).

Weka Pass, North Canterbury: Grey Marls. Geol. Surv. Loc. 71. Hector; 1867.

Sinum (Eunaticina) miocænicum (Sut.).

Age: Eocene or Oligocene.

Reference: Hector, *Rep. of Geol. Explor. during 1868–69*, No. 5, 1869, pp. ix–xii.

Weka Creek, above Weka Pass: Grey Marls. Probably collected by J. A. Thomson; 1913.

Amusium zitteli (Hutt.).
Limopsis aurita (?) (Brocchi). Young shells.

Mount Donald, Weka Pass, North Canterbury: Mount Brown Beds. J. A. Thomson; 1913.

Glycymeris laticostata (Q. & G.).
Lima jeffreysiana Tate. (Mount Brown, fallen boulder).
Limopsis sp. ? Cast with *Flabellum*.
Ostrea (s. str.) *corrugata* Hutt.
Pecten (Patinopecten) beethami Hutt.
,, ,, ,, var. B Hutt. (Sands under Mount Brown limestone.)
Pecten (*Pseudamusium*) *huttoni* (Park).
,, *(Patinopecten) triphooki* Zitt.

Age: Miocene. *Horizon:* Various.

Weka Pass, above Mount Brown Beds. A. Purchas; 1913.

**Ancilla (Baryspira) australis* (Sow.).
* ,, ,, *mucronata* (Sow.).
**Calyptræa* (s. str.) *alta* (Hutt.).
Cerithiella n. sp. ?
**Chione stutchburyi* (Gray).
**Cominella huttoni* Kobelt.
**Dosinia greyi* (?) Zitt.
**Euthria striata* (?) (Hutt.).
**Glycymeris laticostata* (Q. & G.).
**Mactra discors* Gray.
**Mesodesma subtriangulatum* (Gray).
Miomelon corrugata (Hutt.).
**Mytilus canaliculus* Mart.
**Natica australis* (Hutt.).
**Ostrea (Anodontostrea) angasi* Sow.
Phos cingulatus (Hutt.).
Polinices gibbosus (Hutt.).
,, *(Neverita) ovatus* (Hutt.).
**Siphonalia mandarina* (Duclos).
Struthiolaria sp.
**Terebra tristis* Desh.
Trochus conicus Hutt.

Twenty-two species, of which fifteen also Recent = 68 per cent.

Age: Pliocene. *Horizon:* Motunau beds.

Weka Pass, between Waipara and Waikari, North Canterbury. J. A. Thomson; 1913.

I. Upper Mount Brown Limestone (Zone of *Pachymagas parki*). A, M.

A = Main Mount Brown limestone (railway-cutting, $43\frac{1}{2}$ miles)—a series of limestones separated by sands: A_1 = lowest, A_7 = highest bed.
M = Upper part of main body of Mount Brown limestone (valley behind cuesta, lower end of Weka Pass).

Ancilla (Alocospira) papillata (Tate). A_1, A_4.
**Anomia trigonopsis* Hutt. A_1, A_2, A_5.
Lima paucisulcata Hutt. M.
**Mytilus magellanicus* (?) Lamk. A_2.
**Ostrea (Anodontostrea) angasi* Sow. M.
Pecten (Patinopecten) beethami Hutt. M.

II. Uppermost Mount Brown Beds (Zone of *Neothyris sufflata* Tate). B_1, D to L, O, Z.

K, H, E, D = Sands between main Mount Brown limestone and uppermost Mount Brown limestone.
K = Weka Pass Stream above suspension bridge and below H, E, D, in horizon.
H = Weka Pass Stream above suspension bridge: shell-bed.
E = Same shell-bed below suspension bridge.
D = Same shell-bed in Weka Creek, above bridge.

B_1, F, L = *Hinnites* shell-bed at base of uppermost Mount Brown limestone, slightly higher than shell-beds K, H, E, D.
B_1 = In railway-cutting (43 m. 2–3 ch.). (See also IV, B_3.)
F = In Weka Pass Stream.
L = In tributary of Weka Pass Stream crossing railway between the two cuttings.

O, Z = Uppermost Mount Brown limestone.
O = Cuesta above railway-line, behind Weka Pass ridge.
Z = In Weka Pass Creek.

Ampullina (Megatylotus) suturalis (Hutt.). K.
**Ancilla (Amalda) novæ-zelandiæ* (Sow.). D.
,, *(Alocospira) papillata* (Tate). H, K, Z.
**Anomia trigonopsis* Hutt. Z.
**Calyptræa (Sigapatella) maculata* (Q. & G.). D.
**Cochlodesma angasi* (Crosse and Fischer). F.
Crassatellites attenuatus (Hutt.). Fragment. H.
Crepidula gregaria Sow. D, E, Z.
* ,, *monoxyla* (Less.). H.
,, *striata* (Hutt.). E.
Cucullæa alta Sow. var. B Hutt. K.
Cytherea sulcata (Hutt.). E, F, H, Z.
Dentalium solidum Hutt. D, F.
**Dosinia greyi* Zitt. K.
**Fulgoraria arabica* (Mart.). D, H.
Galeodea senex (?) (Hutt.). Z.
,, *sulcata* (Hutt.). E.
Hinnites trailli Hutt. F.
Latirus (Leucozonia) brevirostris (Hutt.). D.
Lima colorata Hutt. K.
,, *paleata* Hutt. Z.
,, *paucisulcata* Hutt. F.
Limopsis zitteli Iher. D, H, K.
Maculopeplum elegantissimum (Sut.). E.
**Natica australis* (Hutt.). K.
**Ostrea (Anodontostrea) angasi* Sow. F.
Pecten (Patinopecten) beethami Hutt. O. Z.
,, *(Pallium) burnetti* Zitt. B_1, D, H, O.
,, *(Patinopecten) crawfordi* Hutt. Fragments. B_1, E, L, O.

Pecten (Pseudamusium) hochstetteri Zitt. Z.
,, ,, *huttoni* (Park). F.
,, *(Patinopecten) triphooki* (?) Zitt. Fragment. Z.
,, *(Chlamys) williamsoni* Zitt. K.
,, n. sp. Fragment. B_1.
Placunanomia incisura Hutt. H.
Polinices gibbosus (Hutt.). D, E.
Protocardia alata Sut. Fragment. D.
Siphonalia costata (Hutt.). D, K.
* ,, *dilatata* (Q. & G.). E.
Surcula fusiformis (Hutt.). K.
**Tellina eugonia* Sut. K.
Thracia n. sp. D.
Turritella (Torcula) concava Hutt. K.
**Venericardia purpurata* (Desh.). H.

Forty-four species, of which twelve also Recent = 27 per cent.

III. Lower Band of Mount Brown Limestone in Mount Donald. W, X.

W = Col to south-west of Mount Donald (exact horizon uncertain).
X = Between W and Mount Donald.

**Anomia trigonopsis* Hutt. X.
Astarte n. sp. Fragment. W.
**Chione stutchburyi* (Gray). X.
**Diplodonta zelandica* (Gray). W.
Pecten (Pallium) burnetti Zitt. W.
Turritella (Torcula) concava Hutt. W.
**Venericardia purpurata* (Desh.). W.

IV. Motunau Beds, Weka Pass. B_3, S, T.

B_3 = In railway-cutting (43 m. 2–3 ch.).
S, T = In Weka Creek, below bridge, right bank; mudstones with *Chione*.
S = Oyster-beds above T; T = Shell-beds above.

**Ancilla (Amalda) novæ-zelandiæ* (Sow.). B_3, T.
**Anomia huttoni* Sut. B_3, T.
Barnea n. sp. Part of a valve. T.
**Calyptræa (Sigapatella) maculata* (Q. & G.). B_3, T.
* ,, (s. str.) *tenuis* (Gray). T.
Chione chiloensis (Phil.). B_3.
Crepidula gregaria Sow. B_3.
Dentalium solidum Hutt. B_3.
**Dosinia subrosea* (Gray). B_3.
**Glycymeris laticostata* (Q. & G.). B_3.
Mactra chrydæa Sut. T.
**Mesodesma australe* (Gmel.). B_3.
**Mytilus canaliculus* Mart. T.
**Ostrea (Anodontostrea) angasi* Sow. B_3.
,, ,, *arenicola* Tate. S.
,, ,, *manubriata* Tate. B_3. New to fauna.
* ,, ,, *tatei* Sut. B_3, T.
Polinices (Neverita) ovatus (Hutt.). B_3.
**Psammobia lineolata* Gray. T.
**Siphonalia dilatata* (Q. & G.). T.
**Spisula æquilateralis* (Desh.). B_3, T.
Trochus conicus (Hutt.). T.

Twenty-two species, of which thirteen also Recent = 59 per cent.

V. Specimens without Special Lettering.

**Anomia trigonopsis* Hutt. Cuesta between North Dean and Waipara River.
**Epitonium (Cirsotrema) zelebori* (Dkr.). Between Weka Pass stone and lower calcareous beds, Waipara River.
**Limopsis aurita* (?) (Brocchi). Grey Marls, Weka Pass.
**Ostrea (Anodontostrea) angasi* Sow. Sands below Mount Brown zone, between Mount Brown and Waipara River.
Pecten (Patinopecten) beethami Hutt. North Dean cuesta.
,, *(Pallium) burnetti* Zitt. North Dean cuesta.
Struthiolaria tuberculata Hutt. Lower Mount Brown beds, Weka Pass.

COLLECTIONS MADE BY J. A. THOMSON, 1913.

(1.) Main Mount Brown Limestone, Foot of the Dip-slope of the Cuesta which faces the Weka Pass.

**Ostrea (Anodontostrea) angasi* Sow.

(2.) Barnacle Conglomerate, Lower Mount Brown Beds, Weka Pass Stream, South of 44-mile Peg.

**Anomia trigonopsis* Hutt.

(3.) **Motunau Beds, Weka Pass, First Railway-cutting South of 43-mile Peg.**

Ancilla (s. str.) *hebera* (Hutt.).
* ,, *(Baryspira) mucronata* (Sow.).
Cerithiella n. sp.
**Dosinia greyi* Zitt.
Glycymeris globosa (?) (Hutt.).
* ,, *laticostata* (Q. & G.).

(4.) **Upper Calcareous Band, Mount Brown Beds, Dean Range Cuesta, and Sandy Beds immediately below it, overlooking Waipara River.**

**Anomia trigonopsis* Hutt.

(5.) **Lower Calcareous Band, Mount Brown Beds, South-west of Mount Brown.**

**Anomia trigonopsis* Hutt.
Ostrea n. sp. ?

(6.) **Sandy Beds, Lower Mount Brown Beds, Boby Creek, below Bridge.**

Nucula sagittata Sut.

Mount Brown, Middle Waipara: Upper Calcareous Band. J. A. Thomson; 1913.

Siphonalia n. sp. One cast with three nodulous keels on body-whorl; nearest to *S. nodosa* but larger and distinct.

This is the same locality as Geol. Surv. Loc. 723.

Lower Gorge of the Waipara. Geol. Surv. Loc. 228. Hector; 1867.

Pecten (Pseudamusium) huttoni (Park).

The beds at the Lower Waipara Gorge itself correspond to the Motunau beds, of Pliocene age. It is not likely that the specimen named above came from the Motunauan horizon. It is probably from one of the older horizons in the immediate neighbourhood.

Lower Waipara: Motunau Beds. J. A. Thomson; 1913.

A to H = Motunau beds on left side of the river from the bridge, towards the sea. A is the lowest bed, and the others follow in upward order to H. A = shell conglomerate on the road-cutting.

**Ancilla (Baryspira) australis* (Sow.). H.
* ,, ,, *depressa* (Sow.). H.
* ,, ,, *mucronata* (Sow.). D.
**Anomia huttoni* Sut. A.
**Atrina zelandica* (Gray). A.
Calliostoma waiparaense Sut. C.
**Cerithidea bicarinata* (Gray). H.
* ,, *tricarinata* Hutt. H. New as a fossil.
**Chione stutchburyi* (Gray). F, H.
Crepidula gregaria Sow. B, D.
* ,, *monoxyla* (Less.). H.
**Cytherea subsulcata* (Sut.). H.
**Glycymeris laticostata* (Q. & G.). B, C, D.
Lutraria solida Hutt. D.
**Mactra ovata* (Gray). F_1.
**Myodora striata* (Q. & G.). H.
**Ostrea (Anodontostrea) angasi* Sow. A, B, E, F.
* ,, (s. str.) *corrugata* Hutt. B.
* ,, *(Anodontostrea) hyotis* (L.). A, E.
,, ,, *nelsoniana* (?) Zitt. D.
* ,, ,, *tatei* Sut. A.
Paphia curta (?) (Hutt.). C. Sands between Grey Marls and Mount Brown beds.
**Pecten (Pallium) convexus* Q. & G. A.
,, *(Patinopecten) crawfordi* Hutt. A.
,, ,, *triphooki* Zitt. A.
**Tellina disculus* Desh. H.
**Turritella* (s. str.) *symmetrica* Hutt. H.

Twenty-seven species, of which twenty also Recent = 74 per cent.

Age: Pliocene.

Lower Waipara: Grey Marls. J. A. Thomson; 1913.

Chione meridionalis (Sow.).
Dentalium solidum Hutt.
Limopsis zitteli Iher.
**Modiolus australis* (Gray).
**Turritella (Peyrotia) carlottæ* Wats.

Kowhai River.† J. A. Thomson; 1913.

A, B, and C are localities in the Motunau beds in the lower end of the basin, seaward side Mount Brown cuesta, B and C being oyster-beds. Probably C is the lowest and A the highest bed.

**Anomia huttoni* Sut. C.
**Architectonica (Philippia) lutea* (Lamk.). C. New as a fossil.
**Chione stutchburyi* (Gray). A.
**Ostrea (Anodontostrea) angasi* Sow. A, C.
* ,, (s. str.) *corrugata* Hutt. A.
* ,, *(Anodontostrea) hyotis* L. A, B, C.
**Psammobia lineolata* Gray. C.

Age: Pliocene.

Middle Waipara. J. A. Thomson; 1913.

F = Grey Marl in a tributary of Boby Creek, above Onepunga Homestead.
H = Grey Marl between the Waipara River and North Dean.
B = Sands below the Mount Brown limestone in Boby Creek; 1 to 5 are various distances down creek between the bridge and the Waipara River, but the succession is not continuous and the collections may be lumped under B.
D = Lower Mount Brown limestone forming the watershed between Onepunga and Mount Grey.
K, L = Adjacent pockets in the main Mount Brown limestone, between Mount Brown and the Waipara River.

Ancilla (Alocospira) papillata (Tate). D.
**Anomia trigonopsis* Hutt. B_1, L.
Corbula canaliculata Hutt. H.
**Diplodonta zelandica* (?) (Gray). F.
Glycymeris cordata (Hutt.) D.
* ,, *laticostata* (Q. & G.). D.
Lima colorata Hutt. K.
**Limopsis aurita* (Brocchi). F.
,, *zitteli* Iher. D.
Maculopeplum elegantissimum (Sut.). D.
**Malletia australis* (Q. & G.). F.
Nucula sagittata Sut. B_3, B_5.
Pecten (Patinopecten) beethami Hutt. B_1.
,, *(Pseudamusium) huttoni* (Park). B_1, D.
,, *(Chlamys) williamsoni* (?) Zitt. K.
* ,, ,, *zelandiæ* Gray. K.
Polinices gibbosus (Hutt.). D.
Siphonalia costata (Hutt.). F.
**Turritella (Peyrotia) carlottæ* Wats. H.

Nineteen species, of which seven also Recent = 37 per cent.

Age and *horizon:* Various.

Middle Waipara: Motunau Beds. J. A. Thomson; 1913.

O = Lowest cuesta of Motunau beds exposed alongside Mount Brown Road.
P = First exposure of Motunau beds, left side, Waipara River, quarter-mile below end of Mount Brown cuesta.
S = First exposure of Motunau beds, Waipara River, right side, opposite end of Mount Brown cuesta.
T = 4 ft. below S.
U = 15–20 ft. below T.

**Ancilla (Baryspira) australis* (Sow.). S.
* ,, ,, ,, *pyramidalis* (Reeve). S.
* ,, ,, *mucronata* (Sow.). T, and top shell-bed above S.
**Anomia huttoni* Sut. U, and top shell-bed above S.
**Barnea similis* (Gray). S.
**Calyptræa (Sigapatella) maculata* (Q. & G.). P, S.
**Cerithidea bicarinata* (Gray). P, T, U,
Chione chiloensis (Phil.). P, S.
* ,, *yatei* (Gray). S, T.
**Chiton quoyi* Desh. S. New as a fossil.
**Cominella adspersa* (Brug.). S.
* ,, *huttoni* Kobelt. S, T.
**Crepidula costata* (Sow.). S.
,, *gregaria* Sow. O, T.
* ,, *monoxyla* (Less.). O, P, S.
Crepidula striata Hutt. S.
Cymbiola (Miomelon) corrugata (?) (Hutt.). S.
**Cytherea oblonga* (?) (Hanley). O.
Dentalium solidum Hutt. O.
**Diplodonta zelandica* (Gray). Juv. S.
**Dosinia greyi* Zitt. P, S.
* ,, *subrosea* (Gray). O, P.
**Fulgoraria (Alcithoë) arabica* (Mart.). S.
**Glycymeris laticostata* (Q. & G.). O.
**Mactra discors* (?) Gray. T. Cast.
**Mangilia sinclairi* (E. A. Smith). S.
**Modiolaria impacta* (Hermann). S. A much-elongated form, but not *M. elongata* (Hutt.).
**Modiolus australis* (Gray). P, S.
**Mytilus magellanicus* Lamk. Loc. ?
**Ostrea (Anodontostrea) angasi* Sow. S, T, U.
,, ,, *nelsoniana* Zitt. O, U.
Plejona huttoni pseudorarispina (?) Sut. S.

† According to the geographical order adopted (see p. 2) this list should follow all the Waipara River lists.

Rissoina vana (Hutt.). S.
**Seila chathamensis* Sut. var. S. More cylindrical than Recent specimens. New as a fossil.
**Siphonalia dilatata* (Q. & G.). S, U.
* ,, *mandarina* (?) (Duclos). O, S.
,, *subreflexa* (Sow.). S.
**Spisula æquilateralis* (Desh.). O.
**Struthiolaria papulosa* (Mart.). T.
**Tellina deltoidalis* Lamk. P, T, U,
* ,, *disculus* Desh. P.
**Terebra tristis* Desh. S.
**Trochus tiaratus* Q. & G. S.
**Trophon corticatus* (Hutt.). S.
**Venericardia difficilis* (Desh.). U.
* ,, *purpurata* (Desh.). S.

Forty-six species, of which thirty-seven also Recent = 80 per cent.

Age: Pliocene.

Middle Waipara: Weka Pass Stone, behind Onepunga Homestead. J. A. Thomson; 1913.

Dentalium solidum Hutt.
Dentilucina (Here) n. sp. Casts.
Epitonium (Cirsotrema) lyratum (Zitt.).
Euthria media (?) (Hutt.).
Leucosyrinx alta (Harris).
†*Lima (Acesta?) imitata* Sut.
**Limopsis aurita* (Brocchi).
Maculopeplum elegantissimum (Sut.).
Pecten (Pseudamusium) huttoni (Park).
Struthiolaria spinosa Hect.
Teredo heaphyi Zitt.

Age: Eocene (?).

This is perhaps the best collection yet made from the Weka Pass stone. For general lists of fossils from this rock see von Haast, *Rep. of Geol. Explor. during 1870–71*, No. 6, p. 13 (most of the fossils are probably from the Curiosity Shop, however), and Hutton, *Q.J.G.S.*, vol. 41, 1885, pp. 554–56 (see also pp. 266–78).

Waipara: Upper Horizon, Motunau Series. A. Purchas; 1913. (Exact locality not stated.)

**Ancilla (Baryspira) australis* (Sow.).
,, (s. str.) *hebera* (Hutt.).
* ,, *(Amalda) novæ-zelandiæ* (Sow.).
,, *(Alocospira) papillata* (Tate).
**Arca novæ-zealandiæ* E. A. Smith.
Bathytoma haasti (Hutt.).
Chione chiloensis (Phil.).
,, *meridionalis* (Sow.).
,, *speighti* Sut.
**Cochlodesma angasi* (C. & F.).
**Cominella huttoni* Kobelt.
**Crassatellites obesus* (A. Ad.).
Crepidula gregaria Sow.
Cucullæa alta Sow.
Dentalium mantelli Zitt.
,, *solidum* Hutt.
**Dosinia greyi* Zitt.
,, *magna* Hutt.
**Ethalia zelandica* (H. & J.).
Euthria media (Hutt.).
**Fulguraria (Alcithoë) arabica* (Mart.).
* ,, ,, *gracilis* (Swains.).
**Glycymeris striatularis* (Lamk.).
Miomelon corrugata (Hutt.).
Olivella neozelanica (Hutt.).
Paphia curta (Hutt.).
Phos cingulatus (Hutt.).
Plejona huttoni pseudorarispina Sut.
**Polinices amphialus* (Wats.).
,, *gibbosus* (Hutt.).
**Psammobia lineolata* Gray.
Sinum (Eunaticina) elegans Sut.
Siphonalia costata (Hutt.).
* ,, *dilatata* (Q. & G.).
* ,, *mandarina* (Duclos).
* ,, *nodosa* (Mart.).
,, *orbita* Hutt.
,, *subnodosa* (Hutt.).
,, n. sp.
Struthiolaria cincta Hutt.
,, *cingulata* Zitt.
Surcula n. sp.
Trophon n. sp.
**Turritella (Peyrotia) carlottæ* Wats.
,, *(Torcula) semiconcava* Sut.
* ,, (s. str.) *symmetrica* Hutt.

Forty-six species, of which eighteen also Recent = 39 per cent.

This collection is probably not from the Motunau beds, but from a Pareoran horizon. Compare with Dr. Thomson's collection (last list but one), with which it has only nine species in common.

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† This specimen came from the Weka Pass stone on the cuesta running from the Waipara River towards the Deans. See *N.Z. Geol. Surv. Pal. Bull. No. 5*, p. 70. I do not remember another specimen.—J. A. T.

Broken River, Trelissick Basin: Based upon Hutton's Catalogue of the Tertiary Mollusca of New Zealand, 1873. (Revised names.)

1. Upper Horizon.

**Anomia huttoni* Sut.
Bathytoma sulcata (Hutt.). Type.
**Calyptræa maculata* (Q. & G.).
Cardium spatiosum Hutt.
Cerithium hectori Harris. Type.
Cominella carinata (Hutt.). Type.
Crassatellites amplus (Zitt.).
**Crepidula monoxyla* (Less.).
Cytherea enysi Hutt.
Dosinia magna Hutt. Type.
* ,, *subrosea* (Gray).
**Fulgoraria (Alcithoë) arabica* (Mart.).
Glycymeris globosa (Hutt.).
* ,, *laticostata* (Q. & G.).
**Modiolus australis* (Gray).
Paphia curta (Hutt.). Type.
Plejona (Athleta) huttoni (Sut.). Type.
Polinices huttoni Iher. Type.
,, *ovatus* (Hutt.).
**Serpulorbis sipho* (Lamk.).
Struthiolaria tuberculata Hutt. Type.
Turbo superbus Zitt.
Turritella cavershamensis Harris.
* ,, *rosea* Q. & G.

Twenty-four species, of which nine also Recent = 37 per cent.

2. Middle Horizon.

Ancilla (s. str.) *hebera* (Hutt.).

3. Lower Horizon.

**Calyptræa maculata* (Q. & G.).
**Cantharidus tenebrosus huttoni* E. A. Smith.
Cardium patulum Hutt.
Crassatellites attenuatus (Hutt.). Type.
Crepidula striata (Hutt.).
Cylichnella enysi (Hutt.). Type.
Cymatium minimum (Hutt.).
Cypræa ovulatella Tate.
**Divaricella cumingi* (Ad. & Ang.).
**Lima bullata* (Born).
Mactra attenuata Hutt. Type.
Maculopeplum attenuatum (Hutt.). Type.
Marginella dubia Hutt. Type.
Modiolaria elongata (Hutt.). Type.
Ostrea subdentata Hutt. Type.
Panope orbita Hutt.
,, *worthingtoni* Hutt.
Pecten athleta Zitt.
,, *chathamensis* Hutt. Type.
,, *huttoni* (Park) or *hochstetteri* Zitt
,, *yahliensis* T.-Woods.
Polinices ovatus (Hutt.).
Protocardia sera Hutt. Type.
Vexillum enysi (Hutt.). Type.

Twenty-four species, of which four also Recent = 17 per cent.

Porter and Thomas Rivers, Trelissick Basin: Fan-coral Bed. Geol. Surv. Loc. 239. McKay; 1879.

**Ancilla (Amalda) novæ-zelandiæ* (Sow.).
**Capulus australis* (Lamk.).
**Corbula zelandica* Q. & G.
Cylichnella enysi (Hutt.).
Dentalium solidum Hutt.
**Diplodonta zelandica* (?) (Gray).
**Divaricella cumingi* (Ad. & Ang.).
**Dosinia cærulea* (?) Reeve.
Glycymeris globosa (Hutt.).
**Lima angulata* Sow.
* ,, *lima* (L.).
**Loripes concinna* Hutt.
**Mactra elongata* Q. & G.
**Modiolus australis* (Gray).
Modiolus dolichus Sut.
**Myodora subrostrata* E. A. Smith.
Panope worthingtoni Hutt.
Paphia curta (Hutt.).
Pecten (Patinopecten) beethami Hutt.
* ,, *(Pallium) convexus* Q. & G.
,, *(Patinopecten) triphooki* Zitt.
**Pholadidea tridens* (Gray).
Polinices gibbosus (Hutt.).
Protocardia sera Hutt.
**Siphonium planatum* Sut.
Solariella prætextilis Sut.
,, *sulcatina* Sut.
Turritella (Torcula) concava Hutt.

Twenty-eight species, of which fifteen also Recent = 53·6 per cent.

Age: Miocene (Oamaruian). *Horizon:* Doubtful. McKay correlated the fan-coral bed with the Hutchinson Quarry beds (= Hutchinsonian).

Notwithstanding the high percentage of Recent species in the above list, a correlation with the Upper Oamaruian (Awamoan) seems to be justified according to our present knowledge. In MS. McKay remarks, "The brachiopods are identical [with] or very similar to those of the Ototara limestone at Kakanui Mouth, Otago." It is noteworthy that *Pecten beethami* and *Pecten triphooki* have not been recorded in other collections from the Trelissick Basin. Both, however, occur in the Oamaruian of the Oamaru district.

Trelissick Basin: Fan-coral Bed. Geol. Surv. Loc. 243. Enys; 1866–79.

**Ancilla (Baryspira) australis* (Sow.).
,, *(Alocospira) papillata* (Tate).
Calliostoma filiferum Sut. Fragments.
,, *oryctum* Sut. Fragment.
* ,, *punctulatum* (?) (Mart.). Fragment.
**Calyptræa (Sigapatella) maculata* (Q. & G.).
Chione subroborata Tate. Juv. New to fauna.
**Corbula zelandica* Q. & G.
Crepidula gregaria Sow.
Cylichnella enysi (Hutt.).
Cypræa ovulatella Tate.
Daphnella (Raphitoma) neozelanica Sut.
**Diplodonta striata* Hutt. New as a fossil.
**Divaricella cumingi* (Ad. & Ang.).
Emarginula wannonensis Harris.
Epitonium (Clathroscala) cylindrellum Sut. Fragment.
**Euthria striata* (Hutt.).
**Fulgoraria arabica elongata* (Swains.).
**Lima lima* (L.).
**Limopsis aurita* (Brocchi).
,, *zitteli* Iher.
**Mactra elongata* Q. & G.
Modiolaria elongata (Hutt.).
**Natica zelandica* Q. & G.
Pecten (Patinopecten) delicatulus Hutt.
,, ,, *palmipes* Tate. Juv.
,, *(Chlamys) williamsoni* Zitt.
Polinices (Neverita) ovatus (Hutt.).
**Protocardia (Nemocardium) pulchella* (Gray).
**Psammobia lineolata* Gray.
Siphonalia nodosa acuticostata Sut.
Trochus avarus Sut.
,, *circinatus* (?) Hutt.
,, *nodosus* Hutt. Fragment.
Turbo etheridgei T.-Woods. New to fauna.
Turritella (Archimediella) huttoni Cossm.
,, *(Torcula) semiconcava* Sut.
Venericardia difficilis benhami Thomson.

Thirty-eight species, of which fourteen also Recent = 37 per cent.

It is remarkable that only five of these species are included in the preceding list. The percentage of Recent species approaches what one would expect in the Awamoan.

Trelissick Basin: Weka Pass Stone. Geol. Surv. Loc. 242. Enys; 1866–79.

Lima paucisulcata Hutt. Juv.
Miomelon corrugata (Hutt.).

Apparently this collection, a small one, was made from the limestone elsewhere called by McKay the Ototara limestone.

Trelissick Basin: Lower Beds. Geol. Surv. Loc. 449. Enys; 1880.

Glycymeris convexa (Tate). New to fauna.
,, *globosa* (Hutt.).
Venericardia pseutes Sut.

Age and *horizon:* Various—possibly pre-Oamaruian.

Whitewater Creek, Trelissick Basin: Tufaceous Greensands. Geol. Surv. Loc. 241. McKay; 1879

**Ancilla (Baryspira) australis* (Sow.).
**Calyptræa (Sigapatella) maculata* (Q. & G.).
**Cantharidus tenebrosus* A. Ad.
**Capulus australis* (Lamk.).
Cardium huttoni Iher. Juv.
**Cochlodesma angasi* (?) (C. & F.).
Cymatium minimum (Hutt.). Fragment.
Cypræa ovulatella Tate.
,, *trelissickensis* Sut.
Cytherea chariessa Sut.
Emarginula wannonensis Harris.
Epitonium (Clathroscala) cylindrellum Sut. Fragment.
Fissuridea (?) *annulata* Sut.

**Lima bullata* (Born).
,, *colorata* Hutt. Juv.
**Limopsis aurita* (Brocchi).
**Mactra elongata* Q. & G.
Marginella dubia Hutt.
Miomelon corrugata (Hutt.). Juv.
Pecten (Patinopecten) palmipes Tate. Juv. New to fauna.
Polinices (Neverita) huttoni Iher.
Protocardia sera Hutt.
Siphonalia nodosa aculicostata Sut.
**Siphonium planatum* Sut.
Surcula antegypsata (?) Sut.
Teredo heaphyi Zitt.
Trivia zealandica T. W. Kirk.
Trochus nodosus Hutt. Fragments.
Turritella (Archimediella) huttoni Cossm.

Twenty-nine species, of which nine also Recent = 31 per cent.

Age : Miocene (Oamaruian).

Trelissick Basin : Upper Part of Mount Brown Limestone. Geol. Surv. Loc. 237. McKay ; 1879.

The list includes fossils collected by J. A. Thomson and R. Speight in 1914 from the shell-bed at the base of the Pareora beds, junction of Porter and Thomas rivers (labelled "Trelissick 'B'").

Ancilla (Alocospira) papillata (Tate).
**Anomia trigonopsis* Hutt.
**Arca novæ-zealandiæ* E. A. Smith.
Astræa bicarinata Sut. Fragment.
,, *transenna* Sut. Fragment.
Cardium huttoni Iher.
,, *subcordatum* Sut.
**Crassatellites obesus* (A. Ad.).
Crepidula striata (Hutt.).
**Fulgoraria (Alcithoë) arabica* (Mart.).
Glycymeris globosa (Hutt.).
Hinnites trailli Hutt. Juv.
**Lima bullata* (Born).
Lima colorata Hutt.
Modiolaria elongata (Hutt.).
**Mytilus canaliculus* Mart.
,, *huttoni* Cossm.
Paphia curta (Hutt.).
Polinices gibbosus (Hutt.).
**Serpulorbis sipho* (Lamk.).
**Siphonalia dilatata* (Q. & G.).
,, *turrita* Sut.
**Stephopoma nucleogranosum* Verco.
Turbo superbus Zitt. Fragments.
Turritella (Torcula) concava Hutt.
,, *(Peyrotia) patagonica* Sow.

Twenty-six species, of which nine also Recent = 35 per cent.

Age : Miocene (Oamaruian).

Trelissick Basin A : Lower Tuffs (so called by McKay)—*i.e.*, Tuffs above Chalk Marl (= Amuri Limestone) and below Lower Limestone—Broken River, above Junction with Porter River. J. A. Thomson and R. Speight ; 1914.

Ampullina (Megatylotus) suturalis (Hutt.).
**Calliostoma aucklandicum* E. A. Smith.
**Calyptræa (Sigapatella) maculata* (Q. & G.).
Clio (Styliola) tatei Sut.
Crassatellites cordiformis Sut.
**Crepidula monoxyla* (Less.).
Cypræa ovulatella Tate. Juv.
**Diplodonta zelandica* (?) (Gray).
Emarginula wannonensis Harris. Cast.
Lima huttoni Sut. Juv.
Martesia concentrica Sut.
**Natica zelandica* Q. & G.
Panope orbita Hutt.
Pecten (Chlamys) williamsoni Zitt.
**Psammobia lineolata* Gray.
**Siphonalia mandarina* (Duclos).
**Siphonium planatum* Sut.
**Tellina eugonia* Sut.
Trochus nodosus Hutt.

Nineteen species, of which nine also Recent = 47 per cent.

Broken River, Trelissick Basin : Coal-beds.

Crassatellites cordiformis Sut.
Martesia concentrica Sut.

These may be specimens from the preceding collection, erroneously labelled.

Trelissick Basin C : Whitewater Creek, where the Marls are followed by Tuffs. J. A. Thomson and R. Speight; 1914.

"The tuffs are followed by the upper limestone. The fossils were collected from the top of these tuffs. It is not certain whether they represent the lower or upper tuffs, this depending on whether the absence of the lower limestone is due to removal by denudation, as Hutton thought, or to non-deposition owing to volcanic conditions, as I think possible."—J. A. Thomson.

Ancilla (Baryspira) depressa (Sow.).
**Calliostoma aucklandicum* E. A. Smith. New as a fossil.
Calyptræa (Sigapatella) maccoyi Sut.
* ,, ,, *maculata* (Q. & G.).
**Cantharidus tenebrosus* A. Ad.
Cardium facetum Sut.
Cymatium minimum (Hutt.).
Emarginula wannonensis Harris.
**Fulgoraria arabica* (Mart.). Protoconch.
**Lima bullata* (Born).
**Natica australis* (?) (Hutt.).
* ,, *zelandica* (?) Q. & G.
Polinices (Neverita) huttoni Iher.
Siphonalia orbita (?) Hutt.
Turritella (Archimediella) huttoni Cossm.

Fifteen species, of which eight also Recent = 53 per cent.

Trelissick Basin D : Coleridge Creek : Tuffs interbedded with Chalk Marls (= Amuri Limestone). Tuff band 25 ft. thick and 10 ft. from the top. J. A. Thomson.

**Admete trailli* (Hutt.).
Ampullina (Megatylotus) suturalis (Hutt.).
Ancilla (Alocospira) papillata (Tate).
,, *(Baryspira) subgradata* (?) (Tate).
**Calliostoma aucklandicum* E. A. Smith.
Chione chiloensis truncata (?) Sut. Cast.
Cominella intermedia (?) Sut
Epitonium (Cirsotrema) lyratum (Zitt.).
,, ,, *zelebori* (Dkr.) var.
Fusinus bicarinatus Sut.
Hemifusus (Mayeria) goniodes Sut.
Limopsis catenata Sut.
Marginella (Glabella) harrisi Cossm.
Polinices (Neverita) huttoni Iher. Juv.
,, ,, *ovatus* (Hutt.).
Seila huttoni Sut.
Sinum (Eunaticina) miocænicum (Sut.).
Siphonalia turrita (?) Sut. Small form.
**Siphonium planatum* Sut.
Surcula seminuda Sut.
Terebra costata Hutt.

Twenty-one species, of which three also Recent = 14 per cent.

To the above list add *Euthria (Dennantia)* sp.

The term "Amuri limestone" has been used by all visitors to the Trelissick Basin, but the correlation appears to be made largely on lithological grounds, and at present cannot be accepted as proved by palæontological data. For the stratigraphical evidence, &c., in its favour see R. Speight, *Trans. N.Z. Inst.*, vol. 49, 1917, p. 326, &c.

Trelissick Basin E : Lower Tuffs, below Lower Limestone, Right Side of Porter River, above the Upper Gorge. J. A. Thomson and R. Speight; 1914.

**Calliostoma aucklandicum* E. A. Smith.
Pecten (Patinopecten) hutchinsoni Hutt.
Pecten (Pseudamusium) yahliensis T.-Woods.
**Siphonium planatum* Sut.

Trelissick Basin F : Junction of Porter and Thomas River : Tuffs between Upper and Lower Limestone (*i.e.*, Upper Tuffs of Hutton, Fan-coral Beds of McKay). J. A. Thomson and R. Speight; 1914.

**Ancilla (Baryspira) mucronata* (?) (Sow).
Calliostoma filiferum Sut. Fragments.
,, *oryctum* Sut. Fragment.
**Calyptræa (Sigapatella) maculata inflata* (Hutt.).
* ,, (s. str.) *tenuis* (Gray).
Cardium waitakiense Sut.
**Chione yatei* (Gray). Juv.
**Corbula zelandica* Q. & G.
Cypræa ovulatella Tate.
**Diplodonta zelandica* (Gray).

Lima colorata Hutt. Juv.
Limopsis catenata Sut. Fragment.
**Macrocallista multistriata* (?) (Sow.).
Modiolaria elongata (Hutt.).
**Modiolus australis* (Gray).
Panope orbita (?) Hutt. Fragments.
**Panope zelandica* Q. & G.
Pecten (Chlamys) chathamensis Hutt.
Teredo heaphyi Zitt.
Turritella (Torcula) semiconcava Sut. Fragment.
**Venericardia difficilis* (Desh.). Fragments.

Twenty-one species, of which ten also Recent = 48 per cent.

See also pages 48-49, and R. Speight in *Trans. N.Z. Inst.*, vol. 49, 1917, pp. 352–55 (col. 4).

Trelissick Basin: Coleridge Creek: Base of Pareora Beds. Presumably J. A. Thomson and R. Speight; 1914.

**Glycymeris laticostata* (Q. & G.).
Polinices callosus (Hutt.).
Polinices gibbosus (Hutt.).
,, *(Neverita) ovatus* (Hutt.).

Trelissick Basin: Whitewater Creek: Amuri Limestone. Presumably J. A. Thomson and R. Speight; 1914.

Pecten (Pseudamusium) aucklandicus Zitt.
,, *(Chlamys?) fischeri* (?) Zitt.

Many of the previous lists were used by Speight in connection with his paper "The Stratigraphy of the Tertiary Beds of the Trelissick or Castle Hill Basin," *Trans. N.Z. Inst.*, vol. 49, 1917, pp. 321–56. (See especially pp. 352–55.)

Curiosity Shop, Rakaia River, Canterbury. Geol. Surv. Locs. 311, 549. McKay; 1879.

Ampullina (Megatylotus) suturalis (Hutt.).
**Anomia huttoni* Sut.
**Astræa sulcata* (?) (Mart.). Cast.
Atrina distans (?) (Hutt.). Fragment.
Chione chiloensis truncata (?).
* .. *spissa* (Desh.).
**Cominella adspersa* (?) (Brug.).
Cominella sp. ?
Cucullæa alta Sow.
.. .. var. B Hutt. Casts.
,, *attenuata* Hutt. Casts.
Cytherea sulcata Hutt. Casts.
Glycymeris sp. Casts.
**Helcioniscus ornatus* (Dillw.). New as a fossil.
Lima huttoni Sut.
,, *paleata* Hutt.
Macrocallista sp. ? Cast.
Olivella neozelanica (Hutt.).
Panope orbita Hutt.
Pecten (Chlamys) aldingensis Tate.
,, ,, *chathamensis* Hutt.
,, *(Patinopecten) delicatulus* Hutt.
,, *(Pseudamusium) huttoni* (Park).
,, ,, *yahliensis* T.-Woods.
* ,, *(Chlamys) zelandiæ* Gray.
**Placunanomia zelandica* (Gray).
Protocardia sera (?) Hutt. Casts.
Siphonalia sp. ?
**Siphonium planatum* Sut.
Solariella sp. ? Casts.
**Struthiolaria papulosa* (Mart.). Cast.
,, sp.
**Tellina glabrella* Desh. Casts.
Teredo heaphyi Zitt. Plentiful.
**Thracia vitrea* (Hutt.). Cast.
Trochus nodosus (?) Hutt.
**Venericardia purpurata* (?) (Desh.). Casts.

Mostly casts, the Pectens excepted. Thirty-seven species and varieties, of which twelve also Recent = 32 per cent.

Age: Miocene (Oamaruian). *Matrix:* Sandy and calcareous beds.

Reference: McKay, *Rep. of Geol. Explor. during 1879–80*, No. 13, 1881, pp. 75–82. On pp. 81–82 McKay gives a list of species and genera identified by him. Several of these were evidently not in the material examined by Mr. Suter. For another fossil-list see F. W. Hutton in *Q.J.G.S.*, vol. 41, 1885, pp. 547–64 (list on pp. 549–54).

Kakahu River, South Canterbury : Weka Pass Stone. Geol. Surv. Loc. 162. McKay ; 1876.

Atrina distans (?) (Hutt.).
Dentalium mantelli Zitt.
Pecten (Pseudamusium) huttoni (Park).

Age : Miocene (Oamaruian). *Horizon :* Ototaran (?). The correlation with the Weka Pass stone is probably to be rejected.

Reference : McKay in *Rep. of Geol. Explor. during 1876–77*, No. 10, 1877, pp. 46, 53, 59–60, &c.

Kakahu River : Greensands overlying Coal-beds. Geol. Surv. Loc. 163. McKay ; 1876.

Atrina distans (Hutt.).
Cardium waitakiense Sut.
Cucullæa australis (Hutt.).
Ostrea (s. str.) *subdentata* Hutt.
Teredo heaphyi Zitt.
**Venericardia purpurata* (Desh.).
,, *pseutes* Sut.

Age : Miocene (Oamaruian). *Horizon :* Waiarekan (?).

Reference : McKay, *loc. cit.*, pp. 47, 62, &c.

Kakahu River : Coal-beds underlying Waitaki Limestone and Greensands. Geol. Surv. Loc. 164. McKay ; 1876.

Ampullina (Megatylotus) suturalis (Hutt.).
**Ancilla (Amalda) novæ-zelandiæ* (Sow.).
Astarte australis (?) Hutt.
Atrina distans (Hutt.).
**Calyptræa* (s. str.) *alta* (Hutt.).
Cardium brunneri (?) Hect.
,, *huttoni* (?) Iher. Juv.
,, *patulum* (?) Hutt. Juv.
,, *waitakiense* Sut.
**Chione mesodesma* (?) (Q. & G.).
**Cominella zealandica* (Reeve).
Corbula pumila Hutt.
Crassatellites amplus (Zitt.).
* ,, *obesus* (A. Ad.).
Cucullæa alta Sow.
,, ,, var. B Hutt.
Cuspidaria kirki (Hutt.). Impression.
Cytherea chariessa Sut.
**Dentalium ecostatum* T. W. Kirk.
,, *pareorense* Pils. & Sharp.
**Dosinia greyi* (?) Zitt.
Euthria (Dennantia) mystica Sut.
**Fulgoraria arabica* (Mart.).
Fusinus solidus Sut.
Galeodes (Pugilina) angusta Sut.
,, *biconica* Sut.
,, *(Pugilina) liræcostata* Sut.
,, *maoriana* Sut.
Galeodes modesta Sut.
**Glycymeris laticostata* (Q. & G.).
,, *subglobosa* Sut.
Harpa (Eocithara) neozelanica (?) Sut.
Lapparia hebes (Hutt.). (Also Loc. 480, Waihao.)
**Mesodesma australe* (Gmel.).
Ostrea (s. str.) *gudexi* Sut. (M. C. Gudex *leg.*)
,, ,, *subdentata* Hutt.
,, ,, *wuellerstorfi* Zitt.
**Panope zelandica* Q. & G.
Pecten (Pseudamusium) huttoni (Park).
Plejona necopinata Sut.
Polinices (Neverita) huttoni Iher.
,, ,, *ovatus* (Hutt.).
Ringicula n. sp.
Siphonalia sp.
Struthiolaria cincta Hutt.
**Tellina eugonia* (?) Sut.
Tudicla neozelanica Sut.
Turritella (Archimediella) ambulacrum Sow. Common.
* ,, *(Peyrotia) carlottæ* Wats.
,, , *cavershamensis* Harris.
**Venericardia difficilis* (?) (Desh.).
* ,, *lutea* (Hutt.) var.
,, *pseutes* Sut.
,, aff. *purpurata* (Desh.).

Fifty-four species, of which fifteen also Recent = 28 per cent.

Age : Miocene (Oamaruian). *Horizon :* Waiarekan (?).

The possible presence of *Cardium brunneri* is noteworthy. The term "coal-beds" used in describing the horizon seems somewhat misleading. Apparently the collection is from the lowest part of the greensands, &c., overlying the coal-measures proper. McKay (*loc. cit.*, p. 47) mentions the occurrence in the Kakahu greensands of *Cardium brunneri* Hect. and *Ostrea carbonacea* Hect. MS. (in this case, no doubt, *O. wuellerstorfi*).

Kakahu River : Pareora Beds. Geol. Surv. Loc. 577. J. Park ; 1885.

Ancilla (Alocospira) papillata (Tate).
Bathytoma haasti (Hutt.).
**Calyptræa* (s. str.) *alta* (Hutt.).
**Chione mesodesma* (Q. & G.).
Cucullæa alta Sow.
,, ,, var. B Hutt.
,, *australis* (Hutt.).
Cylichnella enysi (Hutt.).
Dentalium mantelli Zitt.
**Dosinia cærulea* (Reeve).
* ,, *lambata* (Gould).
* ,, *subrosea* (Gray).
Lima colorata Hutt.
**Limopsis aurita* (Brocchi). Plentiful.
,, *catenata* Sut.
**Macrocallista multistriata* (Sow.).
Modiolus dolichus Sut.
**Nucula strangei* A. Ad.
Pecten (Chlamys) chathamensis (?) Hutt. Juv.
,, *(Pseudamusium) huttoni* (Park).
**Placunanomia zelandica* (?) (Gray).
Polinices (Neverita) ovatus (Hutt.).
**Psammobia lineolata* Gray.
**Siphonalia nodosa* (Mart.).
Struthiolaria cincta Hutt.
**Tellina eugonia* Sut.
Turritella (Torcula) semiconcava Sut.
**Venericardia purpurata* (Desh.).
,, *pseutes* Sut.
**Zenatia acinaces* (?) (Q. & G.).

Thirty species, of which fourteen also Recent = 47 per cent.

Age : Miocene. *Horizon :* Pareoran (probably) = Awamoan.

Mr. Suter's heading to this list originally contained the following words, placed in brackets : " Greensands under Waitaki stone, *fide* Park, 1905." Reference to *Trans. N.Z. Inst.*, vol. 37, 1905, pp. 532–33, shows that the statement attributed to Park is not explicitly made, though it may be held to follow from his remarks. On the other hand, Park's section of 1886 (*Rep. of Geol. Explor. during 1885*, No. 17, 1886, p. 174) shows Pareora beds east of, and necessarily above, the " Waitaki stone," as well as to the west, where possibly they may not be downfaulted, as supposed by von Haast in 1879 (*Geology of Canterbury and Westland*, p. 310), McKay in 1877 (*Rep. of Geol. Explor. during 1876–77*, No. 10, p. 53, and section, " North Bank of Kakahu River," opposite p. 50), and by Park himself in 1885. At present there is no record known to the writer indicating that the collection from Loc. 577 was not made from indubitable Pareoran beds. The list of species identified by Mr. Suter strongly confirms the Pareoran horizon, thus suggesting also that Park's section of 1886 is more correct than his 1905 section. It may profitably be compared with the following list of species from an horizon known to be below the limestone :—

Kakahu River : Greensands under Weka Pass Stone. Geol. Surv. Loc. 578. J. Park ; 1885.

**Anomia trigonopsis* Hutt.
Astarte australis Hutt.
**Astræa heliotropium* (Mart.).
Cæcum n. sp.
Cardium brunneri Hect.
,, *waitakiense* Sut.
,, n. sp.
Chione meridionalis (Sow.). Adult and several young shells.
Cucullæa alta Sow. Cast of young shell.
**Dosinia cærulea* (Reeve).
* ,, *greyi* Zitt.
**Fulgoraria arabica* (Mart.).
Glycymeris aff. *subglobosa* Sut.
**Mesodesma subtriangulatum* (?) (Gray). Juv.
**Myodora pandoriformis* (?) (Stutchb.). Fragment.
Pecten (Pseudamusium) huttoni (Park).
Sinum fornicatum Sut.
**Tellina glabrella* (?) Desh. Juv.
,, n. sp.
Terebra pareoraensis Sut.
Turritella (Archimediella) ambulacrum Sow. Plentiful.
* ,, *(Peyrotia) carlottæ* Wats.
,, *(Archimediella) huttoni* Cossm.
,, *(Peyrotia) patagonica* Sow.
,, *(Torcula) semiconcava* Sut.
**Venericardia lutea* Hutt. Common.
,, *pseutes* Sut.

Twenty-seven species, of which ten also Recent = 37 per cent.

All the shells are embedded in a hard calcareous matrix, and many could not be identified with any approach to correctness. If all could be named, the percentage of Recent shells would no doubt be lower.

Age : Miocene (Oamaruian). *Horizon :* Waiarekan (?).

Only five of the twenty-seven species appear in the preceding list.

Reference : Park, *loc. cit.*, 1886, pp. 173 *et seq.* See also McKay, *Rep. of Geol. Explor. during 1886–87*, No. 18, 1887, pp. 92 *et seq.*

Kakahu River, Canterbury : Coal-beds. J. A. Thomson ; 1917.

Dentalium (Fustiaria) pareorense Pils. & Sharp.
Cucullæa alta var. B Hutt.
**Dosinia greyi* Zitt.
Galeodes biconica Sut.
**Glycymeris laticostata* (Q. & G.).
,, *subglobosa* Sut.
Lapparia hebes (Hutt.).
Ostrea gudexi Sut. Common
Mitra (Cancilla) armorica (?) Sut. Fragment.
Plejona necopinata (Sut.).
Polinices ovatus (Hutt.).
Turritella (Archimediella) huttoni Cossm. Common.

Presumably this is the same locality and horizon as Geol. Surv. Loc. No. 164. (See p. 53.)

Kakahu River : Sands under Limestone. J. A. Thomson ; 1917.

Ancilla (Alocospira) papillata (Tate).
Corbula canaliculata Hutt.
Cytherea chariessa Sut
Dentalium mantelli Zitt.
Galeodea senex (Hutt.).
**Limopsis aurita* (Brocchi).
,, *catenata* Sut.
Polinices gibbosus (Hutt.).
**Psammobia lineolata* Gray.
**Siphonalia nodosa* (?) (Mart.)
,, *subreflexa* (Sow.).
Turritella (Torcula) semiconcava Sut.
Venericardia pseutes Sut.

Age : Miocene (Oamaruian).

Kakahu Bush : Soft Sandstones (Greensands) with Calcareous Bands and Masses, resting upon the Coal-beds and underlying the Waitaki Limestone. Copied and amended from Professor J. Park's list in *Trans. N.Z. Inst.*, vol. 37, 1905, p. 533. A few species from the same locality which are in the Canterbury Museum are added.

Ancilla (s. str.) *hebera* (Hutt.).
**Anomia huttoni* Sut. *(A. alectus.)*
Astarte australis Hutt. *(Crassatellites australis.)*
**Atrina zelandica* (Gray). (Cant. Mus.)
Aturia australis McCoy.
**Chione spissa* (Desh.). (*C. crassa* of *Hand-list* also.)
,, *meridionalis* (Sow.). *(C. vellicata.)*
Corbula canaliculata Hutt.
Crassatellites amplus (Hutt.).
**Crepidula monoxyla* (Less.). (*Calyptræa monoxyla* Martyn.)
Cucullæa alta Sow.
,, *australis* (Hutt.). *(Cucularia.)*
Dentalium mantelli Zitt.
,, *pareorense* Pils. & Sharp. *(D. lævis.)*
Dosinia magna Hutt.
Galeodea senex (Hutt.). *(Cassidaria.)*
Glycymeris globosa (Hutt.).
Leda semiteres Hutt. *(L. fastidiosa.)*
Lima paleata Hutt.
Miomelon corrugata (Hutt.). *(Scaphella.)*
**Ostrea (Anodontostrea) angasi* Sow. (Cant. Mus.)
,, (s. str.) *wuellerstorfi* Zitt.
Panope orbita Hutt. *(Panopæa.)*
Pecten (Pseudamusium) huttoni (Park.) *(Pseudamusium.)*
,, *(Chlamys) williamsoni* Zitt.
Plejona huttoni (Sut.). (Cant. Mus.)
Polinices (Neverita) huttoni Iher. *(Natica darwini.)*
**Siphonalia dilatata* (Q. & G.).
,, *costata* (?) (Hutt.). *(S. regularis* Sow.)
**Struthiolaria papulosa* (Mart.).
,, *spinosa* Hect. (Cant. Mus.)
**Terebra tristis* Desh. (Perhaps *T. pareoraensis* Sut.)
Teredo heaphyi Zitt.
Turritella (Peyrotia) cavershamensis Harris.
* ,, ,, *rosea* Q. & G.
* ,, (s. str.) *symmetrica* Hutt. *(T. kanieriensis.)*

As amended by Mr. Suter the above list contains thirty-six species, of which ten are Recent = 28 per cent.

Age : Miocene (Oamaruian). *Horizon :* Lower Waiarekan (?).

Red Rocks, Opuha Gorge, South Canterbury. J. A. Thomson; 1917.

Cardium cf. *huttoni* Iher.
Corbula pumila Hutt.
Cytherea sp. Juv.
Dosinia sp.
**Ostrea corrugata* Hutt.
Pecten (Pseudamusium) huttoni (Park).
**Tellina eugonia* Sut.
Teredo heaphyi Zitt.
**Venericardia lutea* (?) (Hutt.).

Conglomerate containing mostly casts.

Age: Miocene (Oamaruian).

Sutherland's, Tengawai River, Seventeen Miles North-west from Timaru, Canterbury: Upper Pareora Beds. M. C. Gudex; 1913.

Ancilla (s. str.) *hebera* (Hutt.).
,, *(Alocospira) papillata* (Tate).
**Anomia trigonopsis* Hutt.
Bathytoma sulcata excavata Sut.
Cardium greyi Hutt.
Cominella carinata (Hutt.).
Crepidula gregaria Sow.
* ,, *monoxyla* (Less.).
,, *striata* (Hutt.).
Cucullæa attenuata Hutt.
**Dentalium nanum* Hutt.
,, *solidum* Hutt.
**Dosinia*, aff. *anus* (Phil.).
Epitonium (Cirsotrema) lyratum (Zitt.).
**Fulgoraria arabica* (Mart.).
* ,, ,, *elongata* (Swains.).
**Glycymeris laticostata* (Q. & G.).
Latirus (Leucozonia) brevirostris (Hutt.).
Limopsis zitteli Iher.
**Mactra scalpellum* Reeve.
Polinices gibbosus (Hutt.).
Siphonalia costata (Hutt.).
* ,, *dilatata* (Q. & G.).
,, *subnodosa* (Hutt.).
Struthiolaria tuberculata Hutt.
Surcula fusiformis (Hutt.).
Terebra orycta Sut.
,, *pareoraensis* Sut.
**Turritella (Peyrotia) carlottæ* Wats.
,, ,, *cavershamensis* Harris.
,, *(Torcula) concava* Hutt.
Venericardia pseutes Sut.

Thirty-two species, of which ten also Recent = 31 per cent.

Age: Upper Miocene. *Horizon:* Pareoran = Awamoan.

Reference: M. C. Gudex in *Trans. N.Z. Inst.*, vol. 50, 1918, pp. 244–62.

Raincliff Red Rocks, near Pleasant Point, South Canterbury. J. A. Thomson; 1917

**Anomia huttoni* Sut.
Cardium huttoni Iher.
Crepidula gregaria (?) Sow. Cast.
Epitonium (Cirsotrema) lyratum (Zitt.).
**Ostrea (Anodontostrea) hyotis* (L.).
,, aff. *nelsoniana* Zitt.
Ostrea aff. *wuellerstorfi* Zitt.
Struthiolaria minor Marshall.
Teredo heaphyi Zitt.
**Venericardia lutea* (Hutt.).
,, sp.

Eleven species, of which three also Recent = 27 per cent.

Age: Miocene (Oamaruian).

Current-bedded Shell-bed at Base of Raincliff. J. A. Thomson; 1917.

Corbula canaliculata Hutt.
,, *pumila* Hutt.
Cytherea sp. ? Juv.
**Ostrea corrugata* Hutt.
**Ostrea (Anodontostrea) hyotis* (?) (L.). Juv
Teredo heaphyi Zitt.
**Venericardia purpurata* (Desh.). Juv

Age: Miocene (Oamaruian).

Lower Gorge of Pareora River : Clays. Geol. Surv. Loc. 166. McKay ; 1876.

Acteon ovalis (?) (Hutt.).
Ampullina (Megatylotus) suturalis (Hutt.).
Ancilla (s. str.) *hebera* (Hutt.).
Anomia sp.
Bathytoma haasti (Hutt.).
**Calyptræa (Sigapatella) maculata* (Q. & G.).
Corbula canaliculata (?) Hutt.
,, *humerosa* Hutt.
**Crassatellites obesus* (A. Ad.).
Cucullæa alta Sow.
Cuspidaria kirki (?) (Hutt.).
**Cylichnella striata* (Hutt.).
**Cytherea oblonga* (Hanley).
Dentalium solidum Hutt.
**Dosinia greyi* Zitt.
**Fissuridea monilifera* (Hutt.).
**Fulgoraria arabica* (Mart.).
Glycymeris subglobosa Sut.
Leucosyrinx alta (Harris).
Lima colorata Hutt.
**Limopsis aurita* (Brocchi).
Mesalia striolata (Hutt.).
Miomelon corrugata (Hutt.).
,, ,, var. B Hutt.
**Panope zelandica* (?) Q. & G.
Pecten (Pseudamusium) huttoni (Park). Fragment.
**Psammobia lineolata* Gray.
Sinum (Eunaticina) cinctum (Hutt.).
Siphonalia costata (Hutt.).
Surcula fusiformis (Hutt.).
**Tellina eugonia* Sut.
Teredo heaphyi Zitt.
**Turbonilla zealandica* (Hutt.).
**Turritella (Peyrotia) carlottæ* Wats.
,, *(Torcula) concava* Hutt.
,, *(Peyrotia) patagonica* Sow.
**Venericardia lutea* (Hutt.) var.
**Zenatia acinaces* (Q. & G.).

Thirty-eight species, of which fifteen also Recent = 39 per cent.

Age: Upper Miocene. *Horizon:* Pareoran.

McKay in MS. and his report of 1877 states that the collection was made from blue sandy clays on the left bank of the Pareora River, near the lower east slope of Mount Horrible and from some distance down the river (on the south side: see reference below).

Reference: McKay, *Rep. of Geol. Explor. during 1876–77*, No. 10, 1877, pp. 47, 55, &c.

Lower Gorge of Pareora River : Coal-beds. Geol. Surv. Loc. 167. McKay, 1876 ; Enys, 1879.

**Crassatellites obesus* (A. Ad.).
Cucullæa attenuata Hutt.
**Mytilus (Chloromya) canaliculus* (?) Mart. Juv.
Turritella (Archimediella) ambulacrum Sow.
**Venericardia difficilis* (Desh.) var.
,, *pseutes* Sut.

Age: Miocene (Oamaruian). *Horizon:* Waiarekan.

Reference: McKay, *loc. cit.*, 1877, pp. 47, 64. "The rocks are grey quartzose sands, with occasional beds of small pebbles, composed of quartz, and often contain sharks' teeth. A shell-bed occurs in contact with these sands, but, as it presented some appearance of unconformity, this may belong to a younger series."

Lower Part of Pareora River. Geol. Surv. Loc. 458. Enys ; 1879.

Alectrion (Hima) socialis (Hutt.).
Ancilla (s. str.) *hebera* (Hutt.).
**Anomia trigonopsis* Hutt.
Bathytoma haasti (Hutt.).
**Calyptræa (Sigapatella) maculata inflata* (Hutt.).
* ,, (s. str.) *tenuis* (Gray).
Cardium patulum Hutt.
**Chione stutchburyi* (Gray).
Corbula pumila Hutt.
**Crassatellites obesus* (A. Ad.).
Crepidula striata (Hutt.).
Cucullæa alta Sow.
Cylichnella enysi (Hutt.).
**Dentalium ecostatum* T. W. Kirk.
,, *mantelli* Zitt.
,, *solidum* Hutt.
**Diplodonta zelandica* (Gray).
**Dosinia lambata* (Gould).
**Dosinia subrosea* (Gray).
**Fasciolaria johnstoni* (T.-Woods). New to our fauna.
Galeodea senex (?) (Hutt.).
Genota robusta (Hutt.).
Glycymeris globosa (Hutt.).
* ,, *laticostata* (Q. & G.).
Latirus (Leucozonia) brevirostris (Hutt.).
**Limopsis aurita* (Brocchi).
Loripes laminata Hutt.
**Macrocallista multistriata* (Sow.).
,, *pareoraensis* Sut.
**Mactra discors* (?) Gray.
* ,, *scalpellum* Reeve.
**Natica zelandica* Q. & G.
**Nucula strangei* A. Ad.
**Ostrea* (s str.) *corrugata* Hutt.
Panope orbita Hutt.

Paphia curta (Hutt.).
Placunanomia incisura (?) Hutt.
* ,, *zelandica* (Gray).
**Polinices amphialus* (Wats.).
,, *gibbosus* (Hutt.).
**Psammobia lineolata* Gray.
* ,, *zelandica* Desh. New as a fossil.
Sinum (Eunaticina) cinctum (Hutt.).
Siphonalia costata (Hutt.).
* ,, *dilatata* (Q. & G.).
**Spisula ordinaria* (E. A. Smith).
**Struthiolaria papulosa* (Mart.).
Struthiolaria spinosa Hect.
Surcula fusiformis (Hutt.).
**Tellina glabrella* Desh.
Terebra orycta Sut.
* ,, *tristis* Desh.
**Trophon hanleyi* (Angas). New as a fossil.
Turritella (Peyrotia) cavershamensis Harris.
,, *(Torcula) semiconcava* Sut.
,, *(Peyrotia) patagonica* Sow.
Typhis (Typhina) maccoyi T.-Woods.
**Venericardia purpurata* (Desh.).
**Zenatia acinaces* (Q. & G.). Fragment.

Fifty-nine species, of which twenty-nine also Recent = 49 per cent.

Age: Upper Miocene. *Horizon:* Pareoran.

Right Bank of Pareora River, opposite Mount Horrible: Coal Rocks. Geol. Surv. Loc. 784. McKay; date of collection unknown.

Venericardia lutea (Hutt.) var.

Larger than Recent shells, the radial ribs more numerous, 18 to 20, the interstices narrower; maximum height 19 mm. The specimens are hardly good enough for description.

Age: Miocene (Oamaruian).

Pareora River, South Canterbury. J. A. Thomson; 1917.

Alectrion socialis (Hutt.).
Ampullina (Megatylotus) suturalis (Hutt.).
Ancilla (s. str.) *hebera* (Hutt.).
,, *(Alocospira) papillata* (Tate). Juv.
Borsonia (Cordieria) n. sp.
Corbula canaliculata Hutt.
**Crassatellites obesus* (A. Ad.). Fragment.
Cucullæa australis (Hutt.).
Cylichnella soror Sut.
Diplodonta ampla (Hutt.).
Drillia n. sp. The same from Blue Cliffs.
Epitonium (Cirsotrema) lyratum (Zitt.).
Fusinus n. sp.?
Galeodea senex (Hutt.).
Leda semiteres Hutt. Juv.
Lima colorata Hutt.
**Limopsis aurita* (Brocchi).
Miomelon corrugata (Hutt.).
Mitra (Cancilla) armorica Sut.
Modiolus dolichus Sut.
**Murex zelandicus* Q. & G. Juv.
**Natica australis* (Hutt.).
* ,, *zelandica* Q. & G.
Pecten (Pseudamusium) huttoni (Park). Fragments.
**Placunanomia zelandica* (Gray).
Polinices gibbosus (Hutt.).
**Psammobia lineolata* Gray.
Ptychatractus nodosoliratus Sut.
Sinum (Eunaticina) cinctum (Hutt.).
Siphonalia costata (Hutt.).
* ,, *dilatata* (Q. & G.). Juv.
Struthiolaria cincta Hutt. n. var.
Surcula climacota Sut.
,, *fusiformis* (Hutt.). Juv.
,, n. sp.
Trophon lepidus Sut.
**Turbonilla zealandica* (Hutt.).
Turritella (Torcula) concava Hutt. Fragments.
Typhis maccoyi T.-Woods.
**Venericardia purpurata* (Desh.). Juv.
Vexillum apicale (Hutt.).

Pareora River: Blue Clay below Mount Horrible. J. A. Thomson; 1917.

Clavagella n. sp.
Corbula canaliculata Hutt.
**Crepidula costata* (Sow.).
Dentalium mantelli Zitt.
,, *(Fustiaria) pareorense* Pils. & Sharp.
,, *solidum* Hutt.
Diplodonta ampla (Hutt.).
Leda semiteres Hutt.
**Murex octogonus espinosus* (?) Hutt. Juv.
Pecten (Pseudamusium) huttoni (Park).
Pinna lata (?) Hutt. Juv.
Placunanomia incisura Hutt.
**Psammobia lineolata* Gray.
**Tellina glabrella* Desh.
Teredo heaphyi Zitt.
Venericardia pseutes Sut.
**Zenatia acinaces* (Q. & G.).

This and the preceding list taken together contain fifty-two species, of which fourteen are also Recent = 27 per cent.

Age: Upper Miocene. *Horizon:* Pareoran.

White Rock River, Upper Pareora Valley. Geol. Surv. Loc. 165. McKay; 1876.

Acteon ovalis (Hutt.).
Alectrion (Hima) socialis (Hutt.). Common.
**Ancilla (Baryspira) australis pyramidalis* (Reeve).
**Anomia huttoni* Sut.
**Bathytoma albula* (Hutt.).
,, *perlata* Sut.
,, *sulcata excavata* Sut.
Bela (Buchozia) infelix Sut.
Borsonia (Cordieria) cincta (Hutt.).
**Calyptræa* (s. str.) *alta* (Hutt.). Many young shells.
* ,, *(Sigapatella) maculata* (Q. & G.).
Cardium greyi (?) Hutt. Fragments.
Corbula pumila Hutt.
**Crepidula monoxyla* (Less.).
,, *gregaria* Sow.
,, *striata* (Hutt.).
Cucullæa ponderosa var. B Hutt.
Cylichnella soror Sut.
Cytherea sp.
Dentalium mantelli Zitt. Fairly common.
,, *solidum* Hutt. Fairly common.
**Dosinia greyi* Zitt. Fragment.
* ,, *subrosea* (Gray). Fragment.
Drillia awamoaensis (Hutt.).
,, *buchanani* (Hutt.).
* ,, *chordata* Sut.
,, *wanganuiensis* (Hutt.).
**Epitonium (Cirsotrema) zelebori* (Dkr.).
Fusinus congestus Sut.
,, *spiralis dentatus* (Hutt.).
,, *tegens* (Hutt.).
Genota robusta (Hutt.).
Glycymeris cordata (Hutt.).
,, *globosa* (Hutt.).
* ,, *laticostata* (Q. & G.).
Hemiconus ornatus (Hutt.).
Latirus (Leucozonia) brevirostris (Hutt.).
Limopsis catenata Sut. Common.
Loripes laminata Hutt. Fairly common.
**Mactra scalpellum* Reeve.
Mangilia gracilenta Sut.
,, *leptosoma* (Hutt.). Fairly common.
Mesalia striolata (Hutt.). Plentiful.
Miomelon corrugata (Hutt.). Fragments.
**Natica australis* (Hutt).
* ,, *zelandica* Q. & G. Many young shells.
**Nucula nitidula* A. Ad.
**Ostrea (Anodontostrea) tatei* Sut.
Paphia curta (Hutt.).
Pecten (Pseudamusium) huttoni (Park). Fragment.
Polinices gibbosus (Hutt.).
,, *(Neverita) huttoni* Iher.
,, ,, *ovatus* (Hutt.).
,, ,, *sagenus* Sut.
**Psammobia lineolata* Gray. Fragments.
**Siphonalia dilatata* (Q. & G.). Very massive shells.
* ,, *nodosa* (Mart.).
,, *subnodosa* (Hutt.).
,, *turrita* Sut.
**Spisula ordinaria* (E. A. Smith).
Surcula obliquecostata Sut.
,, *pareoraensis* (Sut.).
Terebra pareoraensis Sut. Plentiful.
Trophon minutissimus Sut.
**Turbonilla zealandica* (Hutt.).
Turris uttleyi (?) Sut. Fragment.
Turritella (Torcula) concava Hutt. Many specimens, both adult and juvenile.
,, ,, *semiconcava* Sut.
**Venericardia lutea* (Hutt.).
Vexillum rutidolomum Sut.
**Zenatia acinaces* (Q. & G.). Fragments.

Seventy-one species, of which twenty-three also Recent = 32 per cent.

Age: Upper Miocene. *Horizon:* Pareoran. *Matrix:* Mainly loose sands or shelly conglomerate.

Reference: McKay, *loc. cit.*, 1877, pp. 47, 54, &c.

White Rock River, Upper Pareora Valley. J. A. Thomson; 1917.

**Anomia trigonopsis* Hutt.
Bathytoma antecostata Sut.
,, *haasti* (Hutt.).
Cardium waitakiense Sut.
Chione speighti Sut.
Circulus helicoides (Hutt.).
Cominella ordinatis Hutt.
,, n. sp.
Corbula humerosa Hutt.
,, *pumila* Hutt.
Epitonium (Cirsotrema) lyratum (Zitt.).
Eulima sp.
Fusinus congestus Sut.
Macrocallista pareoraensis Sut. var.
**Mangilia dictyota* (Hutt.).
**Protocardia (Nemocardium) pulchella* (Gray).
Solariella n. sp.
Strepsidura n. sp. Genus new to fauna.
,, n. sp.
,, n. sp.
Surcula fusiformis (Hutt.).
,, *obliquecostata* Sut.
Trophon minutissimus Sut.
Turbonilla (Chemnitzia) n. sp.
Turritella (Torcula) concava Hutt.

Age: Oamaruian.

The number of Recent species in this list is no indication of the fossil horizon, for the specimens sent to Mr. Suter were selected from a larger collection, and species previously recorded from the upper Pareora district, if noticed, were excluded. Thus this list has only four species in common with the preceding.

Pareora River, South Canterbury. M. C. Gudex; 1913.

(1.) Pareora River (exact locality not stated).

Alectrion socialis (Hutt.).
Ampullina (Megatylotus) suturalis (Hutt.).
Ancilla (Amalda) waikopiroensis Sut.
Bathytoma sulcata excavata Sut.
Borsonia (Cordieria) cincta (Hutt.).
Corbula humerosa Hutt.
**Crassatellites obesus* (A. Ad.).
**Dentalium ecostatum* T. W. Kirk.
,, *mantelli* Zitt.
Exilia dalli Sut.
Lima colorata Hutt.
**Limopsis aurita* (Brocchi).
**Natica zelandica* Q. & G.
Sinum (Eunaticina) miocænicum (Sut.).
**Siphonalia nodosa* (Mart.).
Surcula fusiformis (Hutt.).
Turritella (Torcula) semiconcava Sut.
Typhis maccoyi T.-Woods.
Vexillum apicale (Hutt.).
,, *(Costellaria) rutidolomum* Sut.

(2.) Blue Sands above the Limestone.

Amusium zitteli (Hutt.).
Chione meridionalis (?) (Sow.).
Corbula canaliculata Hutt.
Crepidula gregaria Sow.
**Malletia australis* (Q. & G.).
Polinices sp.
Surcula fusiformis (?) (Hutt.).

(3.) Otaio Coal Series.

Ampullina (Megatylotus) suturalis (Hutt.).
Astarte australis (?) Hutt.
Chione meridionalis (Sow.).
Corbula canaliculata Hutt.
**Dosinia greyi* Zitt.
Mesalia striolata (Hutt.).
**Psammobia* aff. *stangeri* Gray.
**Pupa alba* (?) (Hutt.).
Siphonalia costata (?) (Hutt.).
Struthiolaria cincta Hutt.
**Tellina glabrella* (?) Desh.
Teredo heaphyi (?) Zitt.
Turritella (Peyrotia) patagonica Sow.

(4.) Limestone at Squire's.

Pecten (Chlamys) chathamensis Hutt.

(5.) Clay Bank at Squire's.

Corbula canaliculata Hutt.
**Dentalium ecostatum* T. W. Kirk.
Marginella (Eratoidea) conica Harris.
Ostrea sp.
Vexillum n. sp.

(6.) Red Sands overlying Blue Clays at Squire's.

Ancilla (s. str.) *hebera* (Hutt.).
Nucula sagittata Sut.
Pecten (Pseudamusium) huttoni (?) (Park). Fragment.
Polinices gibbosus (Hutt.).
Siphonalia costata (Hutt.).
Surcula fusiformis (Hutt.).
Turritella (Torcula) semiconcava Sut.
Venericardia pseutes Sut.

(7.) Higginbotham.

Cardium waitakiense Sut.
Cucullæa attenuata Hutt.
Ostrea (s. str.) *subdentata* Hutt.
Venericardia acanthodes Sut.
* ,, *lutea* (Hutt.).
,, *pseutes* Sut.

(8.) CRAB-BEDS CAVE.

Dentalium aff. *mantelli* Zitt.
Pecten (Patinopecten) delicatulus Hutt.
Turritella aff. *patagonica* Sow.

(9.) RED SAND BELOW CRAB-BEDS.

Ostrea (s. str.) *subdentata* Hutt.

The different localities taken together give forty species, of which twelve are also Recent = 30 per cent.

Age: Miocene (Oamaruian). *Horizon:* Various.
Reference: M. C. Gudex, *loc. cit.*

Holme Station, Pareora River: Shelly Sandstone immediately above the Limestone. M. C. Gudex; 1913.

Ancilla (Amalda) novæ-zelandiæ (Sow.).
,, *(Alocospira) papillata* (Tate).
Bathytoma haasti (Hutt.).
,, *sulcata excavata* Sut.
Corbula canaliculata Hutt.
,, *humerosa* Hutt.
Crassatellites obesus (A. Ad.).
Dentalium mantelli Zitt.
,, *solidum* Hutt.
Drillia awamoaensis (Hutt.).
Epitonium (Cirsotrema) lyratum (Zitt.).
Limopsis aurita (Brocchi).
Marginella (Eratoidea) conica Harris.
Miomelon corrugata (Hutt.).
Polinices gibbosus (Hutt.).
Siphonalia costata (Hutt.).
Surcula fusiformis (Hutt.).
Turritella (Torcula) concava Hutt.
,, *(Peyrotia) patagonica* Sow.
Vexillum (Costellaria) rutidolomum Sut.

Twenty species, of which three also Recent = 15 per cent.

Age: Miocene (Oamaruian). *Horizon:* Pareoran.

Holme Station, Pareora River: Uppermost Stratum. M. C. Gudex; 1913.

Alectrion socialis (Hutt.).
Ampullina (Megatylotus) suturalis (Hutt.).
Ancilla (s. str.) *hebera* (Hutt.).
,, *(Alocospira) papillata* (Tate).
Anomia huttoni Sut.
* ,, *trigonopsis* Hutt.
* ,, *undata* Hutt.
Bathytoma haasti (Hutt.).
,, *sulcata* (Hutt.).
Calyptræa (s. str.) *alta* (Hutt.).
Chione meridionalis (?) (Sow.).
,, *speighti* Sut.
Crassatellites obesus (?) (A. Ad.).
Crepidula striata (Hutt.).
Cucullæa alta Sow.
,, *attenuata* Hutt.
Cylichnella enysi (Hutt.).
Dentalium solidum Hutt.
Dosinia greyi Zitt.
* ,, *lambata* (Gould).
Glycymeris cordata (Hutt.).
* ,, *laticostata* (Q. & G.).
Latirus (Leucozonia) brevirostris (Hutt.).
Limopsis aurita (Brocchi).
Limopsis catenata Sut.
Mactra discors Gray.
Modiolus dolichus Sut.
Panope worthingtoni Hutt.
Paphia curta (?) (Hutt.). Casts.
Pecten (Pseudamusium) huttoni (Park).
Placunanomia zelandica (Gray).
Polinices gibbosus (Hutt.).
,, *(Neverita) huttoni* Iher.
Psammobia lineolata Gray.
* ,, *zelandica* Desh.
Pupa alba (Hutt.).
Siphonalia costata (Hutt.).
* ,, *nodosa* (Mart.).
Struthiolaria cincta Hutt.
* ,, *papulosa* (Mart.).
Surcula fusiformis (Hutt.).
Terebra orycta Sut.
,, *pareoraensis* Sut.
Turritella (Peyrotia) cavershamensis Harris
,, *(Torcula) semiconcava* Sut.
Venericardia pseutes Sut.
Vexillum (Costellaria) rutidolomum Sut.
Zenatia acinaces (Q. & G.).

Forty-eight species, of which seventeen also Recent = 35 per cent.

Age: Miocene (Upper). *Horizon:* Pareoran.

Near Bluecliffs Station, Upper Otaio Valley, Canterbury: Bluish Clays above the Oamaru Limestone. M. C. Gudex; 1913.

A list of fossils from this locality has been published by Mr. Gudex in *Trans. N.Z. Inst.*, vol. 46, 1914, p. 278, containing a few species which are not on my own list.

Alectrion socialis (Hutt.).
Ampullina (Megatylotus) suturalis (Hutt.).
Ancilla (s. str.) *hebera* (Hutt.).
* ,, *(Amalda) novæ-zelandiæ* (Sow.).
,, *(Alocospira) papillata* (Tate).
Bathytoma haasti (Hutt.).
,, *sulcata excavata* Sut.
**Calyptræa (Sigapatella) maculata* (Q. & G.).
* ,, ,, ,, *inflata* (Hutt.).
Chione chiloensis truncata (Sut.).
,, *meridionalis* (Sow.).
Cominella pulchra Sut.
Corbula canaliculata Hutt.
**Crassatellites obesus* (A. Ad.).
Cucullæa australis (Hutt.).
**Dentalium ecostatum* T. W. Kirk.
,, *mantelli* Zitt.
,, *solidum* Hutt.
**Dosinia greyi* Zitt.
Drillia awamoaensis (Hutt.).
,, *callimorpha* Sut.
Epitonium (Clathroscala) elatum Sut.
,, *(Cirsotrema) lyratum* (Zitt.).
Exilia dalli Sut.
Fulgoraria arabica turrita Sut.
**Fusinus spiralis* (A. Ad.).
Lima colorata Hutt.
**Limopsis aurita* (Brocchi).
**Malletia australis* (Q. & G.).
Miomelon corrugata (Hutt.).
Mitra (Cancilla) armorica Sut.
,, n. sp.
**Natica australis* (Hutt.).
* ,, *zelandica* Q. & G.
Pecten (Pseudamusium) huttoni (Park).
**Placunanomia zelandica* (Gray).
Polinices gibbosus (Hutt.).
,, *(Neverita) ovatus* (Hutt.).
,, *(Euspira) planispirus* Sut.
Ptychatractus nodosoliratus Sut.
Sinum (Eunaticina) cinctum (Hutt.).
* ,, ,, *undulatum* (Hutt.).
Siphonalia conoidea (Zitt.).
,, *costata* (Hutt.).
* ,, *dilatata* (Q. & G.).
Surcula fusiformis (Hutt.).
Terebra orycta Sut.
,, *pareoraensis* Sut.
Teredo heaphyi Zitt.
Turbonilla (Mormula) prisca Sut.
**Turritella (Peyrotia) carlottæ* Wats.
,, ,, *cavershamensis* Harris.
,, *(Torcula) concava* Hutt.
,, *(Peyrotia) patagonica* Sow.
,, *(Torcula) semiconcava* Sut.
Typhis maccoyi T.-Woods.
**Venericardia difficilis* (Desh.).
* ,, *purpurata* (Desh.).
Vexillum linctum (Hutt.).
,, *(Costellaria) rutidolomum* Sut.

Sixty species, of which seventeen also Recent = 28 per cent.

Age: Upper Miocene (probably). *Horizon:* Pareoran (probably).

Blue Cliffs, Otaio River, South Canterbury. J. A. Thomson; 1917.

Alectrion socialis (Hutt.).
Ampullina (Megatylotus) suturalis (Hutt.).
**Ancilla (Amalda) novæ-zelandiæ* (Sow.).
,, *(Alocospira) papillata* (Tate).
**Bathytoma albula* (Hutt.).
,, *sulcata excavata* Sut.
Borsonia (Cordieria) n. sp.
,, ,, n. sp.
,, *(Mitromorpha)* n. sp.
Chione chiloensis truncata Sut. Cast.
Corbula canaliculata Hutt.
,, *pumila* Hutt.
**Crepidula monoxyla* (Less.).
Cucullæa alta (?) Sow. Fragment.
Cylichnella enysi (Hutt.). Juv.
Dentalium mantelli Zitt.
,, *(Fustiaria) pareorense* Pils. & Sharp.
,, *solidum* Hutt.
Dosinia greyi Zitt.
Drillia awamoaensis (Hutt.).
,, n. sp. ?
,, n. sp. Near *D. lyallensis* Murdoch
**Emarginula striatula* Q. & G. Fragment.
Epitonium (Clathroscala) elatum Sut.
,, *(Cirsotrema) lyratum* (Zitt.).
Exilia dalli Sut.
Fasciolaria johnstoni (T.-Woods).
Leda semiteres Hutt. Juv.
Lima colorata Hutt.
Marginella conica Harris.
Mesalia striolata (Hutt.).
Miomelon corrugata (Hutt.).
**Natica australis* (Hutt.).
* ,, *zelandica* Q. & G.
Pecten (Pseudamusium) hochstetteri (?) Zitt. Fragment.
,, ,, *huttoni* (Park). Fragment.

Ptychatractus nodosoliratus Sut.
,, *pukeuriensis* Sut.
Roxania n. sp.
Sinum (Eunaticina) cinctum (Hutt.).
Siphonalia costata (Hutt.).
* ,, *dilatata* (Q. & G.). Juv.
* ,, *nodosa* (Mart.). Juv.
Surcula climacota Sut.
Surcula fusiformis (Hutt.).
Terebra orycta Sut.
Teredo heaphyi Zitt.
Trophon lepidus Sut.
Turritella (Torcula) concava Hutt. Juv.
**Venericardia purpurata* (Desh.). Juv.
Vexillum apicale (Hutt.).

Fifty-one species, of which ten also Recent = 20 per cent.

Age: Upper Miocene (probably). *Horizon:* Pareoran (probably).

The percentage of Recent species is smaller than is usual in beds of undoubted Pareora age.

Near Waihao River: Grey Marls. Geol. Surv. Loc. 485. McKay; 1880.

Amusium zittelli (Hutt.). Many specimens.
**Anomia trigonopsis* Hutt.
Astræa sp.? Fragment.
**Calyptræa (Sigapatella) maculata inflata* (Hutt.).
Cantharidus fenestratus Sut.
Cardium aff. *huttoni* Iher. Juv.
Chione chiloensis truncata Sut.
* ,, *mesodesma* (Q. & G.).
Corbula canaliculata Hutt.
,, *kaiparaensis* Sut.
**Crassatellites obesus* (A. Ad.).
,, n. sp.
Cylichnella enysi (Hutt.).
Dentalium mantelli Zitt.
,, *pareorense* Pils. & Sharp.
Exilia waihaoensis (?) Sut.
Galeodea senex (Hutt.).
**Leda bellula* A. Ad.
Leucosyrinx alta (Harris).
**Lima suteri* Dall.
**Limopsis aurita* (Brocchi).
,, *zitteli* Iher.
Modiolaria elongata (?) (Hutt.).
Nucula sagittata Sut.
Pecten (Pseudamusium) huttoni (Park).
,, *(Pallium) polymorphoides* Zitt.
Pholadomya neozelanica Hutt.
**Protocardia (Nemocardium) pulchella* (Gray).
Sinum (Eunaticina) cinctum (Hutt.).
Surcula fusiformis (Hutt.).
**Tellina eugonia* Sut.
Terebra orycta Sut.
Teredo heaphyi Zitt.
Turritella (Peyrotia) patagonica Sow.
* ,, (s. str.) *symmetrica* Hutt.
**Venericardia lutea* (?) (Hutt.). Juv.
**Zenatia acinaces* (Q. & G.).

Thirty-seven species, of which twelve also Recent = 32 per cent.

Age: Miocene (Oamaruian). *Horizon:* Upper Waiarekan (?).

In MS. McKay states that the collection was made from beds appearing on the right bank of the Waihao River and in a small creek leading up to the higher part of Mount Harris.

Reference: McKay, *Rep. of Geol. Explor. during 1881*, No. 14, 1882, pp. 56, 69, &c. (no special mention). The so-called "Grey Marls" of the South Canterbury and Oamaru districts cannot be correlated with the Grey Marl above the Weka Pass stone. In making the correlation McKay relied on their conformity to the underlying limestone and palæontological evidence (not stated). In 1887, however, he found that the supposed Grey Marls underlay the Waihao limestone. See *Rep. of Geol. Explor. during 1886-87*, No. 18, 1887, pp. 98, 99, &c.

Waihao Bridge, One Mile and a Half below Waihao Forks. Geol. Surv. Loc. 462. McKay; 1880.

Ampullina (Megatylotus) suturalis (Hutt.).
,, *waihaoensis* Sut.
**Ancilla (Baryspira) mucronata* (Sow.).
,, *(Amalda) waikopiroensis* Sut.
**Dentalium ecostatum* T. W. Kirk.
,, *mantelli* Zitt.
,, *pareorense* Pils. & Sharp.
,, *solidum* Hutt.
Exilia waihaoensis Sut.
Hemiconus ornatus (Hutt.).
**Mangilia sinclairi* (E. A. Smith).
Mitra inconspicua Hutt.
Sinum (Eunaticina) elegans Sut.
Siphonalia conoidea (?) (Zitt.).
,, *costata* (?) (Hutt.). Fragment.
,, *turrita* Sut. Juv.

Surcula serotina Sut.
Terebra costata Hutt.
Turris complicatus Sut.
Turritella (Haustator) aldingæ Tate.
Turritella (Archimediella) ambulacrum Sow.
,, *(Torcula) concava* Hutt. Juv.
**Venericardia difficilis* (Desh.).

Twenty-three species, of which four also Recent = 17 per cent. Only three of these twenty-three species appear on the preceding list, namely, *Dentalium mantelli, Dentalium pareorense* and *Exilia waihaoensis.*

Age: Miocene (Oamaruian). *Horizon:* Waiarekan (?).

Reference: McKay *loc. cit.*, 1882, pp. 56, 72, &c. (no special mention). See also McKay, *loc. cit.*, 1887, p. 98, where he says a collection was made from grey sandy beds two miles below Waihao Forks. These beds were found to rest on the greensands of Waihao Forks.

Mount Harris, Waihao River. Geol. Surv. Loc. 475. McKay, 1880; J. A. Thomson, 1913.

**Ancilla (Amalda) novæ-zelandiæ* (Sow.).
,, *(Alocospira) papillata* (Tate).
Bathytoma haasti (Hutt.).
**Calyptræa (Sigapatella) maculata* (Q. & G.).
Chione meridionalis (Sow.).
Cominella exsculpta Sut.
Corbula canaliculata Hutt.
,, *humerosa* Hutt.
,, *kaiparaensis* Sut.
**Crassatellites obesus* (A. Ad.).
Cucullæa attenuata Hutt.
**Cytherea oblonga* (Hanley).
Dentalium mantelli Zitt.
**Dosinia greyi* Zitt. Fragment.
Drillia awamoaensis (Hutt.).
**Fulgoraria arabica* (Mart.).
* ,, ,, *elongata* (Swains.). Juv.
,, *biconica* Sut.
* ,, *gracilis* (Swains.).
**Fusinus spiralis* (A. Ad.).
Leucosyrinx alta Harris.
,, ,, *transenna* Sut.
Lima paucisulcata Hutt.
**Limopsis aurita* (Brocchi).
**Malletia australis* (Q. & G.).
Marginella (Eratoidea) conica Harris.
Miomelon corrugata (Hutt.)
Panope orbita Hutt.
Pecten (Pseudamusium) huttoni (Park).
,, ,, *waihaoensis* Sut. (P. Marshall *leg.*)
**Placunanomia zelandica* (Gray).
**Polinices amphialus* (Wats.).
,, *gibbosus* (Hutt.).
,, *(Neverita) ovatus* (Hutt.).
Sinum (Eunaticina) miocænicum Sut.
Siphonalia costata (?) (Hutt.). Spire only.
* ,, *dilatata* (Q. & G.).
,, *subreflexa* (Sow.).
Struthiolaria tuberculata Hutt.
Surcula fusiformis (Hutt.).
Tritonidea compacta Sut. Juv.
**Turritella (Peyrotia) carlottæ* Wats.
,, ,, *cavershamensis* Harris.
,, *(Torcula) concava* Hutt.
,, *(Peyrotia) patagonica* Sow.
Typhis (Typhina) maccoyi T.-Woods.
Venericardia pseutes Sut.

Forty-seven species, of which fifteen also Recent = 32 per cent.

Age: Upper Miocene. *Horizon:* Pareoran.

Reference: McKay, *loc. cit.*, 1880, pp. 56, 64; also 1887, p. 98.

Waihao River: Marly Greensands. Geol. Surv. Loc. 479. McKay, 1880; J. A. Thomson, 1913.

Ampullina (Megatylotus) suturalis (Hutt.).
Ancilla (Alocospira) papillata (Tate).
Aturia australis McCoy.
Borsonia (Cordieria) cincta (Hutt.).
,, ,, *rudis* (Hutt.).
Clavatula mackayi Sut.
Clio (Creseis) sp.
Cucullæa attenuata Hutt.
Cymatium n. sp. ?
**Dentalium ecostatum* T. W. Kirk.
,, *mantelli* Zitt.
,, *solidum* Hutt.
Fulgoraria arabica turrita Sut.
Galeodea senex (Hutt.).
Hemifusus goniodes Sut.
Leda semiteres Hutt.
**Limopsis aurita* (Brocchi).
Miomelon corrugata (Hutt.).
Mitra inconspicua Hutt.
**Nucula nitidula* A. Ad.
**Ostrea* (s. str.) *corrugata* Hutt.
Panope orbita Hutt.
Pecten (Æquipecten) devinctus Sut.
,, *(Pseudamusium) huttoni* (Park).
,, ,, *waihaoensis* Sut.
Plejona (?) *gracilicostata* (Zitt.).
,, *necopinata* (Sut.).
**Polinices amphialus* (Wats.).

Polinices gibbosus (Hutt.).
Rapana neozelanica Sut.
**Sinum (Eunaticina) undulatum* (Hutt.). Juv.
Streptochetus n. sp.
Struthiolaria cincta Hutt.
„ *minor* Marshall.
Surcula mordax Sut.
**Terebra tristis* Desh.
Turris duplex Sut.
„ *uttleyi* Sut.
Turritella (Archimediella) ambulacrum Sow.
* „ *(Peyrotia) carlottæ* Wats.
**Venericardia difficilis* (Desh.) var.
Vexillum apicicostatum Sut.

Forty-two species, of which nine also Recent = 21 per cent.

Age : Miocene (Oamaruian). *Horizon :* Waiarekan (?).
Reference : McKay, *loc. cit.*, 1880, pp. 71–72, &c.

Waihao River : Waihao Limestone. Geol. Surv. Loc. 482. McKay ; 1880.

Epitonium (Cirsotrema) lyratum (Zitt.).
Pecten (Pseudamusium) huttoni (Park). Fragment.
**Pecten (Chlamys) zelandiæ* Gray. Fragment.
Struthiolaria sp. (?).

Age : Miocene (Oamaruian). *Horizon :* Ototaran (?).
Reference : McKay, *loc. cit.*, 1880, p. 70. See also McKay, *loc. cit.*, 1887, pp. 91 *et seq.*

Waihao River : Lower Part of Greensands. Geol. Surv. Loc. 480. McKay, 1880 ; J. A. Thomson, 1913.

Acteon ovalis (?) (Hutt.).
Ampullina (Megatylotus) suturalis (Hutt.).
Ancilla (Alocospira) papillata (Tate). Juv.
**Calyptræa (Sigapatella) maculata inflata* (Hutt.).
Cardium waitakiense Sut. Plentiful.
Chione meridionalis (Sow.). Juv.
Clavatula mackayi Sut.
Conus sp. Spire.
Corbula canaliculata Hutt.
„ *kaiparaensis* Sut.
**Crassatellites obesus* (A. Ad.) Juv.
Cucullæa attenuata Hutt. Plentiful ; many young.
Cylichnella enysi Hutt.
Dentalium solidum Hutt.
**Dosinia greyi* Zitt.
Drillia awamoaensis (Hutt.).
„ sp.
Epitonium (Acrilla) gracillimum Sut. Fragments.
Euthria sp.
Euthriofusus spinosus Sut.
Fulgoraria (Alcithoë) biconica Sut.
Fusinus sp.
Galeodea senex (Hutt.).
Glycymeris sp.
Harpa (Eocithara) neozelanica Sut.
Heliacus n. sp. (?).
Lapparia hebes (Hutt.).
Leda semiteres Hutt.
**Limopsis aurita* (Brocchi).
**Natica australis* (Hutt.).
* „ *zelandica* Q. & G.
**Nucula strangei* A. Ad.
Plejona necopinata Sut.
**Polinices amphialus* (Wats.).
„ *(Neverita) huttoni* (?) Iher.
„ „ *ovatus* (Hutt.) Juv.
**Protocardia (Nemocardium) pulchella* (Gray).
„ *sera* (?) Hutt. Valve ; sculpture lost
**Psammobia lineolata* Gray.
Rapana waihaoensis Sut. Cast.
Ringicula n. sp. Apertures filled with matrix.
Sinum fornicatum Sut. Juv.
Siphonalia nodosa acuticostata Sut.
Solariella n. sp.
Streptochetus n. sp.
Struthiolaria cincta Hutt.
„ *minor* Marshall.
„ *tuberculata* Hutt. Juv.
„ „ *concinna* Sut
Surcula antegypsata Sut.
„ *fusiformis* (?) (Hutt.).
„ *laciniata* Sut.
„ *serotina* Sut.
„ *sertula* Sut.
„ sp.
**Tellina eugonia* Sut.
Terebra costata (?) Hutt.
Teredo heaphyi (?) Zitt.
Triphora sp. Cast.
Trophon n. sp.
Turris sp.
Venericardia acanthodes Sut.
* „ *difficilis* (Desh.).
„ *pseutes* Sut.

Sixty-four species, of which twelve also Recent = 19 per cent

Age : Lower Miocene or Oligocene (Oamaruian). *Horizon :* Waiarekan (?).
References : As for preceding list.

Mount Harris, Waihao River, South Canterbury. J. A. Thomson; 1917.

Alectrion socialis (Hutt.).
Ancilla (Alocospira) papillata (Tate).
Bathytoma sulcata excavata Sut.
Borsonia (Cordieria) n. sp.
Corbula humerosa Hutt.
**Crepidula monoxyla* (Less.).
Cymatium minimum (Hutt.).
Drillia awamoaensis (Hutt.).
Heliacus sp. Juv.
Leda semiteres Hutt.
Limopsis catenata Sut. Juv.
Marginella fraudulenta Sut.
**Polinices amphialus* (Wats.).
Surcula fusiformis (Hutt.). Juv.
Trophon lepidus Sut.
Turritella (Peyrotia) cavershamensis Harris. Fragment.
**Venericardia purpurata* (Desh.). Juv.

Seventeen species, of which three also Recent = 18 per cent.

Near McCullogh's Bridge: Waihao Greensands. J. A. Thomson; 1917.

Ampullina (Megatylotus) suturalis (Hutt.). Juv.
,, *waihaoensis* Sut.
Ancilla (Alocospira) papillata (Tate).
Ancistrosyrinx n. sp. Genus new to fauna.
Borsonia (Cordieria) cincta (Hutt.).
,, ,, *rudis* (Hutt.).
Corbula canaliculata Hutt.
* ,, *macilenta* Hutt.
Corbula pumila Hutt.
Dentalium mantelli Zitt.
,, *(Fustiaria) pareorense* Pils. & Sharp.
,, *solidum* Hutt.
Epitonium (Clathroscala) elatum Sut.
,, *(Cirsotrema) lyratum* (Zitt.). Juv.
Gilbertia aff. *paucistriata* (Marshall). Broken.
**Leda bellula* A. Ad.
,, *semiteres* Hutt.
**Limopsis aurita* (Brocchi). Juv.
Merica n. sp.
Miomelon corrugata (Hutt.).
Mitra inconspicua Hutt.
**Natica australis* (Hutt.).
Pecten (Pseudamusium) waihaoensis Sut.
Polinices gibbosus (Hutt.). Juv.
Sinum (Eunaticina) elegans Sut.
**Siphonalia dilatata* (Q. & G.). Juv.
* ,, *mandarina* (Duclos). Juv.
* ,, *nodosa* (Mart.). Juv.
Surcula serotina Sut.
Turris bimarginatus Sut.
,, *complicatus* Sut.
Turritella (Archimediella) ambulacrum Sow.
Vexillum apicicostatum Sut.
,, n. sp.

Thirty-four species, of which seven also Recent = 21 per cent.

Age: Lower Miocene or Oligocene. *Horizon:* Waiarekan.

Right Bank of the Waihao River, Three Miles below the Waihao Forks, in a Bed of Greensands which lies conformably below the Arenaceous Limestone. G. H. Uttley; 1912. (See also *Trans. N.Z. Inst.*, vol. 47, 1915, p. 385.)

Alectrion socialis (Hutt.).
Ampullina (Megatylotus) suturalis (Hutt.).
Ancilla (Alocospira) papillata (Tate).
Bathytoma haasti (Hutt.).
Corbula canaliculata Hutt.
**Crassatellites obesus* (A. Ad.)
Dentalium mantelli Zitt.
Galeodea senex (Hutt.).
Hemiconus ornatus (Hutt.).
Leucosyrinx alta (Harris).
Lima colorata Hutt.
**Limopsis aurita* (Brocchi).
Miomelon corrugata (Hutt.).
**Struthiolaria papulosa* (Mart.).
,, *tuberculata* Hutt.
Surcula fusiformis (Hutt.).
,, n. sp.
**Turritella (Peyrotia) carlottæ* Wats.
,, *(Torcula) concava* Hutt.
,, *(Peyrotia) patagonica* Sow.
,, *(Torcula) semiconcava* Sut.

Twenty-one species, of which four also Recent = 19 per cent.

Age: Lower Miocene or Oligocene (Oamaruian). *Horizon:* Waiarekan.

Waihao Forks, 300 Yards from Hotel, on Rise. G. H. Uttley; 1912.

Ampullina (Megatylotus) suturalis (Hutt.).
Cardium sp.
Lima paleata Hutt.
**Limopsis aurita* (Brocchi).

Age: Oamaruian. *Horizon:* Waiarekan.

Right Bank of the Waihao River, at McCullogh's Bridge : Greensands lying conformably beneath the Arenaceous Limestone. G. H. Uttley; 1912. (See also *Trans. N.Z. Inst.*, vol. 47, 1915, p. 385.)

Ampullina (Megatylotus) suturalis (Hutt.).
**Ancilla (Amalda) novæ-zelandiæ* (Sow.).
Borsonia (Cordieria) rudis (Hutt.).
Corbula canaliculata Hutt.
Dentalium solidum Hutt.
Mitra inconspicua Hutt.
**Natica zelandica* Q. & G.
Siphonalia turrita Sut.
Surcula pareoraensis (Sut.).
Turris duplex Sut.
,, *regius* Sut.
Turritella (Haustator) aldingæ Tate.
,, *(Archimediella) ambulacrum* Sow.

Thirteen species, of which two also Recent = 15 per cent.

Age: Lower Miocene or Oligocene. *Horizon:* Waiarekan.

Near Mount Harris, on the Slope towards the Waitaki Valley—the First Outcrop on the Road leading from the Waitaki to the Waihao Valley ; overlying the Limestone. G. H. Uttley; 1912. (See also *Trans. N.Z. Inst.*, vol. 47, 1915, p. 385.)

**Ancilla (Amalda) novæ-zelandiæ* (Sow.).
Corbula canaliculata Hutt.
,, *humerosa* Hutt.
,, *kaiparaensis* Sut.
**Crassatellites obesus* (A. Ad.).
**Cytherea oblonga* (Hanley) var.
Dentalium mantelli Zitt.
Drillia n. sp.
Epitonium (Cirsotrema) lyratum (Zitt.).
Galeodea senex (?) (Hutt.). Juv.
**Limopsis aurita* (Brocchi).
**Malletia australis* (Q. & G.).
Nucula sagittata Sut.
Polinices gibbosus (Hutt.).
**Psammobia lineolata* Gray.
Surcula fusiformis (Hutt.).
Turritella (Peyrotia) cavershamensis Harris.
,, *(Torcula) concava* Hutt.
,, ,, *semiconcava* Sut.
**Venericardia difficilis* (Desh.).
**Zenatia acinaces* (Q. & G.).

Twenty-one species, of which eight also Recent = 38 per cent.

Age: Upper Miocene. *Horizon:* Pareoran.

Top of the Hill from Waihao Forks to Elephant Hill : The Rocks are Brown Sands similar to those of the Last Locality, overlying the Limestone. G. H. Uttley; 1912. (See also *Trans. N.Z. Inst.*, vol. 47, 1915, p. 386.)

Alectrion socialis (Hutt.).
Ampullina (Megatylotus) suturalis (Hutt.).
**Ancilla (Amalda) novæ-zelandiæ* (Sow.).
Bathytoma sulcata excavata Sut.
Corbula canaliculata Hutt.
**Crassatellites obesus* (A. Ad.).
Cylichnella enysi (Hutt.).
**Dentalium ecostatum* T. W. Kirk.
* ,, *nanum* Hutt.
**Fulgoraria arabica* (Mart.).
Leucosyrinx alta (Harris).
Mangilia n. sp. (?).
Marginella (Eratoidea) harrisi Cossm.
**Natica zelandica* Q. & G.
Polinices (Neverita) huttoni Iher.
Siphonalia conoidea (Zitt.).
Streptosiphon reticulatum Sut.
Surcula fusiformis (Hutt.).
,, *huttoni* Sut.
Terebra costata Hutt.
**Thalassohelix igniflua* (Reeve). New as a fossil.
**Turritella (Peyrotia) carlottæ* Wats.
,, ,, *cavershamensis* Harris.
**Venericardia difficilis* (Desh.).

Twenty-four species, of which nine also Recent = 37·5 per cent.

Age and *horizon:* As for last locality.

Wharekuri, Waitaki River. Geol. Surv. Loc. 251. C. Traill; 1874.

Bathytoma sulcata (?) (Hutt.). Fragment.
Cardium huttoni Iher.
Cucullæa attenuata Hutt.
Dentalium solidum Hutt.
Epitonium (Cirsotrema) lyratum (Zitt.).
**Limopsis aurita* (Brocchi).
,, *zitteli* Iher.
Miomelon corrugata (Hutt.).
Pecten (Pseudamusium) huttoni (Park). Fragment.
Polinices gibbosus (Hutt.).
, *(Neverita) huttoni* Iher.
Teredo heaphyi Zitt.
Turris uttleyi Sut.
Turritella (Peyrotia) cavershamensis Harris.
**Xenophora corrugata* (Reeve). Fragment.

Fifteen species, of which two also Recent = 13 per cent.

Age: Miocene or Oligocene (Oamaruian).

Wharekuri, Waitaki River: Otekaieke Limestone. Geol. Surv. Loc. 478. McKay; 1880.

Crepidula gregaria Sow.
Dentalium mantelli Zitt.
,, *solidum* Hutt.
Ficus transennus (?) Sut.
Nucula sagittata Sut.
Panope orbita Hutt.
Polinices (Neverita) ovatus (Hutt.).
Teredo heaphyi Zitt.

Age: Miocene (Oamaruian). *Horizon:* Ototaran (or, according to J. Park in *N.Z. Geol. Surv. Bull. No. 20*, 1918, Hutchinsonian). McKay's view is roughly the same as Park's—namely, that the Otekaieke limestone is younger than the Ototara stone, but he considered the latter rock to be of Cretaceo-Tertiary age, not middle Tertiary, as now commonly believed.

Wharekuri, Waitaki River: Hutchinson Quarry Beds. Geol. Surv. Loc. 483. McKay; 1880.

Ampullina (Megatylotus) suturalis (Hutt.).
Ancilla (Alocospira) papillata (Tate).
Chione meridionalis (Sow.).
**Crassatellites obesus* (A. Ad.).
Dentalium solidum Hutt.
**Glycymeris laticostata* (Q. & G.)
,, ,, var.
Limopsis zitteli Iher.
Polinices gibbosus (Hutt.).
,, *(Neverita) huttoni* Iher.
,, ,, *ovatus* (Hutt.).
Turris uttleyi Sut.
**Venericardia purpurata* (?) (Desh.).
,, *pseutes* Sut.

Fourteen species, of which three also Recent = 21 per cent.

Age: Miocene. *Horizon:* Hutchinsonian. According to McKay's MS., the beds collected from form the higher part of the ridge south of the coal-mine at Wharekuri.

Reference: McKay, *Rep. of Geol. Explor. during 1881*, No. 14, 1882, p. 65, &c. The fossiliferous beds "consist of loose dirty greensand, full of shells, followed by grey sands."

Wharekuri, Waitaki River: Greensand. Geol. Surv. Loc. 486. McKay; 1880.

Ampullina (Megatylotus) suturalis (?) (Hutt.).
Astarte australis Hutt.
Chione chiloensis truncata (?) Sut.
Crassatellites attenuatus (?) Hutt. Juv.
* ,, *obesus* (A. Ad.).
Cucullæa attenuata Hutt.
**Cytherea oblonga* (Hanley).
Dentalium mantelli Zitt.
Leda semiteres (?) Hutt.
Panope orbita Hutt.
,, *worthingtoni* Hutt.
Pecten (Chlamys) aldingensis Tate.
Pecten (Pseudamusium) hochstetteri Zitt.
,, ,, *huttoni* (Park). Juv.
,, ,, *yahliensis* T.-Woods.
Pholadomya neozelanica (?) Hutt. Cast.
Pleurotomaria tertiaria McCoy.
Polinices (Neverita) huttoni Iher.
Siphonalia conoidea (?) (Zitt.).
Teredo heaphyi Zitt.
Turbo (Marmorostoma) approximatus Sut.
**Turritella (Peyrotia) carlottæ* Wats.
**Venericardia difficilis* (?) (Desh.).
**Xenophora corrugata* (Reeve).

Twenty-four species, of which five also Recent = 21 per cent.

Age: Miocene or Oligocene (Oamaruian). *Horizon:* Waiarekan.

Reference: McKay, *loc. cit.*, 1882, pp. 73–74. See also F. W. Hutton in *Q.J.G.S*, vol. 41, 1885, p. 559, &c.

Left Bank of Waitaki River, about a Mile below Wharekuri: Marly Greensands below the Limestone. G. H. Uttley; 1912. (See also *Trans. N.Z. Inst.*, vol. 47, 1915, p. 382.)

Ampullina (Megatylotus) suturalis (Hutt.).
Ancilla (Alocospira) papillata (Tate).
**Anomia trigonopsis* Hutt.
Bathytoma sulcata excavata Sut.
Borsonia (Cordieria) rudis (Hutt.).
**Calyptræa (Sigapatella) maculata* (Q. & G.).
Chione meridionalis (Sow.).
Corbula humerosa Hutt.
**Crassatellites obesus* (A. Ad.).
Cucullæa attenuata Hutt.
Dentalium mantelli Zitt.
,, *solidum* Hutt.
**Dosinia greyi* Zitt.
Epitonium (Cirsotrema) lyratum (Zitt.).
Glycymeris cordata (?) (Hutt.).
**Limopsis aurita* (Brocchi).
Limopsis zitteli Iher.
**Macrocallista multistriata* (Sow.).
**Malletia australis* (Q. & G.).
Miomelon corrugata (Hutt.).
**Ostrea (Anodontostrea) tatei* Sut.
Polinices gibbosus (Hutt.).
,, *(Neverita) huttoni* Iher.
**Psammobia lineolata* Gray.
Sinum (Eunaticina) cinctum (Hutt.).
Teredo heaphyi Zitt.
Turritella (Archimediella) ambulacrum Sow.
* ,, *(Peyrotia) carlottæ* Wats.
,, *(Torcula) concava* Hutt.
* ,, (s. str.) *symmetrica* Hutt.
Venericardia pseutes Sut.

Thirty-one species, of which eleven also Recent = 35·5 per cent.

Age: Miocene (Oamaruian). *Horizon:* Waiarekan (?).

Otiake, Waitaki County, North Otago. J. A. Thomson; 1917.

Ampullina (Megatylotus) suturalis (Hutt.).
Ancilla (Alocospira) papillata (Tate).
**Anomia trigonopsis* Hutt.
Bathytoma sulcata excavata Sut.
**Calyptræa alta* (Hutt.).
* ,, *maculata* (Q. & G.). Juv.
Corbula canaliculata Hutt.
**Cytherea oblonga* (Hanley). Fragment.
Dentalium (Fustiaria) pareorense Pils. & Sharp.
**Divaricella cumingi* (Ad. & Ang.). Fragment.
**Dosinia greyi* Zitt.
Ficus parvus Sut.
**Fulgoraria gracilis* (Swains.).
Lima colorata Hutt.
**Limopsis aurita* (Brocchi).
**Macrocallista multistriata* (Sow.).
Miomelon corrugata (Hutt.). Fragment.
Mitra (Cancilla) armorica Sut.
**Murex zelandicus* Q. & G.
**Natica zelandica* Q. & G. Juv.
**Ostrea (Anodontostrea) tatei* Sut.
Pecten (Patinopecten) beethami Hutt.
,, *(Chlamys) chathamensis* Hutt. Fragments.
Polinices gibbosus (Hutt.).
,, *huttoni* Iher.
**Siphonalia nodosa* (Mart.).
,, *turrita* Sut.
Surcula cf. *huttoni* Sut. Fragment.
**Tellina glabrella* Desh. Fragment.
Teredo heaphyi Zitt.
**Thyasira flexuosa* (?) (Montagu). Fragment.
**Turbonilla zealandica* (Hutt.).
Turris uttleyi Sut.
Turritella (Archimediella) ambulacrum Sow.
,, *(Peyrotia) cavershamensis* Harris.
,, *(Torcula) semiconcava* Sut.
Venericardia pseutes Sut.
* ,, *purpurata* (Desh.). Juv.
Vexillum n. sp. Near *V. waitei* Sut.
**Zenatia acinaces* (Q. & G.).

Forty species, of which eighteen also Recent = 45 per cent.

Age: Upper Miocene. *Horizon:* Pareoran (Awamoan).

Otiake River, Trig. Z, Maerewhenua District, Half a Mile distant from the Railway-line between Oamaru and Kurow, just below the Bridge over the Otiake Stream: Arenaceous Limestone. G. H. Uttley; 1912. (See also *Trans. N.Z. Inst.*, vol. 47, 1915, p. 383.)

Ampullina (Megatylotus) suturalis (Hutt.).
**Ancilla (Baryspira) mucronata* (Sow.).
,, *(Alocospira) papillata* (Tate).
Bathytoma sulcata excavata Sut.
Borsonia (Cordieria) rudis (Hutt.).
**Calyptræa (Sigapatella) maculata* (Q. & G.).
Corbula canaliculata Hutt.
,, *humerosa* Hutt.
,, *kaiparaensis* Sut.
**Crassatellites obesus* (A. Ad.).
Crepidula striata Hutt.
Cucullæa attenuata Hutt.

Cymatium minimum (Hutt.).
Cytherea chariessa Sut.
* ,, *oblonga* (Hanley).
Dentalium mantelli Zitt.
,, *solidum* Hutt.
**Divaricella cumingi* (Ad. & Ang.).
**Dosinia greyi* Zitt.
Leucosyrinx alta (Harris).
**Limopsis aurita* (Brocchi).
Macrocallista assimilis (Hutt.).
* ,, *multistriata* (Sow.).
Mangilia blandiata Sut.
Marginella (Eratoidea) harrisi Cossm.
Miomelon corrugata (Hutt.).
Mitra (Cancilla) armorica Sut.
Modiolaria elongata (Hutt.).
**Murex zelandicus* Q. & G.
**Natica zelandica* Q. & G.
Polinices gibbosus (Hutt.).
,, *(Neverita) huttoni* Iher.
Ptychatractus tenuiliratus Sut.
Siphonalia turrita Sut.
Surcula n. sp.
,, n. sp.
Teredo heaphyi Zitt.
Turris uttleyi Sut.
Turritella (Peyrotia) cavershamensis Harris.
Typhis maccoyi T.-Woods.
Venericardia pseutes Sut.

Forty-one species, of which ten also Recent = 24 per cent.

Age: Miocene. *Horizon:* Ototaran (or, according to Park, Hutchinsonian).

Station Peak, North Side of Waitaki Valley: Otekaieke Limestone. Geol. Surv. Loc. 477. McKay; 1880.

Ancilla (Alocospira) papillata (Tate).
,, *(Baryspira) subgradata* (Tate).
**Anomia trigonopsis* Hutt.
Astræa (Guildfordia) n. sp.
Bathytoma sulcata (Hutt.).
**Calyptræa (Sigapatella) maculata* (Q. & G.).
* ,, ,, ,, *inflata* (Hutt.).
Corbula canaliculata Hutt.
**Crassatellites obesus* (A. Ad.).
**Crepidula monoxyla* (Less.).
Cucullæa attenuata Hutt.
Cytherea chariessa Sut.
Dentalium mantelli Zitt. Fragments.
,, *solidum* Hutt.
**Divaricella cumingi* (Ad. & Ang.).
**Fulgoraria* sp. Egg-capsule.
Leucosyrinx alta (Harris).
**Lima lima* (L.).
,, *paleata* Hutt.
**Limopsis aurita* (Brocchi).
**Mactra scalpellum* Reeve.
Marginella (Eratoidea) harrisi Cossm.
Mitra n. sp.
**Natica zelandica* Q. & G.
Nucula sagittata Sut. Fragment.
**Ostrea* (s. str.) *corrugata* Hutt.
Panope worthingtoni Hutt.
Pecten (Pseudamusium) huttoni (Park). Fragment.
Phos n. sp. Imperfect.
Ptychatractus tenuiliratus Sut.
Siphonalia aff. *subnodosa* (Hutt.).
**Terebra tristis* Desh.
Teredo heaphyi Zitt.
Turritella (Peyrotia) cavershamensis Harris.
,, *(Torcula) concava* Hutt.
**Zenatia acinaces* (Q. & G.). Fragments.

Thirty-six species, of which fourteen also Recent = 39 per cent.

Age: Miocene (Oamaruian). *Horizon:* Ototaran (?). The locality is on the north side of the Waitaki River, nearly opposite the Otekaieke Junction (*Rep. of Geol. Explor. during 1881*, No. 14, 1882, p. 66).

Otekaieke, Waitaki River: Otekaieke Limestone. Geol. Surv. Loc. 481. McKay; 1880

**Crassatellites obesus* (A. Ad.).
Cucullæa worthingtoni Hutt.
Dentalium solidum Hutt.
**Divaricella cumingi* (Ad. & Ang.).
**Dosinia greyi* Zitt. Fragment.
**Limopsis aurita* (Brocchi).
**Ostrea* (s. str.) *corrugata* Hutt.
**Pecten (Chlamys) zelandiæ* Gray. Fragment.
Polinices (Neverita) huttoni Iher.
Venericardia pseutes Sut.

Age: Miocene (Oamaruian). *Horizon:* Ototaran (?).
Reference: McKay, *loc. cit.*, 1882, pp. 65–67, &c.

Otekaieke, Waitaki Valley. Geol. Surv. Loc. 252. C. Traill; 1874.

**Crassatellites obesus* (A. Ad.).
Crepidula gregaria Sow.
Dentalium solidum Hutt.
**Limopsis aurita* (Brocchi). Plentiful.
Pecten (Pseudamusium) huttoni (Park).
Teredo heaphyi Zitt.
Turritella (Torcula) concava Hutt.

Age: Miocene (Oamaruian). *Horizon:* Ototaran (?).

According to McKay's MS., these fossils were presumably collected from the Otekaieke limestone (which he regarded as equivalent to the Wharekuri limestone, and younger than the Ototara limestone).

Waitaki River: Maerewhenua Limestone. Geol. Surv. Loc. 179. McKay; 1876.

Astræa sp. Cast.
Epitonium (Cirsotrema) lyratum Zitt. Fragments.
**Fulgoraria* sp. Cast.
Lima (Plagiostoma) lævigata Hutt.
Lima paleata Hutt.
**Pecten (Pseudamusium) huttoni* (Park).
Teredo heaphyi Zitt.
**Zenatia acinaces* (Q. & G.).

Age: Miocene (Oamaruian). *Horizon:* Ototaran. McKay writes in MS.: "This limestone resembles and without doubt is the equivalent of the Ototara limestone near Oamaru."

References: McKay, *Rep. of Geol. Explor. during 1876–77*, No. 10, 1877, pp. 48, 60, 61, and *Rep. of Geol. Explor. during 1881*, No. 14, 1882, pp. 69–70, &c.

Pigeon Rock, Waitaki Valley: Maerewhenua Limestone. Geol. Surv. Loc. 484. McKay; 1880.

Anomia sp. Fragment.
Dentalium mantelli Zitt.
,, *solidum* Hutt.
Epitonium (Cirsotrema) lyratum (Zitt.).
Lima colorata Hutt.
Limopsis catenata Sut.
**Odostomia* (s. str.) *pudica* Sut. Fragments.

Age and *horizon:* As for last locality.

Waitaki River: "Kekenodon" Beds. Geol. Surv. Loc. 476. McKay; 1880.

**Ancilla (Baryspira) australis* (Sow.). Mostly the spire only.
**Anomia trigonopsis* Hutt.
Cardium waitakiense Sut.
**Crassatellites obesus* (A. Ad.).
Cucullæa attenuata Hutt.
Dentalium mantelli Zitt.
,, *solidum* Hutt. Plentiful.
Epitonium (Cirsotrema) lyratum (Zitt.).
Limopsis zitteli Iher. Plentiful.
**Malletia australis* (Q. & G.).
Miomelon corrugata (Hutt.). Fragments.
Ostrea aff. *arenicola* Tate. Fragment.
Pecten (Chlamys) chathamensis Hutt.
,, *(Pseudamusium) huttoni* (Park).
**Placunanomia zelandica* (Gray).
Polinices gibbosus (Hutt.).
,, *(Neverita) huttoni* Iher.
Teredo heaphyi Zitt.
Turritella (Peyrotia) cavershamensis Harris. Juv.
,, *(Torcula) semiconcava* Sut.
Venericardia pseutes Sut.

Twenty-one species, of which five also Recent = 24 per cent.

Age: Miocene (Oamaruian). *Horizon:* Waiarekan. According to McKay, the "Kekenodon" beds consist of slightly calcareous greensand, passing downwards into grey sands and rusty quartzose pebble-beds. They occupy an area about four miles by three, near Wharekuri.

References: McKay, *loc. cit.*, 1882, pp. 67–68, 73, &c.; Hector in *Trans. and Proc. N.Z. Inst.*, vol. 13, 1881, pp. 434–36 and pl. 17 (*Kekenodon onamata*).

Black Point, Waitaki River. Geol. Surv. Loc. 176. McKay; 1876.

Ancilla (Alocospira) papillata (Tate). Juv.
**Anomia huttoni* Sut.
Cardium aff. *facetum* Sut.
,, *waitakiense* Sut.
Chione meridionalis (Sow.).
Clio (Styliola) rangiana (Tate).
**Cochlodesma angasi* (C. & F.).
Corbula canaliculata Hutt.
,, *humerosa* Hutt.
Crassatellites amplus (Zitt.).

Cucullæa alta Sow.
,, *attenuata* Hutt.
,, *australis* (Hutt.). Juv.
Cylichnella enysi (Hutt.).
,, *soror* Sut.
Cytherea chariessa Sut. Juv.
**Dentalium ecostatum* T. W. Kirk.
,, *mantelli* Zitt.
,, n. sp.
**Dosinia greyi* Zitt.
,, *magna* Hutt. Juv
Euthriofusus spinosus Sut.
Ficus parvus Sut.
Fusinus morgani Sut.
Galeodea senex (Hutt.).
Galeodes liræcostata (?) Sut. Juv.
,, n. sp.
,, n. sp.
Glycymeris globosa (Hutt.).
,, *subglobosa* Sut.
Heliacus imperfectus Sut. Juv.
Lapparia hebes (Hutt.).
Leda semiteres Hutt.
Limopsis catenata Sut.
Lithophaga nelsoniana Sut.
**Myodora pandoriformis* (Stutchb.).
**Natica zelandica* Q. & G. Juv.
Panope worthingtoni Hutt.
Parvisipho n. sp. Genus new to fauna.
Pecten (Pseudamusium) huttoni (Park).
Pholadomya neozelanica Hutt. Juv.
Plejona necopinata Sut.
Polinices (Neverita) huttoni Iher.
,, ,, *ovatus* (Hutt.).
**Poroleda lanceolata* (Hutt.). New for the Miocene.
**Protocardia (Nemocardium) pulchella* (Gray).
Rapana neozelanica Sut.
Sinum (Eunaticina) miocænicum (Sut.).
Siphonalia compacta Sut.
* ,, *mandarina* (Duclos).
* ,, *nodosa* (Mart.).
**Spisula ordinaria* (E. A. Smith).
Surcula n. sp.
Streptochetus n. sp.
Struthiolaria cincta Hutt. 2 large casts.
,, *minor* Marshall.
,, *tuberculata* Hutt.
,, ,, *concinna* Sut.
**Tellina eugonia* Sut.
* ,, *glabrella* Desh.
Teredo heaphyi Zitt. Many tubes in fossil wood, also 1 valve.
Tritonidea elatior Sut.
Turritella (Archimediella) ambulacrum Sow.
* ,, *(Peyrotia) carlottæ* Wats.
**Venericardia difficilis* (Desh.). Juv.
,, *pseutes* Sut.

Sixty-six species, of which fifteen also Recent = 23 per cent.

Age: Miocene or Oligocene. *Horizon:* Lower Waiarekan.

There are many species in this list not mentioned in that printed on page 34 of *N.Z. Geol. Surv. Bull. No. 20*, 1918.

Reference: McKay, *loc. cit.*, 1877, pp. 49, 64, and 1882, p. 75, &c. The matrix of the fossils is presumably the yellow and green sands mentioned by McKay.

Black Point, Waitaki Valley, in Sandstone immediately overlying the Coal. J. Park; 1916. ("A lower horizon than any other in the district from which I have collected."—J. PARK.)

Cardium waitakiense Sut.
Chione chiloensis truncata Sut. Juv.
,, *meridionalis* (Sow.).
Crassatellites amplus (Zitt.). Fragment.
Cucullæa alta Sow.
**Dosinia greyi* Zitt.
Euthriofusus spinosus Sut. Fragments.
Fulgoraria arabica turrita (?) Sut.
Lyria n. sp. Cast. Genus new to fauna.
Melina zealandica Sut. Juv.
**Ostrea* (s. str.) *corrugata* Hutt.
Panope worthingtoni Hutt.
Pecten (Pseudamusium) hochstetteri Zitt.
Plejona necopinata Sut.
Sinum (Eunaticina) elegans Sut.
Streptochetus n. sp. Genus new to fauna.
Struthiolaria tuberculata concinna Sut.
Surcula serotina Sut.
Teredo heaphyi Zitt.
Turritella (Archimediella) ambulacrum Sow.
* ,, *(Peyrotia) carlottæ* Wats.
**Venericardia difficilis* (Desh.). Juv.

Twenty-two species, of which four also Recent = 18 per cent.

Mostly casts or imperfect specimens.

Age and *horizon:* As for last locality.

Reference: N.Z. Geol. Surv. Bull. No. 20, 1918, p. 34. As a rule, no remarks will be made on the lists of fossils collected by Professor Park, Dr. J. A. Thomson, and Mr. G. H. Uttley in 1912–17 that now follow. Reference may be made to *N.Z. Geol. Surv. Bull. No. 20* for further information.

Oamaru Borough Water-race, Half a Mile below Papakaio Church. J. Park; 1916.

**Calyptræa* (s. str.) *alta* (Hutt.).
Cardium huttoni (?) Iher. 1 juv. and impression of fragment.
Chione meridionalis (Sow.).
Corbula canaliculata Hutt.
Crassatellites sp. Fragment.
Crepidula gregaria (?) Sow.
Cucullæa alta (?) Sow. Fragment.
Cytherea sulcata (Hutt.).
* ,, *subsulcata* (Sut.).
Epitonium sp. ? Cast of juv.
Lima colorata Hutt.
**Limopsis aurita* (Brocchi).
Panope worthingtoni Hutt. Fragments.
Pecten (Pseudamusium) huttoni (Park).
Polinices gibbosus (Hutt.).
**Psammobia lineolata* (?) Gray.
Siphonalia subnodosa (?) (Hutt.). Fragment.
Surcula fusiformis (Hutt.). Fragment.
Teredo heaphyi Zitt.
Turritella (Peyrotia) carershamensis Harris. Plentiful.
,, *(Torcula) semiconcava* Sut.
**Zenatia acinaces* (Q. & G.). One shell very large, 125 mm. × 60 mm.

Twenty-two species, of which five also Recent = 23 per cent.

Many determinations based on fragments only.
Reference: N.Z. Geol. Surv. Bull. No. 20, p. 35.

Near Windmill Creek, Peebles, Waitaki Valley: Below Oamaru Stone. J. Park; 1916. (Lowest horizon in locality.)

Cardium spatiosum (?) Hutt. Fragment.
Chione chiloensis truncata (?) Sut. Fragment.
,, *meridionalis* (Sow.).
Crassatellites amplus (?) (Zitt.). Fragment.
Cucullæa alta (?) Sow. Fragment.
**Dosinia greyi* Zitt. Fragment.
,, *magna* (?) Hutt. Juv.
Melina zealandica (?) Sut. Fragment.
**Nucula strangei* A. Ad.
**Panope zelandica* Q. & G.
**Psammobia lineolata* Gray.
Turritella (Torcula) concava Hutt. Fragment.
**Zenatia acinaces* (Q. & G.). Fragments.

Reference: N.Z. Geol. Surv. Bull. No. 20, p. 35.

Maerewhenua Gold-workings, Waitaki River. Geol. Surv. Loc. 177. McKay; 1876.

Cardium waitakiense Sut. Fragment.
**Chione mesodesma* (Q. & G.). Juv.
**Dentalium ecostatum* T. W. Kirk.
**Dosinia greyi* Zitt.
**Leptomya lintea* (?) (Hutt.).
**Mactra scalpellum* Reeve. Juv.
**Ostrea* (s. str.) *corrugata* Hutt. Juv.
Turritella (Archimediella) ambulacrum Sow. Mostly juv.
* ,, *(Peyrotia) carlottæ* Wats.
**Venericardia* aff. *purpurata* (Desh.). Plentiful.

Material in very poor condition and difficult to identify.

Age: Miocene or Oligocene. *Horizon:* Waiarekan. It is probable either that some of the above identifications are incorrect, or that most of the unidentifiable specimens belong to extinct species. In MS. McKay states that the collection came from a shell-bed overlying the auriferous sands and gravels of Golden Gully, near the township of Livingstone.

Reference: McKay, *loc. cit.*, 1877, pp. 62–63.

Maerewhenua, Waitaki Valley: "Phorus" Beds. Geol. Surv. Loc. 178. McKay; 1876.

**Atrina zelandica* (Gray).
**Calyptræa (Sigapatella) maculata* (Q. & G.).
Cardium patulum (?) Hutt.
Chione meridionalis (?) (Sow.). Cast.
Corbula canaliculata Hutt.
Crepidula gregaria Sow.
Cucullæa attenuata Hutt.
Cytherea chariessa (?) Sut. Casts.
* ,, *oblonga* (?) (Hanley). Casts.
Dosinia magna Hutt. Cast.

**Fulgoraria arabica elongata* (Swains.). Cast.
Galeodea senex (Hutt.). Fragment.
Glycymeris sp.
**Leda bellula* A. Ad.
Lima colorata Hutt.
,, *paleata* Hutt.
Modiolus huttoni (?) Sut.
Panope orbita Hutt.
* ,, *zelandica* Q. & G.
Pecten (Chlamys) aldingensis Tate.
,, *(Pseudamusium) huttoni* (Park).
**Psammobia lineolata* (?) Gray.
Sinum (Eunaticina) miocænicum (?) Sut.
Siphonalia turrita Sut.
**Struthiolaria vermis tricarinata* (?) Less.
Surcula oamarutica Sut. Cast.
Tugalia elata (Sut.).
Turritella (Peyrotia) cavershamensis Harris.
* ,, ,, *rosea* Q. & G.
**Xenophora corrugata* (Reeve).
**Zenatia acinaces* (Q. & G.).

Thirty-one species, of which eleven also Recent = 35·5 per cent.

Age: Miocene (Oamaruian). *Horizon:* Hutchinsonian, or possibly Awamoan. McKay states in MS. that the collection is from calcareous sands that succeed or form the higher part of the Maerewhenua limestone. These beds are developed on the north side of the Maerewhenua River on and over the area denominated "The Earthquakes," within which vast blocks of limestone are shattered and displaced owing to the removal of underlying softer beds.

Reference: McKay, *loc. cit.*, 1877, pp. 48, 57.

Twenty-four Miles North-west of Oamaru: Maerewhenua Greensands, lying above Oamaru Limestone. J. Park; 1916.

**Crassatellites obesus* (A. Ad.). Juv.
Cypræa ovulatella (?) Tate. Cast.
Epitonium (Cirsotrema) lyratum (Zitt.). Fragments.
Pecten (Pseudamusium) huttoni (Park).
,, *(Chlamys) zelandiæ* Gray.
Protocardia sera Hutt. Casts.
Siphonalia sp.
Teredo heaphyi Zitt.
Turritella (Torcula) semiconcava (?) Sut. Fragment.

Maerewhenua River, Right Bank, Ten Miles from the Point where it joins the Waitaki River: Limestone. G. H. Uttley; 1912. (See also *Trans. N.Z. Inst.*, vol. 47, 1915, p. 385.)

**Ancilla (Amalda) novæ-zelandiæ* (Sow.).
**Capulus australis* (Lamk.).
Cardium huttoni Iher.
,, n. sp.
Corbula humerosa Hutt.
Cylichnella enysi (Hutt.).
Mangilia n. sp.
Nucula strangei A. Ad.
**Polinices amphialus* (Wats.).
Sinum fornicatum Sut.
Surcula n. sp.
**Turritella (Peyrotia) carlottæ* Wats.
**Venericardia difficilis* (Desh.).

Thirteen species, of which five also Recent = 38 per cent.

Buick Creek, Ten Miles from Oamaru: Glauconitic Sandstone, older than Awamoan. J. Park; 1916.

Chione chiloensis truncata (?) Sut. Casts.
,, *meridionalis* (?) (Sow.). Casts.
Corbula humerosa Hutt.
**Crassatellites obesus* (?) (A. Ad.).
Dentalium solidum Hutt.
Lima colorata (?) Hutt. Fragments.
Lima huttoni (?) Sut. Fragment.
**Macrocallista multistriata* (?) (Sow.). Juv.
**Malletia australis* (Q. & G.).
Paphia curta (?) (Hutt.). Casts.
Pecten (Pseudamusium) huttoni (Park).
**Zenatia acinaces* (Q. & G.).

This list is not quoted in *N.Z. Geol. Surv. Bull. No. 20.*

Pukeuri, Six Miles North of Oamaru, Otago. J. A. Thomson; 1917.

Alcira n. sp.
,, n. sp. The same from Rifle Butts.
Ampullina (Megatylotus) suturalis (Hutt.). Juv.
Bela (Buchozia) canaliculata Sut.
**Calyptræa alta* (Hutt.). Juv.
Cerithiella fidicula Sut.
Corbula canaliculata Hutt.
,, *pumila* Hutt.
Cylichnella enysi (Hutt.).
Cymatium minimum (Hutt.).
Dentalium (Fustiaria) pareorense Pils. & Sharp.
Drillia awamoaensis (Hutt.).
Drillia costifer Sut.
,, n. sp.
Leucosyrinx alta transenna (Sut.).
**Limopsis aurita* (Brocchi).
Lissarca n. sp. Nearest to *L. aucklandica*.
Merica n. sp.
**Natica zelandica* Q. & G. Juv.
**Nucula hartvigiana* Pfeiffer. Juv.
Pecten cf. *williamsoni* Zitt. Juv.
**Pleurodon maorianus* Hedley. New as a fossil.
Turritella (Torcula) semiconcava Sut.

Twenty-three species, of which five also Recent = 22 per cent.

Pukeuri Beds, North of Oamaru: Above Oamaru Stone; probably Awamoan. J. Park; 1916.

Alcira n. sp.
Alectrion (Hima) socialis (Hutt.).
Ampullina (Megatylotus) suturalis (Hutt.).
**Ancilla (Amalda) novæ-zelandiæ* (Sow.).
,, *(Alocospira) papillata* (Tate).
Bela (Buchozia) canaliculata Sut.
**Calyptræa (Sigapatella) maculata* (Q. & G.).
* ,, ,, ,, *inflata* (Hutt.).
Cominella pulchra Sut. var.
Corbula pumila Hutt.
**Crassatellites obesus* (A. Ad.).
Crepidula gregaria Sow.
Cucullæa alta Sow.
Cylichnella enysi Hutt.
Cymatium minimum (Hutt.).
Dentalium mantelli Zitt.
* ,, *nanum* Hutt.
,, *pareorense* Pils. & Sharp.
Drillia awamoaensis (Hutt.).
**Fulgoraria arabica* (Mart.).
Fusinus spiralis dentatus (Hutt.).
Galeodea senex (Hutt.).
Hemiconus ornatus (Hutt.).
Leucosyrinx alta (Harris).
Lima colorata Hutt.
**Limopsis aurita* (Brocchi).
**Malletia australis* (Q. & G.).
Marginella (Eratoidea) conica Harris.
,, *(Glabella) fraudulenta* Sut.
,, *(Eratoidea) harrisi* Cossm.
Miomelon corrugata (Hutt.).
**Myodora crassa* (Stutchb.). New as a fossil.
* ,, *pandoriformis* (Stutchb.). New as a fossil.
**Natica zelandica* Q. & G.
Pecten (Patinopecten) beethami Hutt.
,, *(Pseudamusium) hochstetteri* Zitt.
**Placunanomia zelandica* (Gray).
Polinices gibbosus (Hutt.).
**Protocardia (Nemocardium) pulchella* (Gray).
Siphonalia excelsa Sut.
,, *turrita* Sut.
Struthiolaria tuberculata Hutt.
Surcula fusiformis (Hutt.).
,, *pareoraensis* (Sut.).
Turritella (Torcula) concava Hutt.
,, ,, *semiconcava* Sut.
**Venericardia difficilis* (Desh.).
,, *pseutes* Sut.
Vexillum apicale (Hutt.).
,, *fenestratum* Sut.
,, *linctum* (Hutt.).
**Zenatia acinaces* (Q. & G.).

Fifty-two species, of which fifteen also Recent = 29 per cent.

Reference: N.Z. Geol. Surv. Bull. No. 20, pp. 92–93. *Lima huttoni* is omitted from the present list, and *Pecten beethami* added.

Pukeuri, Six Miles North of Oamaru. Geol. Surv. Loc. 253. C. Traill; 1874.

Alectrion (Hima) socialis (Hutt.).
Gryphæa tarda (?) Hutt.
Leucosyrinx alta (Harris). Fragments.
**Limopsis aurita* (Brocchi).
Marginella (Glabella) fraudulenta Sut.
Venericardia pseutes Sut. Plentiful.

Age: Miocene (Oamaruian). The exact locality, and therefore the horizon, are unknown.

Tabletop Hill, Head of Oamaru Creek: Tuffs, intercalated in Upper Portion of Oamaru Stone. J. Park; 1916.

Chione meridionalis (?) (Sow.). Juv. cast.
**Lima angulata* Sow. Juv.
* ,, *bullata* (Born). Juv.
Limopsis zitteli Iher. Numerous young shells.
Pecten (Chlamys) aldingensis Tate. Juv.
Pecten (Patinopecten) delicatulus Hutt. Fragment.
Placunanomia incisura Hutt.
**Venericardia difficilis* (Desh.). Juv.

Reference: N.Z. Geol. Surv. Bull. No. 20, p. 65. In the above list *Limopsis zitteli* replaces *L. catenata* of the bulletin list.

Brockman's Hill, South of Tabletop Hill: Calcareous Tuffs below Oamaru Stone. J. Park; 1916.

Ostrea (Anodontostrea) incurva Hutt. With borings of *Pholadidea.*
Panope sp. Fragments.
Teredo heaphyi (?) Zitt.

Reference: N.Z. Geol. Surv. Bull. No. 20, p. 64.

North-west Branch of Landon Creek, near Pukeuri: Glauconitic Sandstone, above Greensands. J. Park; 1916.

Ostrea (Anodontostrea) nelsoniana Zitt.

Reference: N.Z. Geol. Surv. Bull. No. 20, pp. 46–47, 79 (references to locality and matrix only).

North-west Branch of Landon Creek: Greensands. J. Park; 1916.

Chione meridionalis (?) (Sow.). Juv. cast.
**Crassatellites obesus* (?) (A. Ad.). Cast.
**Epitonium (Cirsotrema) zelebori* (Dkr.).
Pecten (Patinopecten) beethami Hutt.
,, *(Pallium) burnetti* Zitt. Fragment.
Pecten (Patinopecten) hutchinsoni Hutt. Fragments.
,, *(Pseudamusium) huttoni* (Park).
,, *(Chlamys) semiplicatus* Hutt. Fragments.

There are also Corals, Echinoderms, Bryozoa, and Brachiopods.
Reference: N.Z. Geol. Surv. Bull. No. 20, pp. 46–47, 64.

Devil's Bridge, Oamaru: Glauconitic Sandstone overlying Oamaru Stone. J. Park; 1916.

(Species marked with T are listed by Park in *Trans. N.Z. Inst.*, vol. 37, 1905, p. 518.)

Astarte australis Hutt.
**Calyptræa (Sigapatella) maculata* (Q. & G.).
**Chione spissa* (Desh.). T.
,, *meridionalis* (Sow.). Plentiful.
,, *acuminata* Hutt. T.
**Crassatellites obesus* (A. Ad.).
Cucullæa alta (?) Sow. Fragment.
Dentalium mantelli Zitt. T.
**Dosinia greyi* Zitt. T.
Emarginula wannonensis Harris.
Lima paleata Hutt.
,, *colorata* Hutt.
**Limopsis aurita* (Brocchi). T.
**Ostrea (Anodontostrea) angasi* Sow. T.
Pecten (Pseudamusium) huttoni (Park).
,, *(Chlamys) williamsoni* Zitt. T.
,, *(Pseudamusium) yahliensis* T.-Woods.
**Sinum (Eunaticina) undulatum* (?) (Hutt.).
Teredo heaphyi Zitt.
Turritella (Torcula) concava Hutt. Fragments.
,, ,, *semiconcava* Sut.
**Venericardia purpurata* (Desh.).
,, *pseutes* Sut.

Twenty-three species, of which eight are also Recent = 35 per cent.

Devil's Bridge: Magellanian Bed overlying Oamaru Stone.

Pecten (Patinopecten) beethami Hutt.
,, *(Pseudamusium) huttoni* (Park).

Twenty-four species in the two lists, of which eight also Recent = 33 per cent.

Reference: N.Z. Geol. Surv. Bull. No. 20, pp. 62, 79, 82.

Devil's Bridge, Oamaru Creek: Limestone. Geol. Surv. Loc. 174. McKay; 1876.

Crassatellites obesus (A. Ad.).
Cucullæa alta Sow.
Galeodea aff. *senex* (Hutt.).
Lima colorata Hutt.
,, *paleata* (?) Hutt. Fragment of a large shell.
Macrocallista multistriata (Sow.). Fragment.
Malletia australis (Q. & G.).
Nucula sagittata Sut.
Panope orbita Hutt.
Pecten (Pseudamusium) huttoni (Park).
Turritella (Torcula) semiconcava Sut.
Venericardia pseutes Sut.

Twelve species, of which three also Recent = 25 per cent.

Age: Miocene (Oamaruian). *Horizon:* Ototaran. According to McKay's MS., the collection was made from the limestone scarp between the Devil's Bridge and the Waiareka Valley.

Reference: McKay, *loc. cit.*, 1877, p. 61.

Oamaru Creek, One Mile South of Devil's Bridge. Geol. Surv. Loc. 175. McKay; 1876.

**Anomia huttoni* Sut.
**Calyptræa (Sigapatella) maculata* (Q. & G.).
* ,, ,, ,, *inflata* (Hutt.).
**Capulus australis* (Lamk.).
Cardium huttoni Iher.
,, *spatiosum* Hutt. Fragment.
,, *waitakiense* Sut.
Chione meridionalis (Sow.).
Clavatula n. sp. ?
**Cochlodesma angasi* (C. & F.). Perfect specimen.
Crassatellites amplus (Zitt.).
,, *attenuatus* (Hutt.).
* ,, *obesus* (A. Ad.).
**Crepidula monoxyla* (Less.).
Cucullæa alta Sow. var. B Hutt.
Cytherea chariessa Sut.
Dentalium mantelli Zitt. Plentiful.
* ,, *nanum* Hutt.
**Dosinia greyi* Zitt.
,, *magna* Hutt.
Genota n. sp. ? In bad condition.
**Glycymeris laticostata* (Q. & G.).
Lima colorata Hutt. Large specimen.
,, *paleata* Hutt. Large right valve.
**Limopsis aurita* (Brocchi).
Maculopeplum attenuatum (?) (Hutt.).
**Malletia australis* (Q. & G.).
Miomelon corrugata (Hutt.).
Panope orbita Hutt.
Paphia curta (?) (Hutt.).
Pecten (Pseudamusium) huttoni (Park). Fragment.
,, ,, *yahliensis* T.-Woods. Fragment.
Placunanomia incisura Hutt. Plentiful.
Siphonalia costata (Hutt.).
* ,, *dilatata* (Q. & G.).
* ,, *mandarina* (Duclos).
Stilifer n. sp. ? Base broken off.
Struthiolaria tuberculata Hutt.
Surcula fusiformis (Hutt.).
,, n. sp.
Turritella (Peyrotia) cavershamensis Harris.
,, *(Torcula) concava* Hutt.
,, ,, *semiconcava* Sut.
Typhis (Typhina) maccoyi T.-Woods.
Venericardia pseutes Sut.

Forty-five species, of which fourteen also Recent = 31 per cent.

Age: Upper Miocene. *Horizon:* Pareoran (Awamoan).

Reference: McKay, *loc. cit.*, 1877, p. 57. See also references to Ardgowan shell-bed (next list).

Ardgowan Shell-bed, East Side of Oamaru Creek, South of Devil's Bridge. J. Park; 1916.

Alectrion (Hima) socialis (Hutt.). Plentiful.
Ancilla (Alocospira) papillata (Tate).
**Anomia trigonopsis* Hutt.
Basilissa n. sp.
,, n. sp.
Bathytoma sulcata (Hutt.).
Bela (Buchozia) canaliculata Sut.
**Calyptræa* (s. str.) *alta* (Hutt.). Many juv.
,, *(Sigapatella) maccoyi* Sut.
* ,, ,, *maculata* (Q. & G.).
* ,, ,, ,, *inflata* (Hutt.).
* ,, (s. str.) *tenuis* (Gray). Juv.
Chione meridionalis (Sow.). Fragment.
Cominella pulchra Sut.
Corbula canaliculata Hutt. Plentiful.
,, *humerosa* Hutt.
,, *kaiparaensis* Sut.
Crassatellites amplus (Zitt.).
* ,, *obesus* (A. Ad.).
**Crepidula monoxyla* (Less.).
Cucullæa alta Sow.
,, *australis* (Hutt.).
Cytherea sulcata (?) (Hutt.). Imperfect examples.

Dentalium mantelli Zitt.
* ,, *nanum* Hutt. Plentiful.
Dosinia magna Hutt.
Drillia awamoaensis (Hutt.).
,, *callimorpha* Sut.
,, n. sp.
Epitonium (Cirsotrema) lyratum (Zitt.).
**Fulgoraria arabica* (Mart.). Cast and fragment.
Fusinus climacotus Sut. Fragment.
Hemiconus ornatus (Hutt.).
**Leda bellula* A. Ad.
Lima colorata Hutt.
**Limopsis aurita* (Brocchi).
,, *catenata* Sut. Juv.
Loripes laminata Hutt.
**Malletia australis* (Hutt.).
Marginella (Eratoidea) conica Harris.
,, ,, *harrisi* Cossm.
Merica (Aphera) n. sp.
Miomelon corrugata (Hutt.). Juv.
**Natica zelandica* Q. & G. Juv. Numerous.
Nucula sagittata Sut.
Panope worthingtoni Hutt.
Paphia curta (Hutt.). Fragment.
Pecten (Pseudamusium) huttoni (Park).
**Phalium achatinum pyrum* (Lamk.). Juv.
Placunanomia incisura Hutt.
**Polinices amphialis* (Wats.).
,, *gibbosus* (Hutt.).
**Psammobia strangei* Gray.
**Serpulorbis sipho* (Lamk.).
**Siphonium planatum* Sut.
Struthiolaria cincta Hutt. Juv.
Surcula fusiformis (Hutt.).
,, *huttoni* (?) Sut.
,, *oamarutica* Sut.
Teredo heaphyi Zitt.
Trophon lepidus Sut.
Turritella (Peyrotia) cavershamensis Harris. Plentiful.
,, *(Torcula) semiconcava* Sut. Plentiful.
**Venericardia difficilis* (Desh.). Juv.
* ,, *lutea* (Hutt.). Juv. Plentiful.
,, *pseutes* Sut.
Vexillum rutidolomum Sut.
**Volvulella reflexa* (Hutt.).
**Zenatia acinaces* (Q. & G.).

Sixty-nine species, of which twenty-two also Recent = 32 per cent.

Reference: N.Z. Geol. Surv. Bull. No. 20, pp. 81, 90. See also P. Marshall and G. H. Uttley in *Trans. N.Z. Inst.*, vol. 45, 1913, pp. 302–3. A sketch-map on p. 299 shows exact position of fossil locality.

Near Oamaru Creek, South of Devil's Bridge: Sandstone at Base of Ardgowan Shell-bed, above the Limestone. J. Park; 1916.

**Calyptræa* (s. str.) *alta* (Hutt.). Juv.
**Crassatellites obesus* (A. Ad.). Juv.
Cytherea chariessa Sut.
**Lima suteri* Dall.
Limopsis catenata Sut. Juv
**Malletia australis* (Q. & G.).
**Modiolus australis* (Gray). Cast.
Pecten (Pseudamusium) huttoni (Park). Juv.
Turritella (Torcula) semiconcava Sut.
**Venericardia lutea* (Hutt.). Juv.
,, *pseutes* Sut.
**Zenatia acinaces* (Q. & G.). Fragment.

Reference: N.Z. Geol. Surv. Bull. No. 20, p. 81.

Ardgowan Road, near Creamery: Basaltic Conglomerate overlying Oamaru Stone. J. Park; 1916.

Ampullina (Megatylotus) suturalis (?) (Hutt.).
**Anomia trigonopsis* (?) Hutt.
**Capulus australis* (?) (Lamk.).
Clio sp.
Cypræa (Eocypræa) trelissickensis (?) Sut.
Galeodea senex (Hutt.).
Lima colorata (?) Hutt. Juv.
Lima huttoni (?) Sut.
Melina zealandica (?) Sut. Juv.
Nucula sagittata Sut. Cast.
Ostrea (Anodontostrea) nelsoniana Zitt.
Panope worthingtoni Hutt. Fragment.
Pecten (Patinopecten) delicatulus Hutt.
Protocardia sera Hutt. Cast.

Nearly all specimens difficult to determine.

Reference: N.Z. Geol. Surv. Bull. No. 20, p. 77. In the above list *Anomia trigonopsis* Hutt takes the place of *A. walteri* Hect., regarded as a synonym.

Grant's Creek, Oamaru : Greensands above Basaltic Conglomerate, overlying the Limestone at Lower End. J. Park ; 1916.

Ampullina (Megatylotus) suturalis (?) (Hutt.).
Chione chiloensis truncata (?) Sut. Cast.
Pecten (Patinopecten) delicatulus (?) Hutt. Fragment.

Many Brachiopods.

Reference : N.Z. Geol. Surv. Bull. No. 20, p. 45 (list not quoted in bulletin).

Teaneraki (Enfield), Oamaru District. Geol. Surv. Loc 630. Thomas Esdaile ; *circa* 1886.

**Ancilla (Amalda) novæ-zelandiæ* (Sow.).
,, ,, *waikopiroensis* Sut.
Aturia australis McCoy. Fragment.
Corbula canaliculata Hutt.
Cymatium n. sp. Not good enough for description.
Daphnella (Raphitoma) neozelanica Sut.
Dentalium solidum Hutt.
**Dosinia greyi* Zitt.
Exilia crassicostata Sut.
Fusinus climacotus Sut.
,, *solidus* Sut.
**Leda bellula* A. Ad. New for the Miocene.
,, *semiteres* Hutt.
**Limopsis aurita* (Brocchi). Juv.
Maculopeplum elegantissimum (Sut.).
Miomelon corrugata (Hutt.).
Pecten (Pseudamusium) huttoni (Park).
Polinices (Neverita) ovatus (Hutt.).
Sinum (Eunaticina) elegans Sut.
**Siphonalia nodosa* (Mart.).
Struthiolaria frazeri Hutt.
Surcula huttoni Sut.
Terebra costata Hutt.
Turris bimarginatus Sut.
,, *neglectus* Sut.
Turritella (Archimediella) ambulacrum Sow.
Venericardia difficilis benhami (Thomson).

Twenty-seven species, of which five also Recent = 19 per cent.

Age : Miocene (Oamaruian). *Horizon :* Waiarekan.
References : J. Park, *Rep. of Geol. Explor. during 1886–87*, No. 18, 1887, p. 139 ; J. Hector, same vol., pp. xliv–xlv.

Teaneraki (Enfield), Waiareka Valley : Waiareka Tufas. Geol. Surv. Loc. 675. J. Park ; 1886.

Siphonalia costata (Hutt.).

Age : Miocene. *Horizon :* Waiarekan.
The next collection listed (Esdaile, Loc. 831) is from the same locality.
Reference : J. Park, *loc. cit.*, 1887, pp. 138–39, &c.

Cave Valley and Upper Waiareka Valley : Chalk Ooze and Tufaceous Greensands. Geol. Surv. Loc. 831. Thomas Esdaile ; *circa* 1886.

Cantharidus fenestratus Sut.
**Capulus australis* (Lamk.).
Cardium patulum (?) Hutt.
,, sp.
Corbula canaliculata Hutt.
,, sp.
**Crassatellites obesus* (A. Ad.). Juv.
Cucullæa attenuata Hutt.
Cylichnella enysi (Hutt.).
Cymatium minimum (Hutt.).
Cytherea sp. ?
Daphnella sp.
Fusinus solidus Sut.
Glycymeris globosa (Hutt.).
Hemiconus ornatus (Hutt.).
Leda semiteres Hutt.
Lima paleata Hutt.
Mitra inconspicua Hutt.
Mytilus huttoni Cossm.
Ostrea (s. str.) *subdentata* Hutt.
Panope orbita Hutt.
Pleurotomaria tertiaria McCoy.
**Protocardia (Nemocardium) pulchella* (Gray).
,, *sera* Hutt.
**Psammobia lineolata* Gray.
**Serpulorbis sipho* (Lamk.).
Siphonalia conoidea (Zitt.). Juv.
Struthiolaria cincta Hutt.

Struthiolaria minor Marshall.
,, *tuberculata concinna* Sut.
**Tellina eugonia* (?) Sut.
**Turritella (Peroytia) carlottæ* Wats.
Turritella (Torcula) concava Hutt.
Venericardia difficilis benhami (Thomson).
,, sp.

Thirty-five species, of which seven also Recent = 20 per cent.

Age: Miocene (Oamaruian). *Horizon:* Waiarekan.
References: As for Loc. 630 (see p. 79).

Parson's Creek, Oamaru: Basaltic Conglomerate under Deborah Limestone. J. Park; 1916.

Dentalium mantelli Zitt.
Ostrea (s. str.) *mackayi* Sut.
Ostrea (Anodontostrea) nelsoniana (?) Zitt.
,, (s. str.) *wuellerstorfi* Zitt. Juv.

Reference: *N.Z. Geol. Surv. Bull. No. 20*, p. 74.

Parson's Creek, West of Oamaru: Bluish-green Sandy Clays. J. Park; 1915-16.

**Ancilla novæ-zelandiæ* (Sow.).
,, *papillata* (Tate).
Bathytoma sulcata excavata Sut.
**Calyptræa maculata* (Q. & G.).
* ,, ,, *inflata* (Hutt.).
* ,, *tenuis* Gray.
**Crassatellites obesus* (A. Ad.).
**Dentalium ecostatum* T. W. Kirk.
,, *mantelli* Zitt.
,, *solidum* Hutt.
**Diplodonta globularis* (Lamk.).
Epitonium lyratum (Zitt.).
Galeodea senex (Hutt.).
Lima colorata Hutt.
**Limopsis aurita* (Brocchi).
,, *catenata* Sut.
Leucosyrinx alta (Harris).
**Macrocallista multistriata* (Sow.).
**Malletia australis* (Q. & G.).
Marginella harrisi Cossm.
Miomelon corrugata (Hutt.).
**Natica zelandica* Q. & G.
Nucula sagittata Sut.
Pecten huttoni (Park).
**Sarepta obolella* (Tate).
Sinum (Eunaticina) cinctum (Hutt.).
**Siphonalia nodosa* (Mart.).
Surcula fusiformis (Hutt.).
Teredo heaphyi Zitt.
Turritella semiconcava Sut.
**Venericardia difficilis* (Desh.).
,, *pseutes* Sut.
**Zenatia acinaces* (Q. & G.).

Thirty-three species, of which fifteen are also Recent = 45 per cent.

Reference: *N.Z. Geol. Surv. Bull. No. 20*, p. 91.

The above list was not in the MS. forwarded by Mr. Suter. It is a copy of a list supplied by him in 1916.

Oamaru Creek, interbedded with Volcanic Rocks. Geol. Surv. Loc. 310. McKay; 1876.

Pecten (Chlamys) chathamensis Hutt.
Struthiolaria cingulata (?) Zitt. Casts.

Age: Miocene (Oamaruian). *Horizon:* Hutchinsonian (McKay in MS.).
Reference: McKay, *loc. cit.*, 1877, pp. 48, 57, &c. (no specific reference).

Limekiln Gully (= Target Gully), Oamaru. Geol. Surv. Loc. 173. McKay; 1876.

Crassatellites attenuatus (?) (Hutt.).
Cucullæa alta var. B Hutt.
Glycymeris sp. ?
Lima colorata Hutt.
Limopsis zitteli Iher.
**Placunanomia zelandica* (Gray).
Teredo heaphyi Zitt.
Turritella (Peyrotia) cavershamensis Harris.
Venericardia acanthodes Sut.
* ,, *difficilis* (?) (Desh.).
,, *pseutes* Sut.

Age: Miocene (Oamaruian). *Horizon:* Hutchinsonian. The locality collected from was probably Hutchinson's Quarry and the immediate neighbourhood.
Reference: McKay, *loc. cit.*, 1877, pp. 48, 57, &c.

Oamaru. Geol. Surv. Loc. 308. Hector; 1876? (and earlier).

**Fulgoraria arabica elongata* (Swains.).
Miomelon corrugata (?) (Hutt.). Cast.

Age: Miocene (Oamaruian). *Horizon:* Various.

This was originally a fairly large collection, including old specimens of the Otago Provincial Geological Survey, partly from greensands and partly from limestone (McKay in MS.).

Target Gully, Oamaru: Shell-bed above the Hutchinson Quarry Beds, which rest on Oamaru Limestone. P. Marshall and J. Park; 1915–16. (Separate collections.)

Acteon præcursorius Sut.
,, n. sp.
Alectrion (Hima) socialis (Hutt.).
Ampullina (Megatylotus) suturalis (Hutt.).
Anachis pisaniopsis (Hutt.). New for the Miocene.
**Ancilla (Baryspira) australis* (Sow.).
,, (s. str.) *hebera* (Hutt.).
* ,, *(Amalda) novæ-zelandiæ* (Sow.).
,, *(Alocospira) papillata* (Tate).
**Anomia huttoni* Sut.
**Arca novæ-zealandiæ* E. A. Smith.
,, (s. str.) *subvelata* Sut.
Barnea n. sp.
Basilissa n. sp.
**Bathytoma albula* (Hutt.).
,, *antecostata* Sut.
,, *perlata* Sut.
,, *sulcata* (Hutt.).
Bela (Buchozia) canaliculata Sut.
,, ,, *infelix* Sut.
Bezanconia (Ataxocerithium) n. sp.
,, ,, n. sp.
Borsonia (Cordieria) rudis (Hutt.).
Calliostoma n. sp.
Calyptræa (Sigapatella) maccoyi Sut.
* ,, ,, *maculata* (Q. & G.).
* ,, ,, ,, *inflata* (Hutt.).
,, ,, ,, n. var.
**Cantharidus tenebrosus* A. Ad.
Cardium patulum Hutt.
Cerithiella fidicula Sut.
Cerithiopsis æquicincta Sut.
Chama huttoni Hect.
**Chamostrea albida* (Lamk.).
Chione meridionalis (Sow.).
* ,, *mesodesma* (Q. & G.).
* ,, *(Salacia) yatei* (Gray).
Circulus helicoides (Hutt.).
,, *politus* Sut.
Cominella intermedia Sut.
,, *ordinatis* Hutt.
,, *pulchra* Sut.
Corbula canaliculata Hutt.
,, *humerosa* Hutt.
,, *kaiparaensis* Sut.
,, *pumila* Hutt.
Crassatellites amplus (Zitt.).
,, *attenuatus* (Hutt.).
* ,, *obesus* (A. Ad.).
**Crepidula costata* (Sow.).
Crepidula densistria Sut.
,, *gregaria* Sow.
* ,, *monoxyla* (Less.).
,, *striata* (Hutt.).
Cucullæa alta Sow.
,, *australis* (Hutt.).
Cuna n. sp.
Cyclostrema n. sp.
Cylichnella enysi (Hutt.).
,, *soror* Sut.
Cymatium minimum (Hutt.).
**Cytherea oblonga* (Hanley).
* ,, *subsulcata* (Sut.).
,, *sulcata* (Hutt.).
,, n. sp.
**Dentalium ecostatum* T. W. Kirk.
,, *mantelli* Zitt.
* ,, *nanum* Hutt.
,, *solidum* Hutt.
**Diplodonta globularis* (Lamk.).
**Divaricella cumingi* (Ad. & Ang.).
**Dosinia (Dosinidea) greyi* Zitt.
,, *(Austrodosinia) magna* Hutt.
Drillia awamoaensis (Hutt.).
,, *callimorpha* Sut.
,, *(Crassispira) costifer* Sut.
,, *imperfecta* Sut.
,, n. sp.
,, n. sp.
Eglisia n. sp.
**Emarginula striatula* Q. & G.
Epitonium (Cirsotrema) lyratum (Zitt.).
* ,, ,, *zelebori* (Dkr.).
Erato neozelanica Sut.
Eulima obliqua (Hutt.). New for the Miocene.
,, n. sp.
Euthria stirophora Sut.
**Fulgoraria arabica* (Mart.).
* ,, ,, *elongata* (Swains.).
* ,, *gracilis* (Swains.).
Fusinus climacotus Sut.
* ,, *spiralis* (A. Ad.).
,, n. sp.
Glycymeris subglobosa Sut.
**Heliacus variegatus* (Gmel.). New as a fossil.
,, *imperfectus* Sut.
Hemiconus ornatus (Hutt.).
Hinnites trailli Hutt.
Latirus (Leucozonia) brevirostris (Hutt.).
Leda semiteres Hutt.
**Leptothyra fluctuata* (Hutt.).

Leucosyrinx alta (Harris).
,, ,, *transenna* (Sut.).
**Lima bullata* (Born).
,, *colorata* Hutt.
Limopsis catenata Sut.
,, *zitteli* Iher.
Lissospira exigua Sut.
**Loripes concinna* Hutt.
,, *laminata* Hutt.
**Macrocallista multistriata* (Sow.)
**Malletia australis* (Q. & G.).
**Mangilia dictyota* (Hutt.) New for the Miocene.
,, *gracilenta* Sut.
,, *leptosoma* (Hutt.).
,, *præcophinodes* Sut.
Marginella (Eratoidea) conica Harris.
,, *(Glabella) fraudulenta* Sut.
,, *(Eratoidea) harrisi* Cossm.
,, n. sp.
**Megalatractus maximus* (Tryon).
Merica n. sp.
,, n. sp.
,, n. sp.
,, *(Aphera)* n. sp.
Mesalia striolata (Hutt.).
Miomelon corrugata (Hutt.).
Mitra armorica Sut.
**Modiolus australis* (Gray).
**Monodonta coracina* (Troschel). New as a fossil.
**Murex angasi* (Crosse).
* ,, *octogonus* Q. & G.
**Myodora subrostrata* Smith.
Mytilus huttoni Cossm.
**Natica australis* (Hutt.).
* ,, *zelandica* Q. & G.
**Nucula nitidula* A. Ad.
,, *sagittata* Sut.
**Odostomia* (s. str.) *pudica* Sut. New for the Miocene.
* ,, *(Pyrgulina) rugata* Hutt.
,, n. sp.
,, n. sp.
**Ostrea (Anodontostrea) angasi* Sow.
,, ,, *nelsoniana* Zitt.
Paphia curta (Hutt.).
Pecten (Pallium) burnetti Zitt.
,, *(Pseudamusium) huttoni* (Park).
* ,, *(Chlamys) radiatus* Hutt.
Placunanomia incisura Hutt.
* ,, *zelandica* Gray.
Polinices gibbosus (Hutt.).
Protocardia sera Hutt.
**Psammobia lineolata* Gray.
Ptychatractus pukeuriensis Sut.
,, *tenuiliratus* Sut.
Ringicula uniplicata Hutt.
**Rissoina (Zebina) emarginata* (Hutt.). New for the Miocene.
Rissoina n. sp.
**Schismope atkinsoni* (T.-Woods).
**Seila bulbosa* Sut. New as a fossil.
**Serpulorbis sipho* (Lamk.).
**Siliquaria weldii* T.-Woods. New as a fossil.
Sinum (Eunaticina) cinctum (Hutt.).
,, *carinatum* (Hutt.).
**Siphonalia caudata* (Q. & G.).
,, *conoidea* (Zitt.).
,, *costata* (Hutt.).
* ,, *dilatata* (Q. & G.).
,, *excelsa* Sut.
,, *nodosa zitteli* Sut.
,, *subreflexa* (Sow.).
**Siphonium planatum* Sut.
Streptochetus n. sp.
Struthiolaria cincta Hutt.
,, *tuberculata* Hutt.
Surcula fusiformis (Hutt.).
,, *pareoraensis* (?) Sut.
Sveltia n. sp.
**Tellina glabrella* Desh.
Terebra costata Hutt.
,, *orycta* Sut.
Teredo heaphyi Zitt.
Tornatina n. sp.
**Triphora lutea* Sut. New as a fossil.
Tritonidea acuticingulata Sut.
,, *compacta* Sut.
,, *elatior* Sut.
,, n. sp.
**Trivia avellanoides* (McCoy). New to our fauna.
**Trochus (Cœlotrochus) chathamensis* (Hutt.).
* ,, ,, *tiaratus* Q. & G.
**Trophon hanleyi* (Angas).
,, *lepidus* Sut.
,, *minutissimus* Sut.
**Tugalia intermedia* (Reeve).
Turbonilla (Pyrgiscus) oamarutica Sut.
,, *(Mormula) prisca* Sut.
* ,, *zealandica* (Hutt.).
Turris regius (?) Sut.
**Turritella (Peyrotia) carlottæ* Wats.
,, *(Torcula) concava* Hutt.
,, *(Peyrotia) patagonica* Sow.
* ,, ,, *rosea* Q. & G.
,, *(Torcula) semiconcava* Sut.
Typhis (Typhina) maccoyi T.-Woods.
**Venericardia difficilis* (Desh.).
* ,, *lutea* (Hutt.).
,, *pseutes* Sut.
,, *subintermedia* Sut. n. var.
Vermicularia n. sp.
Vexillum fenestratum Sut.
* ,, *marginatum* (Hutt.).
,, *rutidolomum* Sut.
**Volvulella reflexa* (Hutt.).
**Zenatia acinaces* (Q. & G.).

Two hundred and fifteen species and varieties, of which seventy-two also Recent = 33 per cent.

References : N.Z. Geol. Surv. Bull. No. 20, pp. 94–96, &c.; P. Marshall and G. H. Uttley, *Trans., N.Z. Inst.*, vol. 45, 1913, pp. 297–307 (see pp. 301–2), and vol. 46, 1914, pp. 279–80; P. Marshall, *Trans. N.Z. Inst.*, vol. 47, 1915, pp. 377–87 (see pp. 378–80).

Target Gully, Oamaru : Greensands below Shell-bed. J. Park ; 1916.

Acteon præcursorius Sut.
Alectrion (Hima) socialis (Hutt.).
Ancilla (Alocospira) papillata (Tate).
**Anomia huttoni* Sut.
**Arca novæ-zealandiæ* E. A. Smith.
,, (s. str.) *subvelata* Sut.
Bela (Buchozia) canaliculata Sut.
**Calliostoma pellucidum* (Val.).
Calyptræa (Sigapatella) maccoyi Sut.
* ,, ,, *maculata* (Q. & G.).
**Cantharidus tenebrosus* A. Ad.
Chione meridionalis (Sow.).
Corbula humerosa Hutt.
,, *pumila* Hutt.
**Crassatellites obesus* (A. Ad.).
**Crepidula monoxyla* (Less.).
,, *gregaria* Sow.
Cucullæa alta Sow.
Cylichnella soror Sut.
Dentalium mantelli Zitt.
,, *solidum* Hutt.
**Diplodonta globularis* (Lamk.).
* ,, *zelandica* (Gray).
Drillia callimorpha Sut.
Lima colorata Hutt.
**Limopsis aurita* (Brocchi).
,, *zitteli* Iher.
**Loripes concinna* Hutt.
,, *laminata* Hutt.
Macrocallista assimilis (Hutt.).
* ,, *multistriata* (Sow.).
**Malletia australis* (Q. & G.).
Marginella (Eratoidea) harrisi Cossm.
Miomelon corrugata (Hutt.).
**Modiolus australis* (Gray).
**Monodonta coracina* (Troschel).
Mytilus huttoni Cossm.
**Natica zelandica* Q. & G.
Nucula sagittata Sut.
**Ostrea* (s. str.) *corrugata* Hutt.
Panope orbita Hutt.
Pecten (Patinopecten) hutchinsoni Hutt.
,, *(Pseudamusium) huttoni* (Park).
* ,, *(Chlamys) radiatus* Hutt.
,, ,, *semiplicatus* Hutt.
,, ,, *williamsoni* Zitt.
,, *(Pseudamusium) yahliensis* T.-Woods.
Placunanomia incisura Hutt.
* ,, *zelandica* (Gray).
Polinices (s. str.) *gibbosus* Hutt.
**Psammobia lineolata* Gray.
Ptychatractus tenuiliratus (?) Sut.
**Siliquaria weldii* T.-Woods.
**Siphonalia caudata* (?) (Q. & G.).
,, *nodosa zitteli* Sut.
,, *subnodosa* (?) (Hutt.).
**Siphonium planatum* Sut.
Struthiolaria cincta Hutt.
Surcula fusiformis (Hutt.).
**Tellina glabrella* Desh.
Terebra orycta Sut.
Teredo heaphyi Zitt.
Tritonidea acuticingulata Sut.
Tugalia elata Sut.
**Turbonilla zealandica* (Hutt.).
Turritella (Torcula) concava Hutt.
,, ,, *semiconcava* Sut.
**Venericardia difficilis* (Desh.).
* ,, *lutea* (Hutt.).
,, *pseutes* Sut.
* ,, *purpurata* (Desh.).

Seventy-one species, of which twenty-eight also Recent = 39 per cent.

Reference: N.Z. Geol. Surv. Bull. No. 20, pp. 80–81. The present list differs from that in the bulletin by the omission of *Lima bullata*. Several generic names have also been changed.

Hutchinson Quarry, Oamaru : Greensands above the Limestone. Geol. Surv. Loc. 172. A. McKay, 1876 ; J. Park, 1916.

(Mc = McKay ; P = Park.)

Cucullæa alta Sow. Cast. P.
**Diplodonta globularis* (Lamk.). Cast. P.
Dosinia sp. Cast. P.
Epitonium (Cirsotrema) lyratum (Zitt.). P.
Lima colorata Hutt. Mc, P.
* ,, *lima* (L.). Mc.
,, *paleata* Hutt. Mc, P.
Ostrea (s. str.) *wuellerstorfi* (?) Zitt. Fragments. Mc, P.
Panope orbita Hutt. Casts. P.
Paphia curta (Hutt.). Cast. P.
Pecten (Patinopecten) beethami Hutt. Fragment. P.
Pecten (Pallium) burnetti Zitt. Mc.
,, *(Patinopecten) hutchinsoni* Hutt. P.
,, *(Pseudamusium) huttoni* (Park). P.
* ,, *(Chlamys) radiatus* Hutt. P.
,, ,, *semiplicatus* Hutt. P.
,, *(Pseudamusium) yahliensis* T.-Woods. Fragment. P. (May be left valve of *P. beethami.*)
**Protocardia (Nemocardium) pulchella* (Gray). Cast. P.
,, *sera* Hutt. Mc, P.
**Siphonium planatum* Sut. P.
**Venericardia purpurata* (Desh.). Cast. P.

Twenty-one species, of which six also Recent = 28·6 per cent.

References: McKay, *loc. cit.,* 1877, pp. 48, 57, &c. ; *N.Z. Geol. Surv. Bull. No. 20,* p. 78. The list in the bulletin does not contain *Lima lima* or *Pecten burnetti.*

South-west Side of Cape Hills, Oamaru : Oamaru Formation. Geol. Surv. Loc. 312. McKay; 1876.

Dentalium mantelli Zitt.
,, *solidum* Hutt.
Lima paucisulcata Hutt.
Turritella (Peyrotia) cavershamensis Harris.

Age : Miocene (Oamaruian). *Horizon :* Ototaran and Hutchinsonian (McKay in MS.).

Reference : McKay, *loc. cit.*, 1877, p. 58, &c. See also McKay, *Rep. of Geol. Explor. during 1883–84*, No. 16, 1884, p. 62 (beds under Ototara limestone collected from).

Boatman's Harbour, Oamaru : Bed No. 5, overlying Oamaru Stone. J. Park; 1916.

Cardium huttoni (?) Iher. Juv. casts.
Glycymeris sp. Fragment.
Polinices sp.

Many Brachiopods.

Reference : N.Z. Geol. Surv. Bull. No. 20, pp. 38, 39, &c. Bed collected from at base of bed *h*, fig. 4, p. 38.

Oamaru Cape (Cape Wanbrow). G. H. Uttley; 1912.

(1.) INSTERSTICES OF PILLOW-LAVA.

Cardium sp.
**Lima bullata* (Born).
* ,, *lima* (L.).
Polinices (Neverita) huttoni (?) Iher.
Trochus sp.
Turritella sp.

(2.) TUFFS, FIRST OUTCROP ON BEACH.

**Dosinia cærulea* (Reeve). New as a fossil.

(3.) LIMESTONE BAND BELOW PILLOW-LAVA.

Emarginula wannonensis Harris.
Pecten (Patinopecten) hutchinsoni Hutt.

(4.) LIMESTONE BAND, BOATMAN'S HARBOUR.

Pecten (Chlamys) aldingensis Tate.
,, *(Patinopecten) hutchinsoni* Hutt.

(5.) GREEN TUFFS BELOW TRACHYTE BRECCIA.

Lima jeffreysiana Tate.
**Limopsis aurita* (Brocchi).
Venericardia lutea (Hutt.).
* ,, *purpurata* (Desh.).

References : N.Z. Geol. Surv. Bull. No. 20, pp. 37, 39; G. H. Uttley in *Trans. N.Z. Inst.*, vol. 50, 1918, pp. 106–17 (see p. 109).

Cape Wanbrow, Oamaru : 12 ft.† Raised Beach. J. Park; 1915.

**Anomia huttoni* Sut.
**Argobuccinum tumidum* (Dkr.) (= *A. argus* of *Manual*).
**Calliostoma punctulatum* (Mart.).
**Calyptræa maculata* (Q. & G.).
**Cantharidus tenebrosus* A. Ad.
**Chione mesodesma* (Q. & G.).
**Cytherea oblonga* (?) (Hanley).
**Dosinia anus* (Phil.).
**Emarginula striatula* Q. & G.
**Euthria striata* (Hutt.).
**Fulgoraria arabica elongata* (Swains.).
**Glycymeris modesta* (Angas).
**Helcioniscus ornatus* (Dillw.).
* ,, ,, *inconspicuus* (Gray).
* ,, *radians* (Gmel.).
* ,, ,, *affinis* (Geml.).
* ,, ,, *flavus* (Hutt.).

† As received this list was headed "40 ft. Raised Beach," but this is an error, as will be seen by reference to *N.Z. Geol. Surv. Bull. No. 20.*

Leptomya lintea (Hutt.).
**Mactra discors* Gray.
**Mesodesma subtriangulatum* (Gray).
**Monodonta æthiops* (Gmel.).
* ,, *coracina* (Troschel).
**Mytilus canaliculus* (?) Mart. Fragment.
* ,, *edulis* L.
* ,, *magellanicus* Lamk.
**Ostrea angasi* Sow.
* ,, *reniformis* (?) Sow.
* ,, *tatei* Sut.
**Siphonaria obliquata* Sow.
**Spisula æquilateralis* (Desh.).
**Tellina alba* Q. & G.
**Trichotropis clathrata* Sow.
**Trochus tiaratus* Q. & G.
**Trophon corticatus* (Hutt.).
* ,, *plebejus* (Hutt.).
**Turbo smaragdus* (Mart.).
**Venericardia difficilis* (Desh.).
* ,, *purpurata* (Desh.).

Thirty-eight species, all Recent.

Reference: N.Z. Geol. Surv. Bull. No. 20, pp. 112–13.

South of Cape Wanbrow, Oamaru : Fossiliferous Tuff, immediately below Oamaru Stone. J. Park; 1916.

Ancilla (s. str.) *hebera* (Hutt.).
**Astræa heliotropium* (Mart.). New for the Miocene.
Calliostoma n. sp.
**Calyptræa (Sigapatella) maculata* (Q. & G.).
**Cardita calyculata* (L.). New for the Miocene.
Crassatellites amplus (Hutt.). Juv.
* ,, *obesus* (A. Ad.). Juv.
Cytherea sulcata (?) (Hutt.). Fragment.
**Diplodonta zelandica* (Gray).
Lima colorata Hutt.
Mactra attenuata Hutt.
**Mytilus (Aulacomya) magellanicus* Lamk.
Ostrea (s. str.) *wuellerstorfi* Zitt.
Panope orbita Hutt.
Pecten (Patinopecten) hutchinsoni Hutt. Fragments.
,, n. sp.
**Psammobia lineolata* (?) Gray. Fragment.
Teredo heaphyi Zitt.
Trochus n. sp.
**Venericardia purpurata* (Desh.).
,, *pseutes* Sut.

Twenty-one species, of which eight also Recent = 38 per cent.

Many Brachiopods and a few Serpulæ.
Reference: N.Z. Geol. Surv. Bull. No. 20, p. 40.

South of Cape Wanbrow, near Rifle Butts, Oamaru : Bed K, Tuffs about 30 ft. below Oamaru Stone. J. Park; 1916.

**Astræa heliotropium* (Mart.).
Calliostoma acutangulum Sut.
**Dosinia greyi* (?) Zitt.
Epitonium (Cirsotrema) lyratum (Zitt.).
Ficus parvus Sut.
**Glycymeris laticostata* (Q. & G.). Juv.
**Mytilus (Chloromya) canaliculus* (?) (Mart.). Fragment.
Polinices (Neverita) ovatus (Hutt.).
Struthiolaria tuberculata (?) Hutt. Juv.
Teredo heaphyi Zitt.
**Venericardia purpurata* (Desh.) var.

Eleven species, of which five also Recent = 45 per cent.

See also *N.Z. Geol. Surv. Bull. No. 20*, p. 40, where the fossiliferous bed is named "*t*."

Rifle Butts, Oamaru : Bed A, overlying Oamaru Stone. J. Park; 1916.

(Incorporated are also collections made in the locality by Dr. P. Marshall and Mr. G. H. Uttley. M = Marshall; P = Park; U = Uttley.)

Alcira n. sp. P.
Alectrion (Hima) socialis (Hutt.). Plentiful. P, U.
Ampullina (Megatylotus) suturalis (Hutt.). U.
**Ancilla (Amalda) novæ-zelandiæ* (Sow.). U.
Atrina distans (Hutt.). Fragment. P.
**Bathytoma albula* (Hutt.). U.
Borsonia (Cordieria) rudis (Hutt.). U.
**Calyptræa (Sigapatella) maculata* (Q. & G.). P.
Chione meridionalis (Sow.). P.
* ,, *mesodesma* (Q. & G.). P.
Corbula canaliculata Hutt. U.
Crassatellites attenuatus (?) (Hutt.). P.
Crepidula gregaria Sow. U.

Cucullæa alta Sow. P.
,, *attenuata* Hutt. U.
,, *australis* (Hutt.). P.
Cylichnella enysi (Hutt.). P, U.
**Cytherea oblonga* (Hanley). U.
Dentalium solidum Hutt. P, U.
**Dosinia greyi* Zitt. P.
Drillia awamoaensis (Hutt.). P, U.
,, *costifer* Sut. P.
Erycina n. sp. P.
**Fulgoraria arabica* (Mart.). Fragments. P.
Leucosyrinx alta (Harris). P.
**Lima angulata* Sow. U.
* ,, *bullata* (Born). U.
,, *colorata* Hutt. P, U.
Limopsis zitteli Iher. U.
Loripes laminata Hutt. P, U.
Macrocallista pareoraensis Sut. P.
**Malletia australis* (Q. & G.). P.
Mangilia leptosoma (Hutt.). U.
,, *præcophinodes* Sut. U.
Marginella (Eratoidea) conica Harris. P, U.
Marginella (Eratoidea) harrisi Cossm. Many juvenile specimens and 3 adult. P, U
**Mesodesma australe* (Gmel.). U.
**Natica zelandica* Q. & G. Juv. P, U.
**Ostrea (Anodontostrea) angasi* (?) Sow. P.
Pecten (Patinopecten) delicatulus (?) Hutt. U.
,, ,, *hutchinsoni* Hutt. P, U.
Pecten (Pseudamusium) huttoni (Park). Fragment. P.
,, *(Chlamys) scandula* (?) Hutt. U.
,, ,, *semiplicatus* Hutt. Fragment. P.
,, *(Pseudamusium) yahliensis* T.-Woods. Fragment. P.
**Phalium achatinum pyrum* (Lamk.). M.
Phos cingulatus (?) (Hutt.). Cast. P.
**Placunanomia zelandica* (Gray). Fragment. P, U.
**Polinices amphialus* (Wats.). U.
,, *gibbosus* (Hutt.). P, U.
**Siphonalia caudata* (Q. & G.). U.
,, *conoidea* (Zitt.). P, U.
,, *excelsa* Sut. U.
,, *turrita* Sut. M.
Surcula fusiformis (Hutt.). Fragment. P, U.
,, *huttoni* Sut. Juv. P.
**Tellina glabrella* Desh. P, U.
Turbonilla (Pyrgiscus) oamarutica Sut. M.
Turritella (Torcula) concava Hutt. U.
,, ,, *semiconcava* Sut. P, U.
**Venericardia difficilis* (Desh.). U.
,, *pseutes* Sut. P.
* ,, *purpurata* (Desh.). P, U.
Vexillum apicale (Hutt.). P, U.
,, *linctum* (Hutt.). P.
**Zenatia acinaces* Q. & G.). P, U.

Sixty-six species, of which twenty-one also Recent = 32 per cent.

References: N.Z. Geol. Surv. Bull. No. 20, p. 89, and *Trans. N.Z. Inst.*, vol. 47, 1915, p. 384 (P. Marshall).

Rifle Butts, South of Cape Wanbrow, Oamaru.

(1.) Calcareous Tuff above the Limestone. G. H. Uttley; 1912.

**Lima angulata* Sow.
* ,, *bullata* (Born).
,, *colorata* Hutt.
Limopsis zitteli Iher.
**Mesodesma australe* (Gmel.).
Pecten (Chlamys) aldingensis Tate.
Pecten (Patinopecten) hutchinsoni Hutt.
**Siphonalia caudata* (Q. & G.).
,, *conoidea* (Zitt.).
,, *excelsa* Sut.
Turritella (Torcula) semiconcava Sut.
**Venericardia purpurata* (Desh.).

(2.) Calcareous Band in Blue Clay above Oamaru Stone. G. H. Uttley; 1912.

Alectrion socialis (Hutt.).
Ampullina (Megatylotus) suturalis (Hutt.).
**Ancilla (Amalda) novæ-zelandiæ* (Sow.).
**Bathytoma albula* (Hutt.).
Borsonia (Cordieria) rudis (Hutt.).
Corbula canaliculata Hutt.
Crepidula gregaria Sow.
Cucullæa attenuata Hutt.
Cylichnella enysi (Hutt.).
**Cytherea oblonga* (Hanley).
Dentalium solidum Hutt.
Drillia awamoaensis (Hutt.).
Leucosyrinx alta (Harris).
Loripes laminata Hutt.
Mangilia leptosoma (Hutt.).
,, *præcophinodes* Sut.
Marginella (Eratoidea) conica Harris.
,, ,, *harrisi* Cossm.
**Natica zelandica* Q. & G.
Pecten (Chlamys) scandula (?) Hutt. Fragment.
**Placunanomia zelandica* (Gray).
**Polinices amphialus* (Wats.).
,, *gibbosus* (Hutt.).
Surcula fusiformis (Hutt.).
**Tellina glabrella* Desh.
Turritella (Torcula) concava Hutt.
,, *(Peyrotia) patagonica* Sow.
,, *(Torcula) semiconcava* Sut.
**Venericardia difficilis* (Desh.).
Vexillum apicale (Hutt.).
,, *linctum* (Hutt.).
**Zenatia acinaces* (Q. & G.).

Thirty-two species, of which nine also Recent = 28 per cent.

(3.) Top of Limestone, Rifle Butts. G. H. Uttley; 1912.

Pecten (Patinopecten) hutchinsoni Hutt.

(4.) Calcareous Band in Blue Tuffs below the Limestone. G. H. Uttley; 1912.

Ficus parvus Sut.
**Lima lima* (?) (L.). Juv.
Pecten sp. Juv.

References to Rifle Butts: See preceding list.

Railway-cutting North of Deborah, near Oamaru, overlying Deborah Limestone: Greensands. J. Park; 1916.

Cardium patulum (?) Hutt. Cast of young shell.
,, *spatiosum* (?) Hutt. Casts and young shells.
Dentalium solidum Hutt.
Epitonium (Pliciscala) n. sp. Fragment.
Fusinus solidus (?) Sut. Cast.
Lima colorata Hutt.
,, *paleata* Hutt.
Mactra attenuata Hutt.
Miomelon corrugata (Hutt.).
Panope worthingtoni Hutt.
Pecten (Patinopecten) beethami Hutt. Fragment.
,, ,, *hutchinsoni* Hutt.
,, *(Pseudamusium) huttoni* (Park). Fragments.
,, *(Chlamys) semiplicatus* Hutt.
Protocardia sera Hutt.
**Siphonalia dilatata* (Q. & G.). Fragment.
Struthiolaria tuberculata (?) Hutt. Juv.
Teredo heaphyi Zitt.
Turritella (Torcula) concava (?) Hutt. Cast.
**Xenophora corrugata* (Reeve).

Twenty species, of which two also Recent = 10 per cent.

Reference: N.Z. Geol. Surv. Bull. No. 20, pp. 59, 78.

It will be observed that the above list does not correspond very closely with that representing the molluscan fauna in the Hutchinson Quarry greensands. (See p. 83.)

Deborah (or Kakanui) Limestone. J. Park; 1916.

Cardium spatiosum (?) Hutt. Casts of young shells.
Cypræa ficoides (?) (Hutt.). Casts.
Lima colorata Hutt. Juv.
Lima huttoni (?) Sut.
Surcula oamarutica (?) Sut. Cast.
Venericardia purpurata (?) (Desh.). Juv.

Mostly casts; determinations therefore somewhat doubtful.

Deborah, Three Miles South of Oamaru. G. H. Uttley; 1912.

(1.) Tuffs with Pillow-lava.

Cardium sp.
**Mesodesma australe* (?) (Gmel.).
Panope orbita Hutt.
Pecten (Patinopecten) hutchinsoni Hutt.

(2.) Nodular Band above the Limestone.

Chione meridionalis (?) (Sow.).
Euthria media (Hutt.).
**Ostrea* (s. str.) *corrugata* Hutt.
Panope orbita Hutt.
Polinices sp.

Old Quarry, Awamoa Creek, near Deborah, Oamaru District: Tuffs below Oamaru Stone. J. Park; 1916.

**Crassatellites obesus* (A. Ad.). Juv. and casts.
Lima colorata (?) Hutt. Fragment.
Ostrea (s. str.) *wuellerstorfi* Zitt.
Panope worthingtoni Hutt.
Pecten (Pallium) burnetti Zitt.
Protocardia sera Hutt. Casts.
Turbo aff. *superbus* Zitt. Fragments of casts, juv.

Reference: N.Z. Geol. Surv. Bull. No. 20, p. 41. The locality is the same as that of the next list.

Old Quarry, Awamoa Creek, near Deborah : Calcareous Tuffs below Oamaru Stone. J. Park ; 1916.

Chione meridionalis (?) (Sow.).
**Crassatellites obesus* (A. Ad.).
Cucullæa attenuata (?) Hutt.
**Glycymeris laticostata* (Q. & G.).
**Lima angulata* Sow.
,, *colorata* Hutt.
,, *paleata* (?) Hutt.
Melina zealandica Sut.
**Mesodesma australe* (Gmel.).
**Modiolus australis* (?) (Gray).
**Ostrea (Anodontostrea) angasi* (?) Sow.
Panope orbita Hutt.
Pecten (Chlamys) aldingensis Tate.
,, *(Patinopecten) marshalli* (?) Sut.
**Placunanomia zelandica* (Gray).
**Siphonium planatum* Sut.
Teredo heaphyi Zitt.
Turritella (Peyrotia) cavershamensis (?) Harris.
**Venericardia difficilis* (?) (Desh.).

Nineteen species, of which nine also Recent = 47 per cent.

A number of specimens, no doubt representing extinct species, could not be identified, and therefore the percentage of Recent forms can safely be taken at a lower figure.

Reference : N.Z. Geol. Surv. Bull. No. 20, pp. 40–41.

Trig. M., South of Alma : Tuff Beds below or on Horizon of the Ototara Limestone.

This locality was discovered by Mr. G. H. Uttley, and the rock is a calcareous tuff. Collections of fossils were made by Dr. J. A. Thomson and Mr. G. H. Uttley in 1914, and by Professor Park in 1916. (T & U = Thomson and Uttley ; P = Park.)

**Arca novæ-zealandiæ* E. A. Smith. T & U.
**Calyptræa (Sigapatella) maculata* (Q. & G.). T & U.
* ,, ,, *inflata* (Hutt.). T & U.
**Capulus australis* (Lamk.). T & U.
Cardium sp. T & U.
**Chione spissa* (Desh.). T & U.
,, *meridionalis* (Sow.). P.
Dentalium solidum Hutt. T & U.
Emarginula wannonensis Harris. T & U.
Ficus transennus (?) Sut. T & U.
**Gadinia conica* Angas. T & U. New as fossil.
**Lima angulata* Sow. T & U, P.
* ,, *bullata* (Born). T & U, P.
,, *huttoni* (?) Sut. P.
Pecten (Patinopecten) accrementus Hutt. T & U.
Pecten (Chlamys) aldingensis Tate. T & U, P.
,, *(Patinopecten) delicatulus* Hutt. P.
,, ,, *hutchinsoni* Hutt. P.
,, ,, *venosus* Hutt. T & U, P.
**Polinices amphialus* (Wats.). T & U.
,, *gibbosus* (Hutt.). T & U.
,, *(Neverita) huttoni* Iher. T & U.
**Protocardia (Nemocardium) pulchella* (Gray). T & U.
**Serpulorbis sipho* (?) (Lamk.). T & U.
**Siphonium planatum* Sut. T & U.
Trochus n. sp. T & U.
Turbo sp., operculum of. P.
Turritella (Archimediella) ambulacrum Sow. T & U.
* ,, (s. str.) *symmetrica* Hutt. T & U.

Twenty-nine species, of which thirteen also Recent = 45 per cent.

Reference : N.Z. Geol. Surv. Bull. No. 20, p. 74.

Near Totara, South of Oamaru : Waiareka Tuffs. J. Park ; 1916.

Pecten (Patinopecten) delicatulus Hutt. Fragment.
Venericardia acanthodes Sut.

Reference : N.Z. Geol. Surv. Bull. No. 20, p. 43.

Old Quarry at Totara : Tuff Bed between Upper and Lower Beds of Oamaru Stone. J. Park ; 1916.

**Anomia huttoni* (?) Sut. Fragment.
Pecten (Patinopecten) delicatulus Hutt. Fragments.
Pecten (Pseudamusium) yahliensis T.-Woods. Fragment.
**Siphonium planatum* Sut.

Reference : N.Z. Geol. Surv. Bull. No. 20, p. 73.

Awamoa Beach and Creek. Geol. Surv. Loc. 170. McKay; 1876.

Alectrion (Hima) socialis (Hutt.) Very plentiful.
Ampullina (Megatylotus) suturalis (Hutt.).
**Ancilla (Amalda) novæ-zelandiæ* (Sow.).
**Anomia huttoni* Sut.
* ,, *trigonopsis* Hutt.
**Arca novæ-zealandiæ* E. A. Smith.
,, (s. str.) *subvelata* Sut.
Bela (Buchozia) canaliculata Sut. var.
**Calyptræa* (s. str.) *alta* (Hutt.).
,, *(Sigapatella) maccoyi* Sut.
* ,, ,, *maculata* (Q. & G.).
Chione chiloensis truncata Sut.
,, *meridionalis* (Sow.).
,, *(Salacia) speighti* Sut.
**Cominella huttoni* Kobelt.
,, n. sp.
Corbula humerosa (?) Hutt.
Crepidula densistria Sut.
,, *gregaria* Sow.
,, *striata* (Hutt.).
Cylichnella enysi (Hutt.). Juv.
Cymatium minimum (Hutt.).
**Dosinia greyi* Zitt.
Drillia buchanani (Hutt.).
,, n. sp.
**Fulgoraria arabica* (Mart.).
**Fusinus spiralis* (A. Ad.).
Hemiconus ornatus (Hutt.). Plentiful.
Leucosyrinx alta (Harris).
**Macrocallista multistriata* (Sow.). Juv.
Mactra chrydæa Sut.
Mangilia n. sp.
Marginella (Eratoidea) conica Harris.
,, *(Glabella) fraudulenta* Sut.
,, *(Eratoidea) harrisi* Cossm.
Miomelon corrugata (Hutt.).
**Modiolus australis* (Gray).
Mytilus huttoni Cossm.
**Natica zelandica* Q. & G.
**Panope zelandica* Q. & G.
**Placunanomia zelandica* (Gray).
Polinices gibbosus (Hutt.).
,, *(Neverita) ovatus* (Hutt.).
**Psammobia lineolata* Gray.
**Serpulorbis sipho* (Lamk.).
Sinum (Eunaticina) miocænicum (Sut.).
**Siphonalia mandarina* (Duclos).
Solariella stoliczkai (?) (Zitt.).
Surcula fusiformis (Hutt.).
**Tellina alba* (?) Q. & G. Juv.
**Turritella (Peyrotia) carlottæ* Wats.
,, ,, *cavershamensis* Harris.
,, *(Torcula) concava* Hutt.
,, ,, *semiconcava* Sut. Plentiful.
* ,, (s. str.) *symmetrica* Hutt.
Venericardia pseutes Sut.
Vexillum apicale (Hutt.).
**Zenatia acinaces* (Q. & G.).

Fifty-eight species, of which twenty-two also Recent = 38 per cent.

Age: Upper Miocene. *Horizon:* Pareoran (Awamoan). McKay in MS. says, "The collection is mainly from boulders between high- and low-water marks."

References: McKay, *loc. cit.*, 1877, pp. 48, 58, &c.; *N.Z. Geol. Surv. Bull. No. 20*, p. 88.

The greater part of the Awamoa collection was not handled by Mr. Suter, and therefore it is probable that many species could be added to the above list.

Awamoa. Geol. Surv. Loc. 254. C. Traill; 1874.

**Crepidula monoxyla* (Less.).
Dentalium solidum Hutt.
**Dosinia subrosea* (Gray).

Age: Upper Miocene. *Horizon:* Pareoran (Awamoan).

References: C. Traill, *Trans. N.Z. Inst.*, vol. 2, 1870, pp. 166–69; McKay, *loc. cit.*, 1877, p. 58.

Teschemaker's Old Quarry, South of Oamaru: Tuffs in Oamaru Stone. J. Park; 1916.

Clavagella sp. Genus new to fauna.
Pecten (Chlamys) aldingensis Tate.
,, *(Patinopecten) delicatulus* Hutt. Left valves.
Pecten (Patinopecten) venosus Hutt.
**Siphonium planatum* Sut
Teredo heaphyi Zitt.
Turritella sp. Cast.

Reference: N.Z. Geol. Surv. Bull. No. 20, p. 72.

Maheno, South of Oamaru, near Flour-mill : Tuffs below Oamaru Stone. J. Park ; 1916.

Amusium zitteli (Hutt.).
Cardium n. sp.
,, n. sp.
Clio (Styliola) annulata (Tate). Fragment. New to fauna.
Crepidula densistria Sut. Juv.
Cuspidaria n. sp.
Cylichnella enysi (Hutt.).
Dentalium (Episiphon) n. sp.
**Divaricella cumingi* (Ad. & Ang.). Fragment.
**Protocardia (Nemocardium) pulchella* (Gray). Many young examples.
**Pupa alba* (Hutt.). Fragment.
Teredo heaphyi Zitt. Fragment of tube.

Also one crab.

Reference: N.Z. Geol. Surv. Bull. No. 20, pp. 43–44.

Left Bank Kakanui River, opposite Maheno : Chalk Marls. Geol. Surv. Loc. 498. McKay ; 1882

Amusium zitteli (Hutt.).

Age: Miocene (Oamaruian). *Horizon:* Waiarekan (probably).

A single specimen from a very large collection probably consisting mainly of Foraminifera.

Reference: McKay, *Rep. of Geol. Explor. during 1883–84*, No. 16, 1884, p. 62, &c.

Left Bank Kakanui River, a little below Maheno : Maheno Marls. Geol. Surv. Loc. 606. McKay ; 1886.

Amusium zitteli (Hutt.).

Age and *horizon:* As for Loc. 498.

This is a single species (twenty-six specimens) from a large collection containing numerous Foraminifera (McKay in MS.).

Reference: McKay, *Rep. of Geol. Explor. during 1886–87*, No. 18, 1887, p. 237.

Kakanui : Tuffs below Limestone. J. A. Thomson.

**Murex zelandicus* Q. & G.
Pecten (Pseudamusium) huttoni (Park).
Pecten (Pallium) polymorphoides Zitt.
Solariella sulcatina Sut.

"Isolated Hill," North Side of Mouth of Kakanui River : Ototara Limestone. Geol. Surv. Loc. 489. McKay ; 1882.

Pecten (Chlamys) dendyi Hutt.

Age: Miocene (Oamaruian). *Horizon:* Ototaran.

McKay in MS. states that the collection (142 specimens) "has been referred to the Ototara limestone rather than to the Hutchinson Quarry beds, largely owing to the different character of the Brachiopods contained in the beds."

Reference: McKay, *Rep. of Geol. Explor. during 1883–84*, No. 16, 1884, p. 63.

"Isolated Hill" is a manuscript name of McKay's.

Isolated Hill, Kakanui, Otago : Volcanic Breccia or Tuff, underlying Ototara Limestone. Geol. Surv. Loc. 490. McKay ; 1882.

Cardium waitakiense Sut.
Cytherea sp. ? Casts
Pecten (Chlamys) aldingensis Tate.

Age: Miocene (Oamaruian). *Horizon:* Ototaran (McKay in MS.).

Isolated Hill, Limekiln Hill, Kakanui, Otago: Ototara Limestone. Geol. Surv. Loc. 627. McKay; 1886.

Pecten (Chlamys) aldingensis Tate.
,, *(Pallium) polymorphoides* Zitt.

Age and *horizon:* As for Locs. 489 and 490.

Three Roads, between Kakanui and Awamoa Creek: Waiareka Tuff on Beach. J. Park; 1916.

**Diplodonta zelandica* (Gray).
**Dosinia cærulea* (Reeve).
Panope worthingtoni Hutt.
Siphonalia turrita Sut. Juv.

Reference: N.Z. Geol. Surv. Bull. No. 20, p. 71.

Road-cutting, Deborah Road, Half a Mile East of Rocky Peak, North of Kakanui: Tuffs intercalated in Upper Portion of Oamaru Stone. J. Park; 1916.

**Astræa heliotropium* (?) (Mart.). Cast.
Cardium sp.
**Crepidula monoxyla* (Less.). Cast.
Dentalium mantelli (?) Zitt. Cast.
**Diplodonta zelandica* (?) (Gray).
Glycymeris sp.
Mytilus huttoni Cossm. Fragments.
Ostrea (s. str.) *wuellerstorfi* Zitt.
Pecten (Chlamys) aldingensis Tate.
,, ,, *chathamensis* (?) Hutt.
,, *(Pseudamusium) huttoni* (Park).
,, ,, *yahliensis* T.-Woods. Fragment.
Protocardia sera (?) Hutt. Cast.
**Siphonium planatum* Sut.
Venericardia sp.

Fifteen species, of which four also Recent = 27 per cent.

Very poor material.
Reference: N.Z. Geol. Surv. Bull. No. 20, p. 71.

Kakanui, Otago: Greensands on North Shore.

Dentalium mantelli Zitt.
Pecten (Patinopecten) delicatulus Hutt.
Pecten (Patinopecten) hutchinsoni Hutt.
Teredo heaphyi Zitt.

Kakanui, Otago: Cliffs on North Shore.

Dentalium mantelli Zitt.
Pecten (Chalmys) aldingensis Tate.
,, *(Pallium) burnetti* Zitt.
Siphonalia turrita (?) Sut.
Solariella sulcatina Sut.

Kakanui Beach: Calcareous Volcanic Breccia, lying below Kakanui Limestone. J. Park; 1916.

Ampullina (Megatylotus) suturalis (Hutt.)
**Astræa heliotropium* (Mart.). Fragment.
**Capulus australis* (Lamk.). Cast.
Cardium patulum (?) Hutt. Cast of juv.
,, *spatiosum* (?) Hutt. Impressions.
,, *waitakiense* Sut. 1 juv., 1 impression
,, n. sp. 9 specimens.
Colubraria sp. Impression. (Same from Geol. Surv. Loc. 642, Waihao Bridge.)
Cytherea chariessa Sut. Cast.
Dentalium mantelli Zitt.
Emarginula wannonensis Harris.
Epitonium (Cirsotrema) lyratum (Zitt.).
,, *(Confusiscala) nympha* (Hutt.). New for the Miocene.
Exilia sp. (?). Cast.
Ficus transennus Sut. Impression.
Fusinus n. sp. (aff. *bicarinatus*).
**Glycymeris laticostata* (Q. & G.).
Maculopeplum elegantissimum (Sut.).
Mytilus huttoni Cossm. Cast.
Pecten (Chlamys) aldingensis Tate.
,, *(Pallium) polymorphoides* Zitt.
Pholadomya neozelanica Hutt. Cast.
Protocardia sera Hutt. Cast.
Siphonalia turrita Sut.
**Siphonium planatum* Sut.
Solariella sulcatina Sut.
Surcula fusiformis (Hutt.). Impressions.
Teredo heaphyi Zitt.
Turritella (Torcula) semiconcava Sut.
Venericardia acanthodes Sut. Impression.
,, *difficilis benhami* (Thomson).

Thirty-one species, of which four also Recent = 13 per cent.

Reference: N.Z. Geol. Surv. Bull. No. 20, p. 68.

Beach near Three Roads, North of Kakanui : Awamoan Beds. J. Park ; 1916.

Ampullina (Megatylotus) suturalis (Hutt.). Cast.
Arca (s. str.) *subvelata* Sut.
Cardium spatiosum (?) Hutt. Juv.
Chione meridionalis (Sow.).
**Crassatellites obesus* (A. Ad.).
,, *attenuatus* (?) (Hutt.). Fragment.
Cucullæa alta Sow.
**Limopsis aurita* (Brocchi).
,, *catenata* Sut.
**Malletia australis* (Q. & G.).
Modiolaria elongata (Hutt.).
Mytilus huttoni Cossm.
Ostrea (s. str.) *wuellerstorfi* (?) Zitt. Fragment.
Paphia curta (Hutt.).
Surcula fusiformis (Hutt.). Cast.
**Tellina glabrella* Desh.
Turritella (Torcula) semiconcava Sut. Fragments.
**Zenatia acinaces* (Q. & G.).

Eighteen species, of which five also Recent = 28 per cent.

Reference : N.Z. Geol. Surv. Bull. No. 20, p. 87.

Kakanui : Kakanui Limestone. J. Park ; 1916.

Pecten (Chlamys) aldingensis Tate.

Lady Jane Creek, Middle Kakanui : Glauconitic Sandstone. J. Park ; 1916.

Pholadomya neozelanica (?) Hutt. Cast.
Surcula fusiformis (?) (Hutt.).

Reference : N.Z. Geol. Surv. Bull. No. 20, p. 35.

Two Roads, Kakanui : Calcareous Breccia below Kakanui Limestone. J. Park ; 1916.

Anomia sp.
Chione meridionalis (?) (Sow.). Cast.
Cymatium minimum (?) (Hutt.). Casts.
**Psammobia lineolata* Gray. Impression.
Teredo heaphyi Zitt.

Reference : N.Z. Geol. Surv. Bull. No. 20, p. 71.

Kakanui and Neighbourhood. G. H. Uttley ; 1912. (See also *Trans. N.Z. Inst.*, vol. 48, 1916, pp. 19–27.)

(1.) Calcareous Tuffs beneath Quarry Limestone, Kakanui, Otago.

Chione meridionalis (Sow.).
Dentalium solidum Hutt.
Pecten (Chlamys) aldingensis Tate.
Pecten (Pallium) polymorphoides Zitt.
,, *(Patinopecten) triphooki* Zitt.

(2.) Nodular Layer on Top of Limestone, Kakanui Beach.

**Arca novæ-zealandiæ* (?) E. A. Smith.
**Astræa heliotropium* (Mart.). Cast.
Cardium aff. *brachytonum* Sut.
Cypræa aff. *ovulatella* Tate. Cast.
**Lima angulata* Sow.
,, *jeffreysiana* Tate.
Lima lima (L.).
Miomelon corrugata (Hutt.).
Olivella neozelanica (Hutt.). Cast.
Pecten (Pallium) polymorphoides Zitt.
Trochus aff. *conicus* (Hutt.). Cast.

(3.) Kakanui Glauconitic Foraminiferal Greensand, above the Limestone.

**Lima angulata* Sow.
* ,, *bullata* (Born).
Pecten (Chlamys) aldingensis Tate.
Pecten (Pallium) polymorphoides Zitt.
,, *(Patinopecten) triphooki* Zitt.
**Siphonalia nodosa* (?) (Mart.). Cast.

(4.) Awamoa Beds—Blue Clays overlying the Limestone, All Day Bay.

Ancilla (Alocospira) papillata (Tate).
Borsonia (Cordieria) rudis (Hutt.).
Cymatium n. sp.
Cypræa trelissickensis Sut.
Ficus transennus Sut.
Macrocallista assimilis (Hutt.).
Marginella (Eratoidea) conica Harris.
,, ,, *harrisi* Cossm.
Miomelon corrugata (Hutt.).
Mitra aff. *hectori* Hutt. Fragment.
**Phalium achatinum pyrum* (Lamk.).
**Placunanomia zelandica* (Gray).
Polinices gibbosus (Hutt.).
Turbonilla (Mormula) prisca Sut.
Vexillum apicale (Hutt.).

Fifteen species, of which two also Recent = 15 per cent.

(5.) Nodular Bed, Top of Limestone, All Day Bay, One Mile South of Kakanui.

Cypræa ovulatella (?) Tate. Casts.
Euthria media (?) (Hutt.).
Miomelon corrugata (?) (Hutt.).
Polinices (Neverita) ovatus (?) (Hutt.).
Siphonalia n. sp. ?
Struthiolaria sp. ?
Turbo sp.

All Day Bay, One Mile South of Kakanui: Hutchinson Quarry Beds. Geol. Surv. Loc. 624. McKay; 1886.

Pecten (Chlamys) semiplicatus Hutt. Fragment.
,, *(Patinopecten) hutchinsoni* Hutt.

Age: Miocene (Oamaruian). *Horizon:* Hutchinsonian.
Two examples from a collection of forty-one specimens (McKay).
Reference: McKay, *loc. cit.*, 1887, pp. 235–36, &c.

North End of All Day Bay: Greensands. J. Park; 1916.

Pecten (Chlamys) williamsoni Zitt.
**Siphonium planatum* Sut.
Teredo heaphyi Zitt.

Reference: N.Z. Geol. Surv. Bull. No. 20, p. 56.

Puketapu, near Palmerston South, Shag Valley, Eastern Otago: Calcareous Sandstone (or Impure Limestone). Geol. Surv. Loc. 620. McKay; 1886.

Ficus sp. ?
Dentalium solidum Hutt.
**Mactra elongata* (?) Q. & G.

Age: Miocene (Oamaruian). *Horizon:* Ototaran (?).
Reference: McKay, *loc. cit.*, 1887, p. 8.

Upper Kyeburn, Maniototo County, Central Otago: Pareora Beds. Geol. Surv. Loc. 493. McKay; 1883.

Bathytoma eximia Sut.
Corbula canaliculata Hutt.

Age: Miocene. *Horizon:* Pareoran (McKay) (?).

This collection originally contained eighty-five specimens. McKay says in MS. that the matrix is greensands, a somewhat uncommon rock in the Pareora formation. The greensands, however, may be of "the age of the limonitic sandstone (decomposed greensands) at the Government Dam, Naseby."

Reference: McKay, *loc. cit.*, 1884, p. 64, and "Older Auriferous Drifts of Central Otago," Parl. Paper C.-4, 1894, pp. 29, 40 (see also 2nd ed., 1897, pp. 74, 100).

Welshman's Gully, Switzers, Southland County. Geol. Surv. Loc. 752. McKay; 1890.

Ancilla (Alocospira) papillata (Tate).
**Arca novæ-zealandiæ* E. A. Smith.
Astarte australis (?) Hutt.
Bathytoma aff. *sulcata* (Hutt.).
Dentalium mantelli Zitt.
Miomelon corrugata (Hutt.).
Ostrea (s. str.) *wuellerstorfi* Zitt. Fragments.
Polinices gibbosus (Hutt.).
**Struthiolaria papulosa* (Mart.).
* ,, aff. *vermis tricarinata* Less.
Turritella (Torcula) concava Hutt.
,, *(Archimediella) huttoni* Cossm.
Vermicularia n. sp. ?

Thirteen species, of which three also Recent = 23 per cent.

Age: Miocene (Oamaruian). *Horizon:* Waiarekan (?).

References: (1) McKay, *Rep. of Geol. Explor. during 1890–91*, No. 21, 1892, pp. 63–64. Reference, however, is made only to Muddy Creek† fossils, and not to fossils at Switzers, which is a locality two or three miles north-east of Waikaia. The rail-head at Waikaia is erroneously named Switzers, and, curiously enough, McKay in the report cited writes "Waikaka" instead of "Waikaia." (2) McKay, *loc. cit.*, 1894, pp. 32, 40; 1897, pp. 81, 99.

Castle Rock, Oreti Valley, Southland. Geol. Surv. Loc. 245. McKay; 1878.

Placunanomia incisura Hutt.

Age: Miocene. *Horizon:* Ototaran (?).

References: McKay, *Rep. of Geol. Explor. during 1877–78*, No. 11, 1878, p. 77. See also F. W. Hutton, *Rep. of Geol. Explor. during 1871–72*, 1872, p. 109.

Ohai (Nightcaps), Forty-four Miles North-west from Invercargill, Southland, nearly a Mile West of Smith's House. Collected as loose specimens from the banks of the Ohai Stream, which had washed them out of slipped mudstone. Geol. Surv. Loc. 888. M. Ongley; May, 1917.

Diplodon n. sp.

Age: Miocene or older.

The specimens collected are almost certainly *Diplodon inflatus* (Hutt.), the type of which has been mislaid or lost, and therefore is not at present available for comparison.

References: 11th Ann. Rep. N.Z. Geol. Surv., Parl. Paper C.-2B, 1917, p. 9; F. W. Hutton, *loc. cit.*, 1872, p. 108; J. Hector, *Rep. of Geol. Explor. during 1868–69*, No. 5, 1869, pp. v *et seq.*

Limehills, Twenty-five Miles North from Invercargill, Southland: J. G. Ward Company's Quarry. M. Ongley; 1917.

Voluta n. sp.

A large Volute resembling somewhat the Patagonian *Adelomelon pilsbryi* (Iher.), but unfortunately too imperfect to determine the genus.

Age: Miocene (Oamaruian). *Horizon:* Ototaran (?).

Reference to Locality: S. H. Cox, *Rep. of Geol. Explor. during 1877–78*, No. 11, 1878, p. 48.

† Muddy Creek is the stream in the valley west of Waikaia.

Chatton, Eight Miles North of Gore, Southland : "In Sands" on the West Bank of the Okapua Creek, about a Mile and a Half North of the Small Village of Chatton. Collected by Mr. R. A. Sutherland, and in the collection of Dr. P. Marshall, Wanganui.

Acteon n. sp.
Ancilla (Alocospira) papillata (Tate).
Batillaria pomahakensis Harris.
**Calyptræa tenuis* (Gray).
Cardium sp.
Circulus n. sp.
Cominella n. sp.
Corbula pumila Hutt.
* ,, *zelandica* Q. & G.
**Crassatellites obesus* (A. Ad.).
**Crepidula costata* (Sow.).
,, *gregaria* Sow. subsp. nov.
Cuna sp. } Provisional identifications.
Cyamiomactra sp. } Provisional identifications.
Dentalium solidum Hutt.
Epitonium (Cirsotrema) lyratum (Zitt.).
Erycina sp. ?
Glycymeris subglobosa Sut.
**Macrocallista multistriata* (Sow.).
Marginella (Eratoidea) conica Harris.
Mesalia striolata (Hutt.).
Mitra n. sp.
**Modiolus australis* (Gray).
**Natica zelandica* Q. & G.
Nerinea n. sp. New to fauna.
**Nucula hartvigiana* Pfeiffer.
,, n. sp.
**Odostomia* (s. str.) *bembix* Sut.
,, *(Jordaniella) sherriffi* Hutt.
Pecten (Patinopecten) hutchinsoni Hutt.
Psammobia n. sp.
Ringicula uniplicata Hutt.
Sinum fornicatum Sut.
**Siphonalia nodosa* (Mart.).
* ,, *valedicta* (Wats.).
Solariella n. sp.
Terebra n. sp.
Trophon sp. ?
Turbonilla (Mormula) prisca Sut.
* ,, *zealandica* Hutt.
Turritella (Peyrotia) cavershamensis Harris.
,, *(Torcula) concava* Hutt.
**Venericardia difficilis* (Desh.).
,, *ponderosa* Sut.
,, *pseutes* Sut.

Forty-five species, of which thirteen also Recent = 29 per cent.

Age: Miocene (Oamaruian). Dr. Marshall considers that the Chatton beds are probably of Oligocene age. See *Trans. N.Z. Inst.*, vol. 49, 1917, p. 465. On p. 460, however, there is a somewhat contradictory statement, which seems to assign the Chatton sandstone to the Cretaceous.

Castle Hill Shaft, Kaitangata Coalfield, Otago. Geol. Surv. Loc. 759. Hector; 1891.

Acteon subovalis Marshall.
Architectonica inornata Marshall.
Astarte australis (?) Hutt. Casts.
Cardium aff. *waitakiense* Sut.
Crassatellites cordiformis (?) Sut.
Crepidula monoxyla var. nov.
Cucullæa alta Sow.
,, ,, var. B. Hutt.
Cylichnella enysi (Hutt.).
Dentalium pareorense Pils. & Sharp.
**Dosinia greyi* (?) Zitt.
Fusinus n. sp.
,, n. sp.
,, n. sp.
Gilbertia paucistriata (Marshall). Juv.
Glycymeris subglobosa Sut.
Lapparia hebes (?) (Hutt.).
Macrocallista assimilis (?) (Hutt.).
Malletia elongata Marshall. Fragment.
Nerinella sp. ?
Panope worthingtoni Hutt.
Phos ordinarius Marshall.
**Placunanomia zelandica* (Gray).
Plejona necopinata (Sut.).
Polinices aff. *gibbosus* (Hutt.).
,, sp.
**Protocardia pulchella* (Gray).
**Psammobia zelandica* (?) Desh.
Struthiolaria minor Marshall.
,, *spinosa* (?) Hect. Cast.
,, *tuberculata* Hutt.
Turris striatus Marshall.
Turritella concava (?) Hutt.
,, *semiconcava* Sut.
**Venericardia difficilis* (Desh.).
* ,, *lutea* (Hutt.).

Also shark-teeth.

Thirty-six species, of which six also Recent = 17 per cent.

Age: Eocene or Upper Cretaceous (Kaitangatan). *Horizon:* Wangaloan. *Matrix:* Calcareous shelly sandstone.

Reference: Hector, *Rep. of Geol. Explor. during 1890–91*, No. 21, 1892, pp. lviii–lix. See also references to following locality.

McKay remarks in one of his MS. lists: "The species individually and collectively have a Tertiary facies, but on stratigraphical considerations the beds have been considered Cretaceo-Tertiary." If the beds are really Upper Cretaceous, then some of the shells named above have been wrongly identified.

Measly Beach, Wangaloa, Kaitangata Coalfield, Otago. Geol. Surv. Loc. 760. Hector; 1891.

Acteon semispiralis Marshall.
,, n. sp.
,, n. sp.
Cardium sp. Juv.
**Crassatellites* aff. *obesus* (A. Ad.). Juv.
Dentalium pareorense Pils. & Sharp. Plentiful.
**Dosinia greyi* Zitt. Plentiful.
Fusinus ? n. sp.
Glycymeris sp. Cast.
Leda semiteres Hutt. Plentiful.
Macrocallista assimilis (Hutt.). Plentiful.
Malletia elongata Marshall.
Melina zealandica Sut. Juv.
Modiolaria elongata (?) (Hutt.).
Nucula sagittata (?) Sut.
Panope worthingtoni Hutt.
Phos ordinarius Marshall.
Polinices gibbosus (?) (Hutt.).
,, n. sp.
**Protocardia pulchella* (Gray).
Roxania n. sp.
Solariella conica (Marshall). *(Heliacus.)*
Struthiolaria minor Marshall.
,, *tuberculata* (?) Hutt. Juv.
Tornatina n. sp.
Turris multicinctus Marshall.
Turritella semiconcava Sut.
* ,, *symmetrica* Hutt.

Twenty-eight species, of which four also Recent = 14 per cent.

Age: Eocene or Upper Cretaceous (Kaitangatan). *Horizon:* Wangaloan.

References: Hector, *loc. cit.*, 1892, p. lviii; Hector, *Rep. of Geol. Explor. during 1871–72*, No. 7, 1872, p. 168; F. W. Hutton, *Geology of Otago*, 1875, p. 57; P. Marshall, *Trans. N.Z. Inst.*, vol. 48, 1916, pp. 114–15, and vol. 49, 1917, pp. 450–60; *11th Ann. Rep. N.Z. Geol. Surv.*, Parl. Paper C.-2B, 1917, p. 10. McKay in MS. makes much the same remarks concerning the collection from Loc. 760 as those quoted above concerning Loc. 759.

Mitchell's Point, Wangaloa, Half a Mile North of Coal Point, near Kaitangata: Shelly Calcareous Sandstone. Geol. Surv. Loc. 887. J. Park; 1912.

Cardium aff. *waitakiense* Sut.
Crassatellites cordiformis Sut.
Cucullæa alta Sow.
**Cytherea oblonga* (Hanley).
Dentalium pareorense Pils. & Sharp.
**Dosinia greyi* Zitt. Juv.
Epitonium parvicostatum (Marshall). *(Scala.)*
,, n. sp.
Eudolium ? n. sp. Juv.
Perissolax n. sp.
Gilbertia n. sp.
Glycymeris concava Marshall.
,, *subglobosa* Sut.
Heteroterma zelandica Marshall.
Leda semiteres Hutt.
Macrocallista assimilis (?) (Hutt.). Cast.
Phos n. sp.
Polinices gibbosus (Hutt.).
Pugnellus australis Marshall. Fragments and casts.
Roxania n. sp.
Struthiolaria minor Marshall.
Surcula n. sp.
Turris multicinctus Marshall.
Turritella semiconcava Sut.
Venericardia ponderosa Sut. var.
* ,, *purpurata* (Desh.).

Twenty-six species, of which three also Recent = 12 per cent.

Age: Eocene or Upper Cretaceous (Kaitangatan). *Horizon:* Wangaloan.
This is the same locality as that of the last list.

Mitchell's Point, Wangaloa, near Kaitangata, Otago: Shelly Calcareous Sandstone. Geol. Surv. Loc. 887A. M. Ongley; 1917.

Cardium greyi (?) Hutt.
Crassatellites amplus (?) (Zitt.). Fragment.
Crepidula sp. Casts.
Dentalium pareorense Pils. & Sharp.
**Dosinia greyi* (?) Zitt. Juv.
* ,, *lambata* (Gould).
Hinnites trailli (?) Hutt.
Limopsis aff. *zitteli* Iher. Juv.

Macrocallista sp. ? Cast.
Malletia elongata Marshall. Cast.
**Polinices amphialus* (Wats.).
,, *gibbosus* (Hutt.).
**Pupa affinis* (A. Ad.). Juv.
Siphonalia sp. ? Fragment.
Struthiolaria minor Marshall.
,, sp. ? Juv.
Turritella semiconcava Sut.
**Venericardia* aff. *purpurata* (Desh.).

Eighteen species, of which five also Recent = 28 per cent.

Age: Eocene or Upper Cretaceous (Kaitangatan). *Horizon:* Wangaloan.

Reference: 11th Ann. Rep. N.Z. Geol. Surv., Parl. Paper C.–2B, 1917, p. 10.

Taken as a whole, the Castle Hill shaft and Wangaloa beds, according to the preceding lists, contain a fauna of seventy-seven species, of which thirteen, or 16·9 per cent., are also Recent. How far Mr Suter's identifications are correct is at present a matter of opinion. Many of the specimens are imperfect and embedded in a hard matrix. On close examination some were found to differ slightly, but perceptibly, from the Oamaruian and Recent species with which they have been identified.

In a report on the Upper Cretaceous Gasteropods of New Zealand (not yet published) Dr. Otto Wilckens advances the opinion that the various species of *Pugnellus* described by Marshall and Trechmann are identical with or merely varieties of *Conchothyra parasitica.* This, if correct, supports the view that the Wangaloa beds are of Cretaceous age. On the other hand, Wilckens thinks that *Conchothyra* may have survived into Tertiary times.

Recent examination of the molluscan faunas in the marine strata underlying the Shag Point and Green Island coal-measures has led to the conclusion that they are of Cretaceous age. This has generally been admitted to be true of Shag Point, but the age of the Green Island coal-measures has been disputed. As in all probability the Kaitangata beds are contemporaneous with those of Green Island and Shag Point, the writer is constrained to believe, at least tentatively, that the former are of Upper Cretaceous age, and therefore practically to come into line with Park, Marshall, Trechmann, and Thomson. Such a belief involves the discarding of Recent species from Mr. Suter's Wangaloa and Castle Hill shaft lists. If, however, the presence of Recent species in the Kaitangata fauna is accepted as a fact, one would more reasonably assign it to the Eocene than to any earlier or later period.

It may be mentioned that the Wangaloa and Castle Hill shaft collections of the Geological Survey have been sent to Mr. R. B. Newton, F.G.S., lately of the British Museum, who has kindly consented to examine and report upon them.

Chatham Islands. Geol. Surv. Loc. 792. H. H. Travers; *circa* 1863 ?

Pecten (Pseudamusium) yahliensis T.-Woods.

Age: Miocene (Oamaruian). *Horizon:* Hutchinsonian (McKay).

This fossil is from a collection of 134 specimens. According to McKay's MS., the "fossiliferous rocks are volcanic tuffs and altered limestones (lithographic), in this agreeing with the Hutchinson Quarry beds at Oamaru. The fossils also indicate a like age."

References: H. H. Travers, *Trans. N.Z. Inst.*, vol. 1, 1869, pp. 173 *et seq.* (2nd ed., 1875, pp. 119–27); Julius von Haast, same vol., pp. 180 *et seq.* (2nd ed., pp. 127–29).

In conversation Mr. Travers has stated that fossils occur mainly at Red Bluff, four miles north of Waitangi, and on the western side of Pitt Island (the rock in the latter locality being, according to von Haast, a tufaceous whitish limestone).

CHAPTER III.

REVIEW OF RESULTS; CLASSIFICATION OF SEDIMENTARY FORMATIONS.

(By P. G. Morgan.)

Important results, the full effect of which cannot yet be foreseen, follow from the palæontological work done on New Zealand Cretaceous and Tertiary fossils during the past few years. The principal workers in New Zealand have been Mr. Henry Suter, Dr. J. A. Thomson, and Dr. P. Marshall; whilst abroad Mr. Henry Woods, of Cambridge University, and Mr. Frederick Chapman, of Melbourne, have made valuable additions to our knowledge.† Many others have contributed to the progress that has undoubtedly been made. In this connection those who have collected fossils in their own time and at their own expense deserve special mention.

The revision of Hutton's types of Tertiary Mollusca, the description of a large number of new species, and the thousands of specific determinations made by Mr. Suter probably constitute the most important and most directly profitable of all the contributions to New Zealand palæontology as yet made. In giving a summary of the results that have followed or are likely to follow from Mr. Suter's work, the writer would like to make it clear that others have assisted in bringing about those results, but he hopes to be pardoned for not making direct references to their work in the following paragraphs.

Mr. Suter's determinations enable broad divisions of the Tertiary to be made with considerable confidence. These are:—

Pliocene (Castlecliffian, Petanian, Waitotaran).
Late Miocene (Pareoran or Awamoan).
Middle Miocene (Ototaran, including Hutchinsonian).
Early Miocene (Waiarekan).

In addition an Eocene horizon may be distinguished on the west coast of the South Island (Westport, Greymouth, &c.), and possibly at Weka Pass (North Canterbury).

The chief criteria for these divisions are (1) the assemblage of fossils, and (2) the percentages of Recent species. As yet no strict line between any two adjacent divisions can be drawn by means of palæontology alone. Thus in the Awatere district and in some other localities the Late Miocene strata pass, or appear to pass, into the Pliocene without a break, either palæontological or stratigraphical. Again, there is no decided palæontological break between the Eocene and the Miocene, and according to some New Zealand geologists there is no stratigraphical break either in this part of the geological succession or anywhere between the Middle Cretaceous (Clarentian) and the Pliocene. Broadly it may be said that the Tertiary faunas are continuous,‡ but this statement need not, and with the writer does not, imply that there are no unconformities of any kind. On the contrary, there are certainly local unconformities in the stratigraphic columns, and one or more of these may be tolerably widespread.

The determinations of Mr. Suter, taken as a whole, enable one to say that in no known locality is there any mingling of Cretaceous and Tertiary faunas. All his lists indicate a purely Tertiary facies,§ and the only localities for which this statement will be disputed are Wangaloa and the neighbouring Castle Hill shaft, Kaitangata. In the former locality Marshall believes that he has recognized a fauna with distinct Cretaceous (Maestrichtian or Danian) affinities. The fauna at the Castle Hill shaft in beds overlying the Kaitangata coal-measures is evidently the same as that at Wangaloa. The lists given on former pages, and the papers

† The late Dr. E. A. Newell Arber's work on New Zealand Mesozoic floras does not come within the scope of this review.

‡ See also preface to *N.Z. Geol. Surv. Pal. Bull. No. 5*, 1917, and P. Marshall in *Trans. N.Z. Inst.*, vol. 50, 1918, p. 277.

§ Since this was written the writer has changed his opinion regarding the age of the Kaitangatan fauna (see last page), and therefore the Wangaloa and Castle Hill shaft lists are admitted to be exceptions to the statement made.

by Marshall and Trechmann which are cited, will enable the reader to form his own opinion. New Zealand geologists at least agree to this extent: that the Wangaloa beds are pre-Oamaruian in age. There is also substantial agreement with the view that no part of the Oamaru Formation contains Cretaceous fossils, or need be placed in a Cretaceo-Tertiary series, as was done by Hector and McKay. Marshall, as one of the upholders of a continuous conformable succession from Cretaceous to Pliocene, may possibly dissent to some extent. His view still seems to be that Cretaceous and Tertiary faunas flourished at the same time, the former in deep water, the latter in the shallow waters close to the Early Tertiary coast-line. Apparently he thinks, however, that at Wangaloa mingling of these faunas took place—a view that is not now held by any one else of prominence, and, as formerly advanced by Hector and McKay, has, rightly or wrongly, been scouted by several European writers.

Thomson claims that certain species of Oamaruian Brachiopoda are probably confined to a comparatively narrow vertical range, and therefore that fairly close zoning can be done by means of their aid; but he has not yet published all his evidence, and in the meantime it may be said, as was implied in a previous paragraph, that only broad zoning can be done by means of palæontological data. At present it would hardly be safe to name a single molluscan species that is confined to any one stage of the Tertiary succession. In the case of the Oamaru Formation, at any rate, the stages cannot be distinguished with certainty by the molluscs alone, unless a considerable collection can be made.

The utility of using percentages of Recent species in determining horizons has often been questioned, but the fact that Lyell's method has been found satisfactory in Europe and North America indicates that its use in New Zealand is justifiable. It is true, however, that the percentage alone is not a safe guide, and possibly there has been a tendency in New Zealand to exaggerate its value, and more especially to neglect some or all of the following additional criteria, which ought to be considered when correlations are to be made:—

(1.) The number of species certainly identified must be considerable.

(2.) The beds to be correlated ought to be lithologically similar, and laid down under similar conditions of depth of water, &c.

(3.) Stratigraphical evidence must be favourable, or at least not opposed.

(4.) It is desirable that the localities should not be widely separated, as, for example, are North Auckland and Otago.

(5.) The personal equations of the palæontologists making the identifications have to be taken into account.

Among other factors affecting the percentage of Recent species found in a collection are the following:—

(*a*.) Imperfect collecting. In particular, the larger shells are sure to be collected, whilst many of the small shells may be overlooked.

(*b*.) It seems to be a fact, as observed by Hutton in 1886, that Recent species are generally more plentiful and more widely distributed than the extinct forms. This presumably is because those species which have survived were better adapted to the conditions and had more vigorous constitutions than those that have died out.

(*c*.) Some shells are less liable to decay than others, especially in certain matrices. Where solution of calcium carbonate is going on, large thick shells may survive, whilst small thin shells disappear.

(*d*.) Some collections are made for special purposes and are not wholly representative. For example, the collector may select only those species which he believes have not previously been recorded, or a beginner may select only the best-preserved shells.

If, owing to the paucity of fossils, only a small collection of, say, twenty or thirty species can be made in a given bed. an application of the theory of probability shows that the percentage of Recent species is likely roughly to conform to the true percentage in the contemporaneous fauna; and this statement becomes almost exact if the percentage of Recent species approaches fifty. In the case of Oamaru faunas, with from 20 to 40 per cent. of Recent species, the probable error of an assumption on the basis indicated will not be so great as to prevent a distinction being made between Upper Oamaru (Pareora) beds and Lower Oamaru (Ototaran and Waiarekan) beds. Even where a considerable collection could be but has not been made, a small collection, if selected with impartiality, is likely to conform to the law of averages.

The fact that all the molluscan determinations given in this bulletin have been made by the one palæontologist enables the personal equation to be eliminated when comparisons are made between the lists: it has to be considered only when the percentage of Recent species is in question, or comparison is made with the determinations of other workers.

Hutton† many years ago showed that when proper precautions are observed the percentage of Recent species in a Tertiary fauna has a real value. A moment's consideration will show that essentially the same principle is generally followed when comparisons are made between two or more wholly extinct faunas. If numerous species, some of which are known or believed to have a restricted time-range, are common to all the faunas, they are considered to be of the same, or nearly the same, age. It is true that wonderful work has been done by Buckman and others in establishing zones by means of the intensive study of a single group of organisms, such as the Ammonites; but it is doubtful if the highly specialized zoning methods have, or can have, such an extensive application to the problems of geology as the broader method of comparing faunas as a whole. Marshall,‡ though at times inclined to deprecate the method of correlation by means of percentages, has also stated the conditions under which it may, in his opinion, be safely used, and in one of his latest papers§ appears to be a fairly strong supporter of it.

Mr. Suter's work has helped to establish, or at least points to the probability of, the following conclusions:—

(1.) The Tertiary age of the bituminous coal-measures of the west coast of the South Island. These strata, it is now admitted, have nothing in common with the Upper Cretaceous (Senonian) beds of Amuri Bluff, &c.

(2.) The pre-Oamaruian age of the Kaitangata coal-measures.

(3.) The Tertiary age of the Weka Pass stone.

(4.) As already stated, the total absence of Cretaceous forms from the Oamaru Formation.

(5.) The Miocene age of the Oamaru Formation, with the proviso that the lowest beds may be Oligocene.

(6.) The correctness or otherwise of many correlations made in past years between Tertiary strata in widely separated localities.

Besides helping to bring about a more general agreement as to correlation among New Zealand geologists, Mr. Suter's work has important economic bearings, especially in connection with the coal deposits of New Zealand. The known coal resources of this Dominion are not great, and the time is approaching when extensive exploration for hidden coalfields by means of boring will have to be made. Until correct correlations between the known coal-seams are made, and until surface strata can be correctly identified, work of this kind cannot be intelligently or efficiently directed. During the past few years considerable advance in establishing a firm foundation for the scientific prospecting of our hidden coalfields has been made. It is imperative, however, that there should be no falling-off in detailed geological survey, or in the collection and precise identification of Tertiary fossils.

The following tentative classification of New Zealand Cretaceous and Tertiary sedimentary strata nearly expresses the present views of the New Zealand Geological Survey. For the sake of completeness it is followed by a tentative classification of pre-Cretaceous strata.

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† Hutton, F. W., The Wanganui System, *Trans. N.Z. Inst.*, vol. 18, 1886, pp. 336–67 (see pp. 344–45).

‡ Marshall, P., The Tertiary Molluscan Fauna of Pakaurangi Point, Kaipara Harbour, *Trans. N.Z. Inst.*, vol. 50, 1918, pp. 263–78 (see pp. 275–76). See also *Trans. N.Z. Inst.*, vol. 46, 1914, p. 280; vol. 47, 1915, pp. 379–80, &c.

§ Marshall, P., Fauna of the Hampden Beds and Classification of the Oamaru System, *Trans. N.Z. Inst.*, vol. 51, 1919, pp. 226–50 (see pp. 243 *et seq.*).

TABLE I.—CLASSIFICATION OF CRETACEOUS AND TERTIARY STRATA.

Approximate Age.	Series or System.	Stage and Group Names (Adjectival Forms).	Northern Auckland.	South-west Auckland, Taranaki, and Wanganui.	East Coast of North Island.	Marlborough and North Canterbury.	South Canterbury and Otago.	Nelson and Westland.
Pliocene.	Wanganui Series or System (Wanganuian).	Castlecliffian or Petanian. Waitotaran.		Castlecliff beds; Kaawa Creek beds. Waitotara beds. Onairo and Tongaporutu Series, &c.	Petane and Scinde Island beds (Napier Series). Te Aute Series. Ormond limestone.	? Great Marlborough conglomerate; Awatere beds (part); Greta and Motunau beds.		Deltaic beds of Inangahua-Grey valley.
		Pareoran (Awamoan).	Waitemata and Orakei Bay beds.	Mohakatino, Mokau, and Mahoenui beds.	Tawhiti Series.	Part of Awatere beds.	Pareora and Awamoa beds.	Blue Bottom and Upper Kongahu beds.
		Hutchinsonian.					Hutchinson Quarry beds.	
Miocene and Oligocene.	Oamaru System (Oamaruian).	Ototaran.	Whangarei limestone.	Raglan and Te Kuiti limestones, &c.	Te Arai Series (8,000 ft. thick).	Mount Brown beds, &c.	Ototara limestone.	Cobden limestone and Lower Kongahu beds.
		Waiarekan.		? Leda Marls, &c.			Waiareka beds.	Port Elizabeth and Omotumotu beds
		Ngaparan.	Whangarei coal-measures.	Waikato (Huntly) coal-measures, &c.			Ngapara beds.	? Reefton coal-measures.
		Kaiatan.	? Part of Kaeo Series; ? Tiger Hill sandstone.		? Wheao Series.	Grey Marl of Weka Pass; Weka Pass stone.	Hampden (Onekakara) beds.	Kaiata beds
Eocene.	Mawheranui or Waimangaroa Series (Mawheranuian).	Islandian. Brunnerian. Paparoan.						Island sandstone. Brunner beds. Paparoa beds. Hawk's Crag breccia.
		"Atiuian."	Part of Kaeo Series; Hydraulic limestone.		Mangatu Series.	Amuri limestone.		
Upper Cretaceous (Danian and Senonian).	Waipara Series or System (Waiparan).	Piripauan (Thomson, 1917).	Part of Kaeo Series; Ammonite beds, Batley (Marshall, 1917).			Saurian beds, Belemnite beds, &c.	? Wangaloa beds and Kaitangata coal-measures. ? Shag Point beds = Makatea (Hutton, 1885) or Pukeiwitahi beds.	
Middle Cretaceous (Albian or Cenomanian).	Coverham, Waiautoa, or Clarence River Series.	Clarentian or Waiautoan.				Coverham, Waiautoa, or Clarence River Series. ? "Cannon-ball" sandstone of Amuri Bluff.		
Lower Cretaceous (Neocomian).	Port Waikato plant beds			Port Waikato plant beds.				
	? Awanui beds.	Awanuian.			? Awanui beds.			

TABLE II.—CLASSIFICATION OF PRE-CRETACEOUS STRATA.

Approximate Age.	Series or System.	Group or Alternative Names.	Chief Localities, &c.
Jura-Trias.	Hokanui System.	Mataura Series (Jurassic); Putataka Series; Catlin's River Series; Flag Hill Series; Bastion Series; Otapiri Series; Oreti Series; Wairoa Series (Triassic); Kaihiku Series; Mount St. Mary Series; Aorangi Series; Manaia Hill Series (Jurassic); Moehau Series; Tokatea Series; Waipapa Series, &c.	Waikawa (Middle Jurassic); Mokoia Farm and Mataura Falls (Lower Jurassic); Malvern Hills (? Lower Jurassic); Owaka (? Rhætic); Hokanui Hills (Rhætic and younger); Kaihiku; Clent Hills and Mount Potts (Rhætic); Nugget Point; Mount St. Mary; Wairoa Valley (Nelson); Wellington district; Coromandel district; Whangaroa district; &c.
Permian or Permo-Carboniferous.	Maitai Series.	? Part of Arahura Series.	Dun Mountain district; ? Taylor's Pass (Marlborough).
Late Palæozoic.	Te Anau Series.	Haupiri Series; Pelorus Series; Kakanui Series.	Western Central Otago; Collingwood district; Pelorus Valley; North-east Otago (Kakanui Series).
Silurian (Wenlock).	Wangapeka Series.	Baton River Series; Reefton beds or Series.	Baton River; Reefton (so-called "Devonian" beds).
Ordovician.	Aorere Series or System.	Greenland Series; Wanaka System of Hutton; Part of Manapouri System of Park; ? Part of Arahura Series.	Collingwood district; Reefton; Paparoa Mountains; Ross; Preservation Inlet; ? Otago schists, &c.
Pre-Ordovician.	Manapouri Series.	Manapouri System of Marshall; ? Part of Aorere Series; Part of Manapouri System of Park.	North-west Nelson and Western Otago (gneisses, &c.).

Remarks on Classification Tables.

If these tables are compared with any of Hector's classifications—for example, that on pages 39–40 of the *Outline of New Zealand Geology*, 1886—it will be seen that the most important differences arise from the abandonment of the Cretaceo-Tertiary hypothesis. The Waitemata and Ototara Series, together with the bituminous coal-measures of the west coast of the South Island and the overlying marine strata, are transferred from the Cretaceo-Tertiary to Miocene and Eocene formations. The Te Aute Series is regarded as Pliocene, the Awatere Series as partly Pliocene, and the Mount Brown Series, &c., as Miocene (and perhaps in part Oligocene). Many names of local application used by Hector, McKay, and others could not conveniently be included in the table. The term "Buller Series" is not likely ever to be used again, and the term "Amuri Series" at present does not appear to have any useful application.†

The classification adopted bears a strong resemblance in its main outlines to that set out by Hutton‡ in 1900. The essential differences lie in the exclusion of the glacier period from the Pliocene, and the introduction of an Eocene system. The Wanganui Series or System, also, is recognized as including the Older as well as the Younger Pliocene.

If compared with Park's§ classification of 1910 the present classification will be found to differ very little in essential principles. The differences in detail are obvious, and therefore it is not necessary specifically to mention them.

Marshall's|| classification of 1912 is a very simple one, which superficially differs from that now advanced mainly by placing the oldest rocks of New Zealand definitely in the Archæan, and the Maitai Series or System in the Trias-Jura. There are, however, very

† See also Thomson, J. A., *Trans. N.Z. Inst.*, vol. 49, 1917, p. 408.

‡ Hutton, F. W., The Geological History of New Zealand, *Trans. N.Z. Inst.*, vol. 32, 1900, pp. 159–83.

§ Park, J., *The Geology of New Zealand*, 1910, p. 25.

|| Marshall, P., *Geology of New Zealand*, 1912, pp. 208–9. See also pp. 6–7 of *New Zealand and Adjacent Islands*, 1912 (reprinted from *Handbuch der Regionalen Geologie*, Heidelburg, 1912).

marked differences in the application of the classification. The Otago schists are considered to be of Triassic age, and the Waipara Series is regarded as a subdivision of the Oamaru System.

In 1917 Thomson† proposed the term "Notocene" as an age-name for the "covering strata" or "younger rock-series" of New Zealand. This term is intended to include the Upper Cretaceous and Tertiary strata of this country, and if, as some believe, there is no stratigraphic break between the Cretaceous and the Tertiary it will probably be accepted by most geologists.‡ It will also be useful if any break that exists is of a minor character. The writer cannot adopt the former view, but has an open mind regarding the extent of the stratigraphic and palæontological hiatus that he believes does exist between Mesozoic and Tertiary. Thomson§ has also proposed adjectival names applicable to the divisions of the Notocene. These terms are quoted in the classification, and most of them are likely to be generally adopted, notwithstanding the objection that may well be raised by purists in language to the combination of an English (or Latin) suffix and a Maori name. Hybrid terms have previously been used by Park, and it appears useless to oppose a practice which is convenient, and against which only sentimental objections can be urged. One of the proposed Oamaruian stage-names, the Hutchinsonian, is not likely to be of much use. Outside the Oamaru district the corresponding beds are recognizable, if at all, with difficulty, and no harm would be done by merging the Hutchinsonian with the Middle Oamaru or Ototaran stage. Thomson almost fails to recognize the stages present in the older Tertiary rocks of the west coast of the South Island, an area that has been geologically surveyed in detail, and stratigraphically placed on a sure basis. That the whole of the Mawheranui Series belongs to lower horizons than any part of the Oamaru System as developed near Oamaru might well be regarded as proved. It is true that the beds of the Kaiatan and Islandian stages are somewhat poor in recognizable marine organisms, whilst the Brunner and Paparoa beds (the latter recognized by Thomson as forming a stage) have only plant fossils, but nowhere else in New Zealand has so much careful field-work been done as in the districts where these beds occur.

Several new names have been introduced in the classification. The terms "Te Arai," "Wheao," and "Mangatu" Series will be found in Geological Bulletin No. 21, dealing with the Gisborne district. The adjective "Atiuan," from Atiu Point, Kaikoura Peninsula, is intended to cover the Amuri limestone, for which a stage or alternative name, notwithstanding its poverty in fossils, seems desirable. Possibly a better term may hereafter be found, and in the meantime no claim for priority is advanced. Waiautoa is the Maori name for the Clarence River, and the adjectival form "Waiautoan" is a mere synonym of "Clarentian." If Maori names are to be employed as much as possible in New Zealand geological nomenclature, then Waiautoan may be used, but on other grounds preference ought to be given to Clarentian. No brief for the Maori term is held, but it may as well be suggested now as later.

One other matter requires discussion here—the use of European time-names in the classification. Objection to the European terms has been taken on the ground that there is not sufficient evidence to show that the New Zealand formations correspond exactly to the European formations with which they are intended to be correlated. It may be admitted at once that exact correlation cannot be made; but there are some good reasons for using the European time-names. In the first place, it is abundantly clear that the latter are by no means as precisely defined as is inferred by the argument

† Thomson, J. A., Diastrophic and other Considerations in Classification and Correlation, and the Existence of Minor Diastrophic Districts in the Notocene, *Trans. N.Z. Inst.*, vol. 49, 1917, pp. 397–413.

‡ Marshall has lately stated objections to the use of the word "Notocene," and suggests that some other expression is desirable in order to convey the intended meaning. At the same time he prefers to use the term "Oamaru System" in the same sense.—"Fauna of the Hampden Beds and Classification of the Oamaru System," *Trans. N.Z. Inst.*, vol. 51, 1919, pp. 226–50 (see p. 240).

§ *Loc. cit.*, pp. 408–11.

mentioned above. In practice a certain amount of latitude is taken and allowed. There is really, in the present state of our knowledge, no reason why the time-names "Cretaceous," "Eocene," "Miocene," &c., should not be considered somewhat elastic terms. No one has ever supposed that the New Zealand Miocene corresponds exactly to the Miocene of England or to the Miocene of any other country. To be sure, the New Zealand Miocene (Oamaruian) might be called the "Noto-Miocene," the New Zealand Eocene the "Noto-Eocene," and so on; but nothing can be gained by this terminology, and it might well cause inconvenience when comparing, say, New Zealand and South American formations. One advantage of using a measure of European nomenclature is that thereby the world-wide scope of geology is emphasized. An important practical advantage is that it enables European geologists who have not visited this country more easily to grasp the broad outlines of our geology, and assists New Zealand students, especially beginners, in making use of foreign text-books and other literature. Geologists in outside countries show a very evident preference for the European time-names when they touch on New Zealand geology: hence it is clear that the retention of the chief European names tends to co-operation. The writer, however, must deprecate the use of the minor subdivisions of the European time-scale, for this implies an exactness in correlation which is wanting. It is somewhat strange that those writers on New Zealand geology who are most inclined to discard the Tertiary time-names used in Europe have adopted the terms "Cenomanian," "Senonian," "Maestrichtian," and "Danian" without apparent hesitation. The introduction of several of these terms in the classification table is not to be regarded as giving an unqualified approval to their use. Moreover, it is in all cases desirable to give prominence to the series or system name approximately corresponding to the European time-name.

It is to be hoped that no one will suppose that the writer in advocating the use of the chief European time-names wishes to infer that diastrophic movements throughout the world have always been contemporaneous. This must be left an open question; but there is reason to believe, at least tentatively, that the major diastrophic movements were world-wide, and that minor movements in one area have generally been reflected by similar movements somewhere else. It is possible, for example, that each minor deformation in New Zealand can be correlated with a similar event in some other part of the Pacific region.

NORTH ISLAND
OF
NEW ZEALAND
SHOWING FOSSIL LOCALITIES &c.
Scale
MILES 10 5 0 10 20 30 40 50 60 70 80 90 MILES
KILOMETRES 10 0 50 100 150 KILOMETRES
Reference
Railways, opened
" under construction
" proposed
P G MORGAN
DIRECTOR
SOUTH PACIFIC OCEAN
North Cape
C. Reinga
C. Maria van Diemen
Spirits Bay
Parengarenga Har.
Great Exhibition Bay
C. Karikari
Doubtless Bay
Whangaroa Har.
Ahipara Bay
Reef Pt.
Bay of Islands
Cape Brett
Whangaruru Bay
Poor Knights Is
Hokianga Har
Dargaville
Bream Bay
Bream Tail
Great Barrier Id
Aiguilles
C. Barrier
C. Rodney
C. Colville
Kaipara Har.
Hauraki Gulf
Waiheke Id
AUCKLAND
Mercury Bay
The Aldermen
Firth of Thames
Manakau Har.
Mayor Id
Waikato R.
Bay of Plenty
Matakana Id
Motiti Id
Whale Id
C. Runaway
East C
Raglan Har.
(Whangaroa Har)
Aotea Har.
Kawhia Har.
Albatross Pt
Rotorua
Cambridge
Hamilton
Tauranga
Whakatane
Opotiki
Tokomaru Bay
Tolaga Bay
Gable End Foreland
Gisborne
Poverty Bay
UREWERA COUNTRY
LAKE TAUPO
Kaingaroa Plains
Rangitoto Range
North Taranaki Bight
NEW PLYMOUTH
C Egmont
Stratford
Hawera
Opunake
South Taranaki Bight
Patea
Wanganui
Table Cape
Mahia Peninsula
Hawke Bay
NAPIER
Cape Kidnappers
Ruahine Range
Palmerston
Woodville
Porangahau R
Cape Turnagain
Akitio R.
Aohanga R.
Castle Point
Kapiti I
Porirua Har
Cook Strait
WELLINGTON
Palliser Bay
C Palliser
Flat Point
C Campbell
Cape Farewell
NELSON
BLENHEIM
SOUTH ISLAND
172° 173° 174° 175° 176° 177° 178°
35° 36° 37° 38° 39° 40° 41°


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169°
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173°
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C. Farewell
Golden Bay
Tasman Bay
D'Urville Id
C Stephens
Pelorus Sound
Queen Charlotte Sd
C. Jackson
WELLINGTON
NELSON
Karamea R
Karamea Bight
Cape Foulwind
Cloudy Bay
Wairau R.
BLENHEIM
Awatere R
C. Campbell
Flaxbourne R.
Clarence R.
Hapuku R.
Amuri Bluff
Conway R.
Waiau-ua R.
Hurunui R.
Pt Elizabeth
Taramakau R.
HOKITIKA
Hokitika R.
Waipara R
Pegasus Bay
Waimakariri R.
CHRISTCHURCH
Lyttelton
East Head
Akaroa
Banks Peninsula
Wanganui R.
Abut Head
Whataroa R
Paringa R.
Jacksons Bay
Cascade Id
Ashburton
Rakaia R
Ashburton R.
Rangitata R.
Opihi R.
Timaru
Canterbury Bight
Pareora R.
Waitaki R.
Milford Sound
George Sound
Secretary Id
Doubtful Sd
Breaksea Sound
SOUTHLAND
Oamaru
Shag Pt
Otago Peninsula
Cape Saunders
DUNEDIN
Taieri River
Molyneux (Clutha) River
Nugget Pt.
INVERCARGILL
Foveaux Strait
The Bluff
Toetoes Bay
Ruapuke Id
Chaslands Mistake
Stewart Id (Rakiura)
Paterson Inlet
Port Pegasus
S W Cape
South Cape
Chalky Inlet
Preservation Inlet
Te Waewae Bay
SOUTH PACIFIC OCEAN
G.E. Harris, del '19

LOCALITY INDEX.

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NEW ZEALAND.

Department of Mines.

GEOLOGICAL SURVEY BRANCH.

(P. G. MORGAN, Director.)

PALÆONTOLOGICAL BULLETIN No. 9.

THE UPPER CRETACEOUS GASTROPODS OF NEW ZEALAND.

BY

OTTO WILCKENS, Ph.D.,

Formerly Professor of Geology and Palæontology and Director of the Geological and Palæontological Institute of the University of Strassburg, now of Bonn University.

TRANSLATED INTO ENGLISH BY THE AUTHOR.

ISSUED UNDER THE AUTHORITY OF THE HON. G. J. ANDERSON, MINISTER OF MINES.

WELLINGTON.

BY AUTHORITY: MARCUS F. MARKS, GOVERNMENT PRINTER

1922.

LETTER OF TRANSMITTAL.

GEOLOGICAL SURVEY OFFICE,
Wellington, 1st March, 1921.

SIR,—

I have the honour to transmit herewith Palæontological Bulletin No. 9, entitled "The Upper Cretaceous Gastropods of New Zealand," written by Dr. Otto Wilckens, of Bonn, Germany, who is recognized as probably the most eminent European authority on Cretaceous Gastropoda.

The fossils here described were originally sent in 1912 to Mr. Henry Woods, F.R.S., of Cambridge, England, the author of Palæontological Bulletin No. 4, but on his recommendation they were forwarded in 1913 to Dr. Wilckens, then at Strassburg, for description. The intervention of the war prevented Dr. Wilckens from making much progress with this work, but all care was taken of the fossils, and in 1919 an arrangement was made with him to complete his descriptions and furnish a full report. The valuable memoir now submitted is the result. It contains 42 pages of letterpress, together with five plates, two text-figures, and a map showing fossil localities.

I have the honour to be,
Sir,
Your obedient servant,
P. G. MORGAN,
Director, New Zealand Geological Survey.

The Hon. G. J. Anderson,
Minister of Mines, Wellington.

AUTHOR'S PREFACE.

The Cretaceous Gastropods described in this memoir were collected by the officers of the New Zealand Geological Survey. They were transmitted to me for study in the year 1913, but the war prevented me from going on with the work before 1919. The Pelecypods and Cephalopods of the same faunas are treated by Mr. Woods in Palæontological Bulletin No. 4 of the New Zealand Geological Survey.

I am greatly indebted to Dr. J. A. Thomson for information about the geology of the localities where the fossils were collected, and to Mr. P. G. Morgan for all the care taken in the printing of this memoir. Finally, it is an agreeable duty for me to give expression to my gratitude to the University of Bonn—which, after my expulsion from my former position, gave me the possibility of continuing my scientific work—as well as to my old teacher and friend Professor Dr. G. Steinmann, who placed at my disposal all the means of the Geological Institute and of his own library.

Dr. Otto Wilckens.

CONTENTS.

TEXT-FIGURES.

MAP.


P. G. MORGAN
DIRECTOR.
SOUTH ISLAND
OF
NEW ZEALAND
SHOWING FOSSIL LOCALITIES &c.,
Scale
MILES 10 0 10 20 30 40 50 60 70 80 90 MILES
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Karamea R.
Karamea Bight
Buller R.
Cape Foulwind
Charleston
Brighton
Pt. Elizabeth
Cobden
Greymouth
Brunner
Taramakau R.
Kumara
HOKITIKA
Hokitika R.
Kanieri
Totara R.
Ross
Arthur's Pass
Amuri Bluff
Conway R.
Waiau-ua R.
Hurunui R.
Culverden
Waipara R.
Ashley R.
Oxford
Pegasus Bay
Waimakariri R.
CHRISTCHURCH
Lyttelton
Banks Peninsula
East Head
Akaroa
Little River
Springfield
Ashburton
Rakaia R.
Ashburton R.
Rangitata R.
Geraldine
Fairlie
Temuka
Opihi R.
Timaru
Pareora R.
Canterbury Bight
Wanganui R.
Abut Head
Whataroa R.
Okarito
Waiho R.
Paringa R.
Haast R.
Jackson's Bay
Cascade Pt.
Southern Alps
Two Thumb Range
Mt. Aspiring
Milford Sound
George Sound
L. Wakatipu
Kingston
Cromwell
Clyde
Alexandra
Roxburgh
Ranfurly
Kyeburn
Naseby
St. Bathan's
Kurow
Waimate
Waihao R.
Waitaki R.
Oamaru
Ngapara
Kakanui
Hampden
Dunback
Shag Pt.
Palmerston
Pleasant R.
Waikouaiti
Taieri R.
Taieri River
Milton
Balclutha
Clinton
Gore
Mataura
Wyndham
Winton
Nightcaps
Riverton
Tuatapere
Tewaewae Bay
Wairaoka
INVERCARGILL
The Bluff
Toetoes Bay
Ruapuke Id
Foveaux Strait
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Paterson Inlet
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S.W. Cape
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L. Te Anau
L. Manapouri
Eyre Mts
Breaksea Sound
West Cape
L. Hauroto
L. Poteriteri
Chalky Inlet
Preservation Inlet
Puysegur Pt.
SOUTH PACIFIC OCEAN
167° 168° 169° 170° 171° 172° 173° 174°
41° 42° 43° 44° 45° 46° 47°
G. E. Harris del.

THE UPPER CRETACEOUS GASTROPODS

OF

NEW ZEALAND.

A. THE GASTROPODA OF THE UPPER SENONIAN.

I. INTRODUCTION.

1. The Occurrence of the Fossils.

The Gastropods of the Upper Senonian beds are found in the old provincial districts of Marlborough and Canterbury at (1) Amuri Bluff, (2) Waipara River and Weka Pass, (3) in the Malvern Hills. A stratigraphical description of these three localities has been given by Mr. H. Woods in Palæontological Bulletin No. 4, pp. 13–16. Therefore it may be sufficient to summarize here only the sequence of the beds according to the data contained in Mr. Woods's memoir.

(a.) *Sequence of Beds at Amuri Bluff.*

	Weka Pass stone.			
	Amuri limestone ..	Eocene ?		
c	Upper *Teredo* limestone Greensands .. Grey sandstone .. Lower *Teredo* limestone	Eocene ?	Upper Cretaceous ?	Greensand Group, 485–680 ft. thick.
b	Concretionary greensands ..			
a	Saurian beds ..			
b	Upper black grit .. Greensands .. Grey sands .. Lower black grit ..		Upper	Amuri Group, 360–585 ft. thick.
a	Calcareous conglomerate ..		Lower	
	Lower or wood sands.			
	(Unconformity.)			
	Jurassic ?			

(b.) *Sequence of Beds in the Waipara River and Weka Pass Districts.*

Saurian beds (= Saurian beds at Amuri Bluff).
Sandstones (= Amuri Group at Amuri Bluff).
Loose sands with coal and conglomerates.

(c.) *Sequence of Beds in the Malvern Hills.*

Loose sands and volcanic rocks.

Saurian beds (without fossils, but agreeing lithologically with the Saurian beds of Amuri Bluff)
Selwyn Rapids beds (= Upper Amuri Group).
Quartz sands and conglomerates with coal.

The various localities are usually designated by numbers attached to the fossils derived therefrom. Localities 2, 3, 4, 5, 6, 8, 9, 13, and 14 are at Amuri Bluff. Fossils of localities 2, 3, 4, 5, 6, and the greatest part of the fossils of locality 13, are from the Lower Amuri

Group—viz., the calcareous conglomerate; 8 indicates the black-grit horizon; 9, the Saurian beds. The fossils of 13 are from all beds at Amuri Bluff, from the calcareous conglomerate up to the concretionary greensands (collections of McKay, 1873 and 1876). As all these beds form one stratigraphical unit, this commingling of the collected material is not of great importance. Locality 14 (Oaro Creek, west wing of Amuri Bluff) comprises all Cretaceous beds up to the Amuri limestone. The material from this locality contains only seven fossils.

The localities 149, 277, 761, and 762 are situated in the Waipara district. The stratigraphical position is known only for the last two: 761 indicates the Saurian beds, and 762 probably the *Ostrea* beds in the sandstones, which are the equivalent of the Amuri Group.

The Malvern Hills have yielded the fossils of the localities 23, 589, and 754, the former two those of the Selwyn Rapids beds, the latter (probably) those of the *Ostrea* beds (= Amuri Group).

Besides these numbered fossils the material transmitted to me contains several single specimens, the label of which bears no number but only the name of the locality. Among these are fossils from the region of Amuri Bluff, and single pieces from Shag Point (Otago) and Hapuka River (Marlborough), collected by McKay in 1865 and 1876.

2. The Rocks and the State of Preservation of the Fossils.

When I received the fossils many of them were already isolated, but in part they were not yet freed from rock-material. So it is possible to state that the matrix in which the fossils are embedded is generally a glauconitic calcareous sandstone of dark-green colour and considerable hardness, which, when weathered, assumes a brownish colour and becomes a little softer. The fossils are often embedded in a broken state, and sometimes the rock is full of large or small fragments of shells. The nature of the rock and the state of preservation of the fossils show a striking resemblance to the corresponding features of the Upper Senonian of the Concepcion district in Chile (Quiriquina, Tomé, S. Vicente), of South Patagonia, and of Seymour Island (Grahamland). The lithological character, the light- or dark-yellow colour of the fossils, and the often considerable brittleness of the shells are the same in these four regions mentioned. The New Zealand fossils (like those of the above-named regions of the Western Hemisphere) could not be cleaned with hammer and chisel, but were worked out almost exclusively with the needle (sometimes the pincers). In some cases it was impossible to clean the shells thoroughly from every adhering grain of sand.

The glauconitic and sandy character of the rock and the fractured shells indicate a shallow sea, not very far from a coast, as the locality of deposition for the beds here in question. The facies is a pronounced one of Gastropods and Lamellibranchs. Cephalopods are not entirely wanting, but are rarer, and other groups of animals are almost entirely lacking. These conditions also agree perfectly with the *habitus* of the other Upper Senonian faunas on the borders of the South Pacific (geologically speaking)—viz., those of the Chilean coast, of South Patagonia, and of Grahamland. For in these regions Cephalopods occur, but there are many localities which have yielded only, or almost only, the two other classes of Mollusca.

II. DESCRIPTION OF SPECIES.

(*a*.) **Gastropoda.**

Pleurotomaria J. Sow.

Pleurotomaria maoriensis sp. nov. (Plate I, figs. 1, 2.)

Description.—The large and thick shell is of conical form, and is broader than high. In none of the specimens are more than 6 whorls preserved, yet there must be at least 8. The whorls are provided with a narrow spiral ridge, below which they are a little more declivous than above. In the spire the portion below the spiral ridge is very short, so that the ridge lies immediately above the suture. As the suture is very little impressed, the slope of the shell from the apex to the margin of the base appears almost uniform in the upper part, and only slightly gradate in the lower part. The slit-band is situated in the spiral ridge. The base of the last existing whorl is flattened. There is no umbilicus, or only a very small one. On the upper surface as well as on the base the ornamentation consists of fine spiral ribs. These are quite slightly granulated by the fine growth-lines. The recurvation of the growth-lines in the sinus-band is visible in one specimen. The aperture and the slit are not preserved.

Dimensions.—By combination there results for the specimens in hand a height of 74 mm., but certainly the shell must have reached a still greater height. For a height of 74 mm. the basal diameter would be about 100 mm.

Localities.—Loc. 5 (calcareous conglomerate, Amuri Group, east wing of Amuri Bluff), 3 specimens; loc. 6 (same as loc. 5), 1 specimen; loc. 13 (calcareous conglomerate, Amuri Group, west wing of Amuri Bluff), 1 specimen.

Relations.—This *Pleurotomaria* shows a very close resemblance to *Pl. arnoldi* Wollem.(1) from the Aptian of Northern Germany, a species to which belongs perhaps also the big *Pl. fingal* Wollem.(2) from the same beds. The former species agrees so completely with the New Zealand shell (except in being somewhat smaller) that one would be almost inclined to identify them as the same.

Among the occurrences of the Upper Senonian on the border of the South Pacific only that of Grahamland has yielded a *Pleurotomaria*, and that one is also a species of considerable dimensions, *Pl. larseniana* O. Wilck.(3). The comparison is rendered difficult by the fact that the Antarctic form is known only as a cast. It may well be a related specimen.

Leptomaria indica Forbes(4) resembles *Pl. maoriensis* in shape and sculpture. Stoliczka, who had at his disposal more than 100 specimens of this species, emphasizes the great variability of the form of the whorls. *L. indica* is from the Ariyalúr Group. Stoliczka compares it with *Pleurotomaria subgigantea* d'Orb.(5) from the Upper Senonian of Aachen (Germany), which has likewise a narrow slit-band, a fine spiral sculpture and no umbilicus, but differs in having no ridge. According to Holzapfel(6) the *Pl. gigantea* of Goldfuss is identical with *Pl. subgigantea* d'Orb. *Pl. seriato-granulata* Goldf.(7), with which Stoliczka compares likewise the *Leptomaria indica*, is much lower.

Pl. tardensis Stant.(8), from the Lower Cretaceous (Belgrano beds) of Lake Pueyrredon (Argentina), is flatter and has a stronger sculpture than *Pl. maoriensis.* On the other hand, *Pl. la hayesi* d'Orb.(9), from the French Upper Cretaceous, may possibly belong to a related group, but the ridge is wanting.

Pritchard(10) gave a list of the Tertiary *Pleurotomariæ* known up to 1903. Of the two Australasian species mentioned by him *Pl. bassi* Pritch. resembles *Pl. maoriensis* in shape, spiral sculpture, and dimensions, but differs from it in having a very broad slit-band.

It is surprising that neither Pritchard nor Harris(11) mentions any Tertiary *Pleurotomariæ* from New Zealand, although there seems to occur a *Pleurotomaria tertiaria* McCoy(12) in the Oamaru.

(1) A. Wollemann, Die Bivalven und Gastropoden des norddeutschen Gault (Aptiens und Albiens). Jahrbuch d. kgl. preuss. Geol. Landesanst., xxvi (1906), p. 281, pl. 8, fig. 5.

(2) *Ibidem*, p. 282, pl. 9, fig. 1.

(3) O. Wilckens, Die Anneliden, Bivalven und Gastropoden der antarktischen Kreideformation. Wissenschaftliche Ergebnisse der Schwedischen Südpolar-Expedition unter der Leitung von Dr. Otto Nordenskjöld, 1901–3, Bd. iii, Lief. 12, p. 73, pl. 3, fig. 24. *Pl. larseniana* resembles to a certain extent *Pl. perspectiva* Mant. sp. in H. B. Geinitz, Das Elbtalgebirge in Sachsen. 2 Teil. Der mittlere und obere Quader (Palæontographica, xx, ii, p. 166, pl. 29*p*, fig. 11). But this species has a large umbilicus.

(4) F. Stoliczka, The Cretaceous Fauna of Southern India, ii, Gastropoda, p. 387, pl. xxvi, fig. 1.

(5) A. Goldfuss, Petrefacta Germaniæ, iii, p. 77, pl. 187, fig. 6.

(6) E. Holzapfel, Die Mollusken der Aachener Kreide (Palæontographica, xxxiv), p. 175.

(7) Not *striato-granulata*, as Stoliczka writes. (Compare A. Goldfuss, Petref. Germ., iii, p. 75, pl. 186, fig. 10.)

(8) T. W. Stanton, The Marine Cretaceous Invertebrates. Reports Princeton University Expeditions to Patagonia, vol. iv (Palæontology), p. 29, pl. vii, figs. 1, 2.

(9) A. d'Orbigny, Paléontologie française. Terr. crét., vol. 2, pp. 251–52, pls. 193, 194.

(10) G. B. Pritchard, On Some Australian Tertiary Pleurotomarias. Proc. Roy. Soc. Victoria, xvi (n.s.), pp. 83–91, pls. xiii, xiv; 1903. Pritchard's list is, besides, not complete—*e.g.*, several species described by Oppenheim from the Priabona beds are omitted.

(11) G. F. Harris, Catalogue of Tertiary Mollusca in the Dep. of Geol. Brit. Mus. (Nat. Hist.), pt. i; The Australasian Tertiary Mollusca. 1897.

(12) Mentioned, *e.g.*, by H. v. Ihering, Les mollusques fossiles du crétacé supérieur et du tertiaire de l'Argentine. Anales del Museo nacional de Buenos Aires, xix, p. 88.

Suter in his recent memoirs does not mention this form, but includes it in his "Alphabetical List of New Zealand Tertiary Mollusca" (1918).

Pleurotomaria sismondai Goldf.(1) from the Lower Oligocene(2) of Bünde, Germany, has a similar shape to *Pl. maoriensis*, but the ridge is situated above the middle of the whorls and the sculpture shows a marked granulation.

Among the living *Pleurotomaria*(3) one may distinguish two groups, one of which embraces the forms with a large umbilicus and with a ridge above the middle of the whorls; the other contains the species without umbilicus and with the ridge below the middle of the whorls. Our *Pl. maoriensis* apparently belongs to the second group, which comprises the living species *Pl. beyrichi*, *Pl. salmiana*, *Pl. quoyana*, and perhaps (if it be a different species) *Pl. hirasei*. *Pl. quoyana* is not to be compared with *Pl. maoriensis* because of its small dimensions. *Pl. beyrichi* shows a stronger granulation of the ribs, and so does *Pl. hirasei*. The living form which most resembles *Pl. maoriensis* is *Pl. salmiana* from the Japan Sea. The New Zealand species attains a larger size.

Pleurotomaria woodsi sp. nov. (Plate I, figs. 3, 4.)

Description.—The rather small but thick shell is of flat-conical shape, broader than high. It consists of 5 whorls, which are slightly arched. The sutures are impressed. The lower margin of the last whorl is rounded, the base flattened. There seems to be no umbilicus. The aperture is oval. The slit is situated nearly in the middle of the upper side of the outer lip and is relatively broad. The surface of the shell is covered with strong spiral ribs, 5 above the slit-band and 1 below. They are crossed by transverse ribs originated by strong growth-furrows, so that the shell becomes granulated. The base seems to be smooth. The last whorl has its upper margin a little lowered, so that the outer margin of the penultimate whorl becomes free. The growth-lines curve forward between the slit-band and the outer margin of the whorl, as is characteristic of *Pleurotomaria*.

Dimensions.—Height, 25 mm., 18 mm.; diameter, 37 mm., 30 mm.

Localities.—Loc. 5 (calcareous conglomerate, Lower Amuri Group, east wing of Amuri Bluff), 2 specimens.

Relations.—I do not know any Cretaceous species of similar *habitus*. Perhaps there are related forms in the Jurassic (*Pl. quenstedti* Goldf.).

Remark.—I dedicate this interesting species to Mr. Woods, the describer of the Cephalopods and Pelecypods of the New Zealand Upper Cretaceous, whose memoirs on Cretaceous fossils have often been of great value to me in my palæontological work.

Delphinula Lam.

Delphinula ? sp. (Plate I, figs. 5 *a–c*.)

Description.—It is only tentatively that I ascribe to the genus *Delphinula* two casts which are in a very bad state of preservation. The larger specimen shows 2½ whorls, of which the last one is one and a half times to twice as high as the spire. The whorls are rounded, near the suture a little flattened. The last whorl is sculptured by 7 spiral ribs, which are notched by transverse ones. The aperture is rather circular.

Dimensions.—Height, 24 mm.; diameter, 21 mm.

Localities.—Loc. 13 (Lower Amuri Group, west wing of Amuri Bluff), 1 specimen; loc. 23 (Selwyn Rapids beds, Selwyn River, Malvern Hills), 1 specimen.

Calliostoma Swainson.

Calliostoma decapitatum sp. nov. (Plate I, figs. 6 *a*, *b*, 7 *a*, *b*.)

Description.—The initial whorls are lacking in all specimens, the shells being already embedded in the rock without them. The present specimens show altogether 5 whorls, which are flattened

(1) A. Goldfuss, Petref. Germ., iii, p. 77, pl. 188, fig. 1.

(2) Pritchard commits an error in assuming a Miocene age for the beds in which this fossil occurs.

(3) Martini und Chemnitz, Systematisches Conchylienkabinet, Bd. vi, Abt. 1c. Die Gattung *Pleurotomaria*, by G. Schmalz.

and have a rounded ridge immediately above the suture. In the spire the external layer of the shell has been destroyed; it is probable that on that account the whorls appear a little concave. The body-whorl has a rounded margin, the base is flat. Apparently there is no umbilicus. The external surface of the shell is well preserved on the base and on the last portion of the body-whorl immediately before the aperture. It shows rather coarse growth-lines, which are directed very obliquely behind; accordingly the aperture stands very obliquely. It is of quadrangular outline. The outer lip is sharp, the inner one seems to be callous. It is impossible to state whether there is a prominence or not.

Dimensions of the largest specimen (3–4 whorls).—Diameter of the base, 34 mm.; height, 31 mm. (if perfectly preserved this would be 40 mm.).

Localities.—Loc. 2 (calcareous conglomerate, Lower Amuri Group, east wing of Amuri Bluff), 1 specimen; loc. 14 (calcareous conglomerate, Lower Amuri Group, Oaro Creek, west wing of Amuri Bluff), 4 specimens, one of which is only a half body-whorl.

Relations.—If the inner lip has a prominence the species should be considered as nearly allied to *Tectus tamulicus* Stol.(1) from the Ariyalúr Group of Southern India. This form has lower ridges than *Calliostoma decapitatum*, but agrees well with it in general shape and in the form of the base. Unfortunately it is impossible to clean the inner lip of the New Zealand specimens.

As for the rest, *C. decapitatum* is only to be compared with the living *C. zizyphinus* L.(2) from the Mediterranean Sea, which very much resembles our species. Certainly this resemblance of a Cretaceous shell from New Zealand to a living form from the Mediterranean is surprising, but we shall meet with a similar fact in *Pseudodolium speighti* Trechm., described below.

Remark.—To one of the specimens of *C. decapitatum* from loc. 14 there is attached a little *Discina.*

Patella L.

Patella ? amuritica sp. nov. (Plate I, fig. 8.)

Description.—The outline of the shell is oval, the shape cap-like. The apex is nearly central. Between the apex and the nearer end the shell is a little concave, towards the other end a little convex. The upper layers of the shell-substance are not preserved; the muscular impression is not visible. Even the generic determination, therefore, is uncertain.

Dimensions.—Length, 5 mm.; breadth, 3·5 mm.; height, 1·5 mm.

Locality.—Loc. 13 (Lower Amuri Group, west wing of Amuri Bluff), 1 specimen, free in the rock.

Relations.—Perhaps one may compare this fossil with *Nacella (Anisomyon?) ovata* O. Wilck.(3) from the Antarctic Senonian. This form, it is true, is much larger, and the apex seems to have a more eccentric position. These patelloid shells are not very significant.

Crepidula Lam.

Crepidula hochstetteriana sp. nov. (Plate I, figs. 9 *a*, *b*.)

Description.—The shell is of rounded-rectangular outline, patelliform, on the left side convex, on the right side concave, almost twice as long as broad, with the top in an eccentric position. The apex curves to the right and reaches a little beyond the margin. The surface of the shell is not sculptured, except by wide coarse wrinkles. The diaphragma is a little arched in the same direction as the shell, and has a concave margin. It reaches nearly to the middle of the shell. The cast shows a vertical declivity on the convex side and a flatter one on the right. The cast of the apex forms a slightly curved horn. The position of the diaphragma is marked by a deep horizontal furrow.

Dimensions.—Length, 49 mm.; width, 26 mm.; height, 22 mm.

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(1) F. Stoliczka, Cret. Fauna S. India, ii, Gastropoda, p. 371, pl. xxiv, figs. 5, 5*a*.

(2) L. C. Kiener et P. Fischer, Spécies général et Iconographie des coquilles vivantes, xii (1880), p. 123, pl. 42, fig. 2.

(3) O. Wilckens, Die Anneliden, Bivalven und Gastropoden der antarktischen Kreideformation, p. 71, pl. 3, fig. 22.

Localities.—Loc. 2 (calcareous conglomerate, Lower Amuri Group, east wing of Amuri Bluff), 1 cast, much damaged; loc. 13 (Amuri Group, west wing of Amuri Bluff), 2 specimens.

Relations.—The existence of this species in the Cretaceous of New Zealand is of special interest, for the youn er Tertiary of this country has furnished in *Cr. incurva* Zitt.(1) a similar form, which hardly differs except by another position of the apex. Ortmann(2) and v. Ihering(3) regard *Cr. incurva* Zitt. as identical with *Cr. gregaria* G. B. Sow.(4) from the Patagonian Molasse. This is a view with which I cannot agree, as the apex of *Cr. incurva* is more tapering and the diaphragma longer. The other species mentioned by Harris from the younger Tertiary of New Zealand are quite different.

The other occurrences of the South Pacific Upper Cretaceous have not yielded representatives of this genus, which, in general, is rare in Cretaceous deposits. There is no Cretaceous form available for comparison.

Calyptræa Lam.

Calyptræa solitaria sp. nov. (Plate I, fig. 10.)

Description.—One cast, the only specimen of this form, belongs to a shell of elliptical outline. It is highly arched; the apex approaches the margin and is rolled inward; the cast of the extremity of the apex is broken away; the diaphragma is spirally bent. If an umbilicus and an excavation in the columella were present the species would belong to the subgenus *Calyptropsis* Tate. Unfortunately, one cannot state anything about these characters.

Dimensions.—Length, 25 mm.; width, 19 mm.; height, 9 mm.

Locality.—Loc. 277 (upper Waipara Gorge and Boby's Creek, Waipara), 1 specimen.

Relations.—There seems to exist a near relationship between our species and *Calyptræa (Calyptropsis) calyptræformis* Lam.(5), found, among other occurrences, in the Miocene and Pliocene of New Zealand(6).

Natica Scopoli.

Natica selwyniana sp. nov. (Plate II, figs. 1 *a*, *b*.)

1917. *Natica (Euspira) variabilis* Moore: Trechmann, C. T., Cret. Moll. from New Zealand (Geol. Mag., n.s., dec. vi, vol. iv), pp. 299-300. No figure.

Description.—The semi-globose shell has a very low spire, which occupies only one-eleventh of the height of the whole shell. The spire consists of 3½ rounded whorls. The body-whorl is broad and globose, its shell rather thick and, on the surface, covered with coarse growth-lines. The aperture has an oval outline, and a position oblique to the axis of the shell. At its upper margin it is callous. The umbilicus is almost quite free; the callosity formed by the inner lip overlaps it only to a certain extent.

Dimensions.—Height, 35 mm.; breadth, 32 mm.; thickness, 22 mm.

Localities.—Loc. 589 (Selwyn Rapids beds, Selwyn River, Malvern Hills), 2 specimens (in one of these the surface of the shell is weathered and the inner lip damaged, the other one is very much broken); loc. 761 (Saurian beds, Middle Waipara), 1 large crushed specimen.

Relations.—The comparison with other forms is rendered difficult by the damaged state of the inner lip. Perhaps *N. selwyniana* belongs to the group of *Naticina subcrassa* M. & H.(7), which Meek compares with *Mammilla carnatica* Stol.(8). Further, there exists a certain

(1) K. A. Zittel, Paläontologie von Neu-Seeland (Reise der Novara), i, p. 44, pl. xv, fig. 9. G. F. Harris, Catal. of Tert. Moll., i, Australasian Tert. Moll., p. 248.

(2) A. E. Ortmann, Tert. Invertebrates. Rep. Princeton Univ. Exped. to Patagonia, iv, p. 184, pl. xxxii, fig. 10.

(3) H. v. Ihering, Les moll. foss du crét. sup. et du tert. de l'Argentine. An. Mus. Nac. Buenos Aires, xiv (ser. 3*a*, vii), p. 148.

(4) G. B. Sowerby in Ch. Darwin, Geol. Obs. S. America, German trans., 2 ed., p. 254, pl. 3, fig. 24.

(5) See Reeve, Conchologia iconica, xi, Trochita, pl. iii, fig. 11. [The identification of the New Zealand shell with Lamarck's species is not upheld by recent workers. See H. Suter, Manual N.Z. Moll., p. 285, 1912; T. Iredale, Trans. N.Z. Inst., xlvii, p. 456, 1915.—P. G. M.]

(6) Harris, Australasian Tert. Moll. (Catal. Tert. Moll. Brit. Mus. i), p. 253.

(7) F. B. Meek, A Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country. Rep. U.S. Geol. Surv. of the Territories, ix, p. 316, pl. 39, fig. 3.

(8) F. Stoliczka, Cret. Fauna S. Ind., ii, Gastropoda, p. 307, pl. xxii, fig. 5.

resemblance to *Polynices* cf. *subtenuis* v. Ih.(1) from the Tertiary of Seymour Island (Grahamland). *Natica microstoma* Quoy(2) may be a related living species.

Trechmann identifies this form with *Natica variabilis* Moore from the Australian Cretaceous, but I think that the outline of the shell is too different to allow us to do so.

Natica ingrata sp. nov. (Plate II, figs. 2 *a–c*.)

1917. *Natica variabilis* Moore: Trechmann, C. T., Cret. Moll. from New Zealand (Geol. Mag., n.s., dec. vi, vol. iv), pp. 299–300, pl. xix, figs. 8–10.

Description.—The shell is oval in shape, and consists of 4½ rounded whorls. Besides the growth-lines directed obliquely behind, there is no sculpture on the surface. In two specimens there appear 5 spiral grooves on the base of the body-whorl. The whorls of these specimens being more flattened near the suture than those of the others, I am not sure whether one may unite these forms with our species. Trechmann, however, has done so. The body-whorl is globose and about five times higher than the spire. The aperture is ovate, but acutely angled above. The inner lip is covered by a callosity, closing up more or less the umbilicus. Unfortunately, the latter cannot be perfectly cleared in any specimen.

Dimensions.—Height, 12 mm., 10 mm.; breadth, 10 mm., 8 mm.; diameter, 10 mm., 8 mm.

Locality.—Loc. 589 (Selwyn Rapids beds, Selwyn River, Malvern Hills), 7 specimens without sculpture, and 2 with the mentioned spiral grooves on the lower part of the body-whorl.

Relations.—This small *Natica* resembles the foregoing *N. selwyniana* in all characters, except in size, in the higher spire, and in the form of the aperture (which is angled above, and not rounded). In spite of these differences it seems not improbable that *N. ingrata* represents only stages of *N. selwyniana.* The greater number of whorls, which in this case would result for *N. ingrata*, may perhaps be explained by a better preservation of the first whorls in the young shells, which are eroded in the older ones.

According to v. Ihering(3) the living Magellanian and Antarctic species of *Natica* all belong to the subgenus *Polynices* Montfort. Of this, the chief characteristic is a horny operculum. This cannot be determined in the fossil forms, setting aside the question whether the differences in the chemical constitution of the operculum have even a systematic importance. Since v. Ihering regards all Naticidæ from the Patagonian and Chilean Tertiary as belonging to *Polynices,* we would be compelled to place our New Zealand *Naticæ* in the genus *Polynices* too, for it is a certainty that *N. selwyniana* and *N. ingrata* belong to a group of Naticidæ which is represented in the Upper Senonian of Quiriquina (*Ampullina australis* d'Orb.)(4) and of Southern India (*Mammilla carnatica* Stol.)(5), and in the older Tertiary of Patagonia (*Polynices subtenuis* v. Ih.)(6) and of Grahamland (*Polynices* cf. *subtenuis* v. Ih.)(7)—*i.e.*, it is widely distributed in the Upper Senonian and older Tertiary beds in the South Pacific region (*sensu latiore*). Trechmann(8) affirms the identity of our two species with *Natica variabilis* Moore of the Australian Cretaceous (see above). It is of special interest that the Tertiary of New Zealand, too, has yielded a form of this group—viz., *Natica darwini* Hutt.(9).

(1) O. Wilckens, Die Mollusken d. antarkt. Kreideformation. Wiss Erg. d. Schwed. Südpolar-Exp. 1901–3, Bd. iii, Lief. 13, p. 11, pl. 1, figs. 23 *a*, *b*, 24 (not 22 and 23, as is stated in the text).

(2) Quoy et Gaimard, Mollusques. Dumont d'Urville, Voyage au Pol. Sud et dans l'Oceanie, Zoologie, Atlas, pl. 66, fig. 9.

(3) H. v. Ihering, Les mollusques foss. du tert. et du crét. sup. de l'Argentine. An. Mus. nac. de Buenos Aires, xiv (ser. 3*a*, vii), p. 150.

(4) O. Wilckens, Revision der Fauna der Quiriquinaschichten (Beitr. z. Geol. und Paläontologie von Südamerika, herausgeg. v. G. Steinmann, xi). N. Jahrb. f. Min. Geol. u. Pal., Beil.-Bd. xviii, p. 196, pl. xvii, figs. 11, 12.

(5) F. Stoliczka, Cret. Fauna S. India, ii, Gastropoda, p. 307, pl. xxii, fig. 5.

(6) A. E. Ortmann, Tertiary Invertebrates. Rep. Princeton Univ. Exp. to Patagonia, 1896–99, iv, pt. ii, p. 190, pl. xxxiii, fig. 5.

(7) O. Wilckens, Die Moll. d. antarkt. Kreideformation. Wiss. Erg. d. Schwed. Südpol.-Exp., Bd. iii, Lief. 13, p. 21, pl. 1, figs. 23, 24 (not 22 and 23, as is stated in the text).

(8) C. T. Trechmann, Cret. Moll. from New Zealand. Geol. Mag., n s., dec. vi, vol. iv, p. 300.

(9) Described by Zittel under the name of *Natica solida* G. B. Sow., in Fossile Mollusken und Echinodermen aus Neu-Seeland. Reise d. Novara. Pal. v. N.-Seeld., p. 42, pl. xv, fig. 6. I quote the name of *N. darwini* according to v. Ihering (Les moll. foss. du tert. et du crét. de l'Arg., p. 152). Suter in his synopsis of the New Zealand Tertiary Naticidæ (N.Z. Geol. Surv. Pal. Bull. No. 5, p. 88) does not mention this species, naming the so-called *Natica solida* of New Zealand *N. huttoni* v. Ih.

Scalaria Lam.

Scalaria (Cirsotrema ?) pacifica sp. nov. (Plate II, fig. 3.)

Description.—The best-preserved specimen, coming from loc. 13 (Plate II, fig. 3), shows 7 whorls. The first one or the first two are lost, and the last whorl preserved is not the body-whorl. The shell is turreted. The whorls increase slowly. The first ones are rounded and smooth, the succeeding ones rounded and sculptured with strong axial ribs which are crossed by fine spiral threads. On the last preserved whorl there are 18 axial and 12 spiral ribs on the upper and 9 spiral ones on the lower side. The growth-lines are so fine that they can be seen only by using a lens. On the lower part of the whorl, which is covered by the following one, the axial ribs become slighter. Therefore, contrary to the other parts of the surface, the spiral ribs are here more elevated than the axial ones. The aperture is missing.

Localities.—Loc. 13 (Lower Amuri Group, west wing of Amuri Bluff), 2 specimens; loc. 589 (Selwyn Rapids beds, Selwyn River, Malvern Hills), 1 specimen.

Relations.—From the Upper Senonian of South Patagonia *Scalariæ* with cancellated sculpture are mentioned(1), but, unfortunately, not figured. Perhaps these are related forms. In the Quiriquina beds occurs the similar *Scalaria steinmanni* Mör.(2). Possibly one may be allowed to compare *Scala striato-costata* Müller (Stol.)(3) from the Ariyalúr Group of Southern India. In the Senonian of Pondoland this group of *Scalariæ* is represented by *Scala ornata* Baily(4). A similar form comes from the Upper Senonian of Maestricht: *Scalaria contorta* Kaunh.(5). *Sc. elegans* Ravn(6) from the Danian of Faxe (Denmark) is not without resemblance, but a little more slender. A very nearly related form seems to be *Scalaria (Cirsotrema) lyrata* Zitt.(7), especially the younger individuals, named *Sc. browni* Zitt., from Aotea Harbour, N.Z. (older Tertiary). It is worthy of remark that the Cretaceous and the Tertiary of New Zealand contain two forms so nearly related.

Cerithium Ad.

Cerithium inæquicostatum sp. nov. (Plate II, fig. 4.)

Description.—The whorls of the turreted shell are slightly arched, and increase slowly. The sculpture consists of rounded axial ribs crossed by spiral threads, a granulation thus resulting. In the lower part of the whorls the spiral threads become slighter. In the only fragment which exhibits well-preserved sculpture two axial ribs of the last whorl correspond to one of the penultimate. The number of spiral ribs on the surface of one whorl is 5.

This Gastropod is provisionally regarded as a *Cerithium*, because its characteristic sculpture much resembles that of *C. talahabense* K. Martin(8) from the Tertiary of Java.

Locality.—Loc. 9 (Boulder-sands, Saurian beds, east wing of Amuri Bluff), 1 specimen.

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(1) O. Wilckens, Die Lamellibranchiaten, Gastropoden, &c., der oberen Kreide Südpatagoniens. Ber. d. Naturf. Gesellsch. Freiburg i. B. xv, pp. 14–15 (110–11).

(2) W. Möricke, Die Gastropoden und Bivalven der Quiriquinaschichten in Chile. (G. Steinmann, W. Deecke, und W. Möricke, Das Alter und die Fauna der Quiriquina-Schichten in Chile. D.) N. Jahrb. f. Min., Geol. u. Pal., Beil.-Bd. x, p. 96, pl. vii, fig. 14.

(3) F. Stoliczka, Cret. Fauna S. India, ii, Gastropoda, p. 233, pl. xviii, fig. 4. Holzapfel [Die Mollusken der Aachener Kreide (Palæontographica xxxiv), p. 130] contests the correctness of Stoliczka's determination, although Stoliczka claims to have had the holotype of Müller in his hands. Besides this, he puts *Scalaria striato-costata* in the genus *Mesostoma*, while Cossmann (Essais de Paléoconchologie comparée, Livr. 7, p. 195) takes it for an *Atresius*. In fact, the Aachen species is much smaller than the Indian, and Holzapfel could not find the type in the collection of Müller. So there is a great and insoluble confusion.

(4) H. Woods, The Cretaceous Fauna of Pondoland. Annals of the South African Museum, iv, p. 314, pl. 38, fig. 2.

(5) F. Kaunhowen, Die Gastropoden der Maestrichter Kreide. Paläontologische Abhandl., herausgeg. von W. Dames und E. Kayser, N.F. iv, Heft 1, p. 43, pl. iii, fig. 2.

(6) J. P. J. Ravn, Molluskerne i Danmarks Kridtaflejringer, ii. D. K. Danske Vidensk. Selsk. Skrifter, 6. Raekke, naturvid. og math. Afd., xi, 4, p. 14 (218), pl. v, fig. 10.

(7) K. A. Zittel, Fossile Mollusken und Echinodermen aus Neu-Seeland (Reise der Novara, Paläontologie von Neu-Seeland), p. 42, pl. ix, especially fig. 9. Suter (Descriptions of New Tertiary Mollusca occurring in New Zealand, &c., Part I, N.Z. Geol. Surv. Pal. Bull. No. 5, p. 85) agrees with Ortmann's statement that Zittel's *Scalaria lyrata* and *Sc. browni* are different stages of the same species.

(8) K. Martin, Die Fossilien von Java, i, Gastropoda, p. 201, pl. xxxi, fig. 462.

Remarks.—A second specimen from the same locality cannot be quite decidedly identified with the described one. With reservation, too, I mention here a Gastropod with similar sculpture from loc. 8 (black grit, east wing of Amuri Bluff). In this specimen the change of the sculpture in the succeeding whorls is not visible, but as the fragment is very small this change would make its appearance on a later whorl, not preserved.

Arrhoges Gabb.

Arrhoges haastianus sp. nov. (Plate II, figs. 5 *a*, *b*, 6, 7.)

1917. *Aporrhais gregaria* Wilckens: Trechmann, C. T., Cretaceous Moll. from New Zealand (Geol. Mag., n.s., dec. vi, vol. iv), p. 304, pl. xix, figs. 6, 7.

Description.—The number of whorls of this shell cannot be determined, as the protoconch is not preserved in any specimen. The height of the spire seems to be three-fifths of that of the body-whorl, but possibly it is equal to half of the shell. The spire is cone-shaped; a little below its middle the whorls bear strong nodes, which are lengthened somewhat obliquely forward and below. On the penultimate whorl there are 10 such nodes. The large body-whorl is likewise sculptured by this line of nodes. The last 4 nodes swell to a considerable size, the penultimate becoming the strongest. The aperture stands obliquely to the axis of the shell, and has a rectangular outline. The inner lip spreads over the body and forms a strong callus; it reaches upward to the penultimate whorl, encrusting its nodes. The outer lip is aliform; it is sinuous above, and has a callous margin; at its extremity it forms a short sharp projection, which turns a little backward. The external margin of the wing is nearly rectilinear, thick and callous. The lower margin forms an obtuse angle with the outer margin, and is likewise callous, but less thick than the outer one; it is slightly sinuate, and passes into the quite short canal. The chief node-ridge of the body-whorl becomes extinct towards the wing. The whorls and the wing are decorated with fine spiral striæ. The number of these is about 13 on the part above the strong node-ridge and about 30 below. On the last whorl there is a second and a third keel beneath the chief node-ridge, both of which are rounded and much less distant from each other than the upper one from the chief ridge. The upper of these two lower ridges bears nodes. In some specimens both ridges melt into each other, forming a broad elevation. The growth-lines are well developed on the last whorl; they bend forward in the upper node-ridge and recurve in the lower ones; they are also strong on the whorls of the spire, and form partly fine sharp ridges, partly furrows.

Dimensions.—Three small, rather well-preserved, specimens from loc. 589 show the following dimensions: Height, 31 mm., 40 mm., 45 mm.; breadth, 25 mm., ?, 30 mm.; thickness, 18 mm., 19 mm., ?. Large specimens of this Gastropod reach a height of 50–60 mm.

Localities.—Loc. 13 (Lower Amuri Group, west wing of Amuri Bluff), 1 imperfect and eroded cast, but sufficiently preserved to permit its determination; this is the only specimen from the whole Amuri district. Loc. 149 (McKay's Creek, Middle Waipara), 13 specimens, among which are 4 with more or less preserved wing, 3 with preserved inner lip; in all, the first whorls and the canal are missing. Loc. 589 (Selwyn Rapids beds, Selwyn River, Malvern Hills), 14 specimens; of these, 9 are smaller (of which 3 are well but not perfectly preserved), the others large, but all damaged; the latter agree well with those from loc. 149. Loc. 761 (Saurian beds, Middle Waipara), 25 specimens.

Remarks.—The characters of the genus *Arrhoges* given by Cossmann(1) agree for this Gastropod in all points, except that in *Arrhoges* the wing is attached to the *two* penultimate whorls. The less ascending wing in *A haastianus* cannot induce me to establish a new genus for that species, this character, for example, varying in the single individuals of *Aporrhais pes pelicani.*

(1) M. Cossmann, Essais de paléoconchologie comparée, Livr. 6, p. 73.

Young stages of Aporrhaidæ, in which the aliform outer lip has not yet fully grown out, differ considerably from adult individuals(1). This circumstance, and the injuries to which the wings are naturally exposed, make it difficult to determine the fossil material(2).

In the first instance I was inclined to take *Arrhoges haastianus* for a younger stage of *Perissoptera waiparaensis.* The long digit of the latter species has not been formed at once, but must have grown in length successively. But those specimens of *Arrhoges haastianus* which show the thick callosity of the inner lip and a callous margin of the outer lip must be regarded as adults, for the projection in which the wing terminates is in these individuals not in process of growing out to a long digit. This becomes evident by the fact that the inner last-formed layers of the wing remain behind from the extremity. In the last stages of development the hook of the wing becomes thicker, but not longer. Furthermore, there are the following differences between the two forms : In *Perissoptera waiparaensis* the nodes have a lower position on the whorls of the spire ; the lower keel of this species approaches more to the node-ridge. In *Arrhoges haastianus* the nodes on the body-whorl are stronger and the spiral ribs slighter.

Relations.—According to Cossmann the type of the genus *Arrhoges* is the living species *A. occidentalis* Beck(3). An Oligocene form, *Arrhoges speciosus* Schl. sp.(4), is more nearly related than this to the New Zealand species ; compare, *e.g.*, the figure of a specimen from Segeberg (Holstein, Germany)(5). The rib-sculpture is different, *A. haastianus* having nodes on the spire-whorls too, while *A. speciosus* has real transversal ribs ; but the breadth of variation is the same in the two species. According to Beyrich the lower keel of the last whorl may be missing and the middle one may be knotty or smooth ; the same feature is observable in *A. haastianus.* The attachment of the wing-production to the spire differs widely ; sometimes it reaches only the penultimate whorl, sometimes nearly the apex. Among the specimens of *A. speciosus* figured by Speyer that of pl. xxxi, fig. 4, most resembles the New Zealand form.

The Paleocene *Arrhoges heberti* Desh. sp.(6) resembles *A. haastianus* in general appearance and in size, but differs by the long transversal (*i.e.*, axial) ribs and the knots at the upper margin of the wing.

Aporrhais gregaria O. Wilck.(7), from the Upper Senonian of South Patagonia, resembles *A. haastianus* very much in the general shape of the shell and of the spire-whorls and their sculpture. In the Patagonian species the wing projects to a longer and sharper point. This character seems to be a constant one, missing in *A. haastianus.* Trechmann unites the New Zealand form with the Patagonian species, but I prefer not to do so.

Supplement.—The locality "*Aporrhais* beds, Okarahia Stream, Amuri Bluff," has yielded two pieces of rock with several Gastropod shells, which agree with *A. haastianus* in shape, but not in size, being rather small. The shells can be observed only in sections, as the matrix is too hard to be removed ; thus the determination is difficult, but, considering the shape of the outer lip, we may assume that they belong to *Arrhoges haastianus.*

The name of this species is given in honour of J. v. Haast, a geologist of New Zealand, born in Rhenish Prussia, where this memoir has been written.

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(1) Compare the figures of young *Aporrhais pes pelicani* with those of adults in—Martini und Chemnitz, Syst. Conchylienkabinet, Bd. iv, Abt. 1, pl. 24, fig. 7 ; Kiener, Spécies général et iconographie des coq. viv., iv, pl. 4, fig. 1A ; F. A. Quenstedt, Petrefaktenkunde Deutschlands, vii, Gasteropoden, pl. 207, fig. 34 ; P. Fischer, Manuel de Conchyliologie, p. 674, fig. 436.

(2) F. A. Quenstedt (Petrefaktenkunde Deutschlands, vii, Gasteropoden, p. 561) has given very affecting expression to this experience.

(3) Figured in L. C. Kiener, Spec. gen. &c., iv, pl. 3, fig. 4.

(4) E. Beyrich, Die Conchylien des norddeutschen Tertiärgebirges, 2. Stück. Zeitschrift d. deutsch. geol. Ges. 6 (1854), p. 492, pl. 11, figs. 1–6. O. Speyer, Die Conchylien der Casseler Tertiärbildungen (Palæontographica, ix), p. 166, pl. xxxi, figs. 1–5.

(5) Beyrich, *l.c.*, pl. 11, fig. 2.

(6) G. P. Deshayes, Description des animaux sans vertèbres, T. 11, pl. 92, fig. 3.

(7) O. Wilckens, Die Lamellibranchiaten, Gastropoden, &c., der oberen Kreide Südpatagoniens. Berichte d. Naturf. Ges. Freiburg i. B., Bd. 15, p. 16, pl. iii, figs. 10, 12 ; pl. iv, fig. 1 (not pl. iii, fig. 11).

PERISSOPTERA Tate.

Perissoptera waiparaensis (Hect. sp.) O. Wilck. (Plate II, figs. 8, 9.)

1886. *Rostellaria waiparaensis* Hector, Catalogue of the Indian and Colonial Exhibition, London (Wellington, 1886), p. 58, fig. 20, No. 3.

Description of Hector's Holotype (Plate II, fig. 8).—The presumed holotype of Hector is a crushed sculptured cast with remains of the shell. The shell consists of 9 (possibly more) whorls, 7 of which are preserved. The spire takes up about half of the whole shell. Although the shape and the sculpture are hardly perceptible on account of the damaged state of the specimen, one may notice that the whorls bear a spiral keel, formed by nodes, directed a little forward and below. Moreover, the whorls are spirally grooved. The body-whorl is inflated. Besides the keel, which is marked by nodes of medium strength, there still exists a lower spiral low-arched ridge. The last whorl is spirally sculptured down to the channel. The shell lies in the matrix with the aperture inside, so that this is not visible. The outer lip forms a long, curved, sabre-shaped digit, tapering towards its extremity. It probably has a position in continuation of the chief node-row, but in consequence of being crushed it now extends from about the middle of the body-whorl from below the knob-ridge. The top of the digit reaches nearly as high as the suture between the last and the penultimate whorl. The upper margin of the outer lip, according to the sabre shape of the digit, is largely sinuate and callously thickened. The digit curves not only upward but also backward. The channel is short, curved backward, and a little tortuous.

Dimensions of the Holotype.—Height of the whole shell, 60 mm., of the spire, 27 mm.; breadth, measured from the top of the digit, 62 mm.

Locality.—Loc. 9 (boulder beds, Saurian beds, east wing of Amuri Bluff).

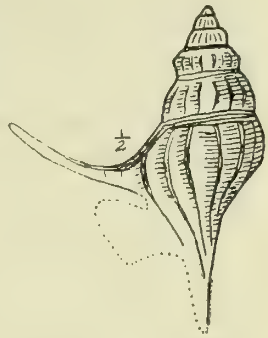

FIG. 1.—Hector's figure of *Perissoptera waiparaensis.*

Remarks.—This specimen, marked on the label as the presumed holotype of Hector's figure, has never been described by Hector, and is figured in an insufficient manner (see fig. 1). Hector's restoration is erroneous in the number of the whorls, in the shape, and in the sculpture. Further, the channel is drawn too slender and the punctuate lobe of the outer lip does not exist.

Supplement to the Description of the Species from the Remaining Material.—A second specimen from locality 9 is too damaged to give an idea of the general shape of the shell, but shows well the form and the sculpture of several whorls. There are 4 whorls preserved. The protoconch is missing. The sutures of the spire are slightly impressed. The whorls are decorated with knots a little oblique to the axis. On the penultimate whorl are 12 fine spiral ribs. On the body-whorl stand several strong nodes at unequal distances. In the continuation of this row of knots is a keel, continuing upon the wing. Below this knot-ridge the shell is a little concave, but farther below it is equally rounded. The surface of the whole body-whorl is decorated with a strong spiral sculpture. The preserved remains show that the wing of the outer lip forms a digit. The concave upper margin of the wing is thickened; this callosity, on the external surface, is accompanied by a furrow. The upper keel of the body-whoil, forming the continuation of the node-ridge, continues upon the wing of the outer lip. Below the digit the margin of the wing is a little sinuate. The lower part of the wing and the channel are broken away.

A specimen from loc. 13 (Plate II, fig. 9), embedded in the rock-matrix, is a cast composed of calcite. It shows the body-whorl, with the wing much damaged, and two preceding whorls. The channel is sufficiently preserved to show the conformity with the holotype. It is broken, and undoubtedly was somewhat longer than it seems now. The nodes of the body-whorl are not very strong. Below the keel, formed by them, the shell shows a low arch. The spiral sculpture is well developed. The number of the spiral ribs on the last whorl and the channel is about 50. The growth-lines are very slight. The outer lip seems to be attached to the penultimate whorl—viz., to the lower two-thirds at least.

The other specimens from loc. 13 show no essential differences from the features mentioned above, only the lower arch of the body-whorl is sometimes marked more distinctly. The spire is narrow-conical. The node-series of the whorls are situated immediately above the suture. The spiral sculpture decorates the whorls of the spire in the same manner as the body-whorl.

Localities.—Loc. 8 (black grit, east wing of Amuri Bluff), 1 cast; loc. 9 (boulder-sands, Saurian beds, east wing of Amuri Bluff), 8 specimens, including the holotype; loc. 13 (calcareous conglomerate, Lower Amuri Group, west wing of Amuri Bluff), 10 specimens (all damaged, one consisting only of a fragment of a wing of an outer lip).

Relations.—This New Zealand species of *Perissoptera* belongs to the group of *P. marginata* Sow. sp.(1) (Gault of Folkestone), which is sometimes named *Rostellaria orbignyana* Pict. et Roux(2). In addition, *P. obtusa* Pict. et Camp.(3) from the Gault, perhaps (according to Gardner) only a variety of the foregoing, is very similar. Very near relations exist to *P. nordenskjöldi* O. Wilck.(4) from the Antarctic Upper Senonian. The shape and the sculpture are very similar. In *P. waiparaensis* the digit is not so long as in *P. nordenskjöldi*, but in the latter species itself the extension of it is not the same in all individuals(5). The lower lobe of the wing, to all appearance, does not occur in *P. waiparaensis*, in contrast to *P. nordenskjöldi*. In *P. marginata* the attachment of the outer lip to the spire seems to reach higher up than in the other two species mentioned(6).

In conclusion, there exists a resemblance between our New Zealand species and a Gastropod named by myself *Aporrhais* cf. *gregaria*(7), a fossil from the Sierra Contreras in South Patagonia. I am obliged now to separate this form from *Aporrhais gregaria* under the name of *Perissoptera monodactyla* sp. nov.(8). Although *A. gregaria* is figured only from a poorly preserved specimen, there can be no doubt that its outer lip develops only one digitiform projection, below which it forms a slight lobe. In quite the same manner as in *P. waiparaensis* the nodes of the upper keel of the body-whorl obliterate against the wing. Likewise, the large arch rises below the node-ridge and the spiral sculpture is strongly marked. The space between ridge and arch is only small.

There results the remarkable fact that the Senonian beds of New Zealand, of Grahamland, and of South Patagonia yield forms of the same group of *Perissoptera*. Furthermore, there is a similarity between New Zealand and Patagonia in the occurrence of two similar species of *Arrhoges*, together with the large *Perissopteræ*.

As Cossmann(9) has pointed out, it is of remarkable interest that *Hemichenopus araucanus* Phil. sp.(10) from the Magellanian Tertiary is a form much resembling *Perissoptera*, and is the only Gastropod from Tertiary beds which does so. It does not seem permissible—on account of the different sculpture—to regard this species as an immediate descendant from the Cretaceous *Perrissopteræ* mentioned above, but certainly it is remarkable enough that the only *Perissoptera*-like shell of the Tertiary occurs just in that faunal province, where several species of that genus lived in the latest period of the Cretaceous.

(1) J. St. Gardner, On the Gault Aporrhaidæ. Geol. Mag., n.s., dec. ii, vol. ii, p. 198, pl. vi, fig. 1.

(2) F. J. Pictet et W. Roux, Description des fossiles qui trouvent dans les grès verts des environs de Genève (1847–53), p. 249.

(3) F. J. Pictet et G. Campiche, Description des fossiles de Sainte-Croix, 2 Partie, p. 610, pl. 93, figs. 9–13.

(4) O. Wilckens, Die Anneliden, Bivalven, und Gastropoden d. antarkt. Kreideformation. Wiss. Ergebn. d. Schwed. Südpol.-Exp., 1901–3, Bd. iii, Lief. 12, p. 83, pl. 4, figs. 2–5.

(5) Compare Wilckens, *l.c.*, pl. 4, figs. 2, 4.

(6) The sculpture of Aporrhaidæ varies considerably. Gardner (*l.c.*, pl. vi) unites, under the name of *Aporrhais marginata*, types with 2 and 3 ridges on the body-whorl and a rather unequal sculpture. If other authors, as Quenstedt, assure us that no great importance may be attached to the form of the wing, there would remain almost no character on which to rely.

(7) O. Wilckens, Die Lamellibranchiaten, Gastropoden, &c., d. ob. Kreide Südpatagoniens. Ber. Nat. Ges. Freiburg i. B. 15, p. 113, pl. iii, figs. 11, 13.

(8) O. Wilckens, Beiträge zur Paläontologie von Patagonien. N. Jahrbuch f. Min., Geol. und Pal., 1921, i, p. 12.

(9) M. Cossmann, Revue crit. de paléozoologie, 12 (1908), p. 177.

(10) G. Steinmann und O. Wilckens, Kreide und Tertiärfossilien aus den Magelläanslandern, gesammelt von der Schwedischen Expedition, 1895–97. Arkiv f. Zoologi, K. Svenska Vetenskapsakademien Stockholm, Bd. 4, Nr. 6, p. 79, pl. 7, figs. 4 *a*, *b*.

Perissoptera novo-seelandica sp. nov. (Plate II, figs. 10, 11, 12, 13, 14.)

Description.—The rather small shell consists of about 6 whorls. The initial whorls are lost in all specimens. The spire is narrow-conical. The oldest whorls bear no sculpture. It is impossible to state if here the uppermost layer of the shell has been worn away or if these whorls were simply rounded. It is only in the middle of the penultimate whorl that a node-ridge appears, which becomes quite distinct only on the last whorl. The nodes have a direction a little oblique to the axis of the shell. Above the node-ridge the whorl is declivous, below it has a vertical slope. The suture is not impressed. The nodes reach to the beginning of the wing, but there they become obsolete. Besides the nodes there exists a fine spiral sculpture. The growth-lines are faint ; on the shoulder of the whorls they recurve down to the keel, below this they are bent forward. The body-whorl bears a second ridge below the nodes, forming a second keel a little noded ; a third and smooth one follows below it, and from this downward the growth-lines recurve. The third keel is very slight in some specimens ; in others it is more marked, and even followed by a fourth. The inner lip spreads over the parietal wall and forms a very thick callosity. The outer lip is enlarged, and is attached to the penultimate whorl up to its node-ridge. In the prolongation of the chief keel the outer lip forms a broad digit, the top of which reaches almost as high as the suture between the penultimate and the antepenultimate whorl. The lower part of the outer lip, lying in the prolongation of the second keel, forms a rounded projection, separated from the digit by a deeper or shallower sinus. Sometimes this projection is only slightly indicated. The short channel of the shell is separated from the lower lobe of the wing by a shallow sinus. The sculpture of the external surface of the wing is imperceptible ; it seems to have spiral striæ. The inside of the wing shows furrows corresponding to the keels of the outside ; the uppermost furrow continues up to the top of the digit.

The casts show whorls a little flattened at the sutures, and two keels on the body-whorl, a noded one above and a smooth rounded one below.

Dimensions.—Height, about 22 mm. ; height of the body-whorl, about 12 mm. ; breadth (with the wing), 17 mm. ; diameter, 9 mm.

Localities.—Loc. 13 (Lower Amuri Group, west wing of Amuri Bluff), many specimens, composing sometimes whole rock-pieces ; loc. 589 (Selwyn Rapid beds, Selwyn River, Malvern Hills), 7 specimens.

Relations.—There are several Aporrhaidæ with a single hook-like digit, but no species seems to be nearly related to *P. novo-seelandica*, as all forms have a different sculpture. I enumerate the following species : *Perissoptera infortunata* White(1), from the Lower Senonian of Brazil, with a similar outline of the wing ; *Arrhoges ruidus* White(2), from the Colorado Group (Senonian) of the North American Upper Cretaceous ; *Aporrhais californica* Gabb(3), from the Upper Cretaceous of California ; *Arrhoges nebrascensis* Ev. & Shum.(4), from the Fort Pierre Group (Senonian) of the Black Hills of Dakota. Furthermore, *Aporrhais speciosa* Schl. var. *unisinuata* Sandb.(5), from the Upper Oligocene of Cassel (Germany), shows a certain resemblance.

Among the Gastropods of South Patagonia there is a small *Aporrhais* found at the locality " q " on the south-western margin of the Sierra de los Baguales(6). I have placed this form in the species *A. (Arrhoges) gregaria* O. Wilck. It is difficult to distinguish small shells of *Arrhoges haastianus* without wing from those of *Perissoptera novo-seelandica*. So it seems

(1) Ch. A. White, Contributions to the Palæontology of Brazil. Arch. Mus. Nac. Rio de Janiero, vii, pl. xi, fig. 20.

(2) T. W. Stanton, The Colorado Formation and its Invertebrate Fauna. Bull. U.S. Geol. Surv. No. 106, pl. xxxi, figs. 3, 4.

(3) W. M. Gabb, Triassic and Cretaceous Fossils. Geol. Surv. California, Palæontology, i, pl. 29, fig. 230*a*.

(4) R. P. Whitfield, Palæontology of the Black Hills, in H. Newton and W. P. Jenney, Rep. on the Geology and Resources of the Black Hills of Dakota, p. 429, pl. xii, figs. 2, 3.

(5) O. Speyer, D. Conchylien d. Casseler Tertiärbildungen. Palæontographica, ix, pl. xxxi, fig. 3*c*.

(6) O. Wilckens, Die Lamellibranchiaten, Gastropoden, &c., d. ob. Kreide Südpatagoniens. Ber. Nat. Ges. Freiburg i. B. 15, p. 114. The situation of the fossil-localities of the Cretaceous of South Patagonia is marked on the map accompanying the paper of O. Wilckens, Erläuterungen zu R. Hauthals geol. Karte, &c., *ibidem*, pl. i.

possible that the small *Aporrhais* from Baguales, "q," is nearly related to *A. gregaria*, and may be a form nearly resembling *Perissoptera novo-seelandica.*

Remark.—From the locality "Okarahia Stream, Amuri Bluff," there are 2 specimens in a piece of rock, which may possibly be *A. haastianus* or *P. novo-seelandica.*

Conchothyra (McCoy MS.) Hutton.

Conchothyra parasitica (McCoy MS.) Hutt.(1). (Plate III, figs. 1 *a*, *b*, 2 *a*, *b*, *c*, *d*, 3 *a*, *b*, 4, 5 *a*, *b*, 6 *a*, *b*; Plate IV, figs. 1 *a*, *b*, *c*, 2 *a*, *b*.)

1886. *Conchothyra parasitica* (McCoy): Hector, J., Cat. Ind. and Col. Exhib., p. 58 (figure only).
1893. *Conchothyra parasitica* (McCoy): Hutton, F. W., On *Conchothyra parasitica.* Trans. and Proc. N.Z. Inst., xxvi, pp. 358–59, pl. xliii, figs. 1–5.
1904. *Conchothyra parasitica* McCoy: Wilckens, O., Revision der Fauna der Quiriquinaschichten. N. Jahrb. f. Min., Geol., Pal., Beil.-Bd. xviii, p. 207, pl. xviii, figs. 3 *a*, *b*.
1907. *Conchothyra parasitica* McCoy: Wilckens, O., Die Lamellibranch., Gastr., &c., der ob. Kreide Südpatagoniens. Ber. Nat. Ges. Freiburg, i, B. 15, pp. 19–20, rem. 2.
1916. *Pugnellus australis*, Marshall, Trans. and Proc. N.Z. Inst., xlviii, p. 120, pl. xi, figs. 1–3.
1917. *Conchothyra parasitica* McCoy: Trechmann, C. T., Cret. Moll. from N.Z. Geol. Mag., n.s., dec. vi, vol. iv, pp. 301–2, pl. xx, figs. 4, 5.
1917. *Pugnellus marshalli* Trechmann, *ibidem*, pp. 302–3, pl. xix, figs. 1–4.
1917. *Pugnellus waiparaensis* Trechmann, *ibidem*, p. 303, pl. xx, figs. 3 *a*, *b* (not 1 *a*, *b*).
1917. *Pugnellus australis* Marshall, var. Trechmann, *ibidem*, pp. 303–4, pl. xx, figs. 1*a*, 1*b*.

Description.—The adult shell is extremely heavy. It is semi-globular. The spire is invisible, the last whorl incrusting the former ones. The shell thus consists externally of a laminated shell-mass. These laminæ are formed in such a manner that they have a margin upturned towards the wing, while their larger portion is parallel to the surface of the shell. The upturned margins of these growth-laminæ produce coarse growth-striæ, the direction of which corresponds to the shape of the wing—*i.e.*, is turned forward in the middle and recurved above and below in nearly a rectangular direction. The laminæ lying more towards the surface of the adult shell have been formed before the lower ones, which were secreted later at the aperture. Generally, the shells are more or less worn on the exterior at the top. In this case the coarse growth-lines are missing here(2). One cannot well explain how it is that in a large specimen from loc. 23 there appear two series of nodes on this worn portion of the shell. One must assume that even on the last whorl a sculpture is formed by the mantle. The height of the aperture is two-thirds to four-fifths of the whole shell. The aperture is narrow and of rectangular shape. The inner lip spreads over the body and is very callous. It incrusts the whole spire up to its apex, and forms a thick knotty mass at its lower extremity. The boundary between the inner lip and the surface of the shell is clearly seen in well-preserved shells.

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(1) I am indebted to Dr. J. A. Thomson for the following census of *Conchothyra parasitica*, compiled by him:—

Conchothyra parasitica (McCoy MS.) Haast, Rep. Geol. Expl. 6 (during 1870–1), 1871, p. 10 (*Ostrea* beds, Malvern Hills and Waipara). Rep. Geol. Expl. 7 (during 1871–2), 1872, pp. 10 and 68 (*Ostrea* beds, Waipara, and Oyster Gully, Malvern Hills).
Conchothyra parasitica (McCoy MS.) Hutton, Geol. Mag. dec. ii, vol. i, 1874, p. 515*p* (Waipara Formation). Rep. Geol. Expl. 8 (during 1873–4), 1877, pp. 37, 38 (Waipara Formation, Waipara and Malvern Hills); this is the first definition of *Conchothyra.*
Conchothyra parasitica Haast, Geology of Canterbury and Westland, 1879, p. 295 (Waipara Formation).
Conchothyra parasitica Hector, Appendix Off. Catal. Sydney Exhib. 1879, p. 12 (Amuri Series, Amuri Bluff). Catal. Ind. and Col. Exhib. 1886, p. 58, fig. 20, No. 4 (first figure very poor, turned upside down) (Cretaceo-Tertiary Formation).
Conchothyra parasitica McKay, Rep. Geol. Expl. 17 (during 1885), 1886, p. 37 (Amuri Bluff). Rep. Geol. Expl. 18 (during 1886–87), 1887, p. 233 (north bank Selwyn River).
Conchothyra parasitica Park, Rep. Geol. Expl. 19 (during 1887–88), 1888, p. 30 (oyster-bed, Waipara).
Conchothyra parasitica Hutton, Trans. N.Z. Inst., xxvi, pp. 358–59, pl. 43, figs. 1–5. (Waimakariri River, Canterbury.)

(2) Such a specimen has been figured by me in Revision d. Fauna der Quiriquinaschichten, p. xviii, fig. 3*a*.

The outer lip of the right-handed shell(1) is developed in the form of a large wing, reduced a little at its extremity. Its distal portion is much thicker than the shell where the wing begins. The upper margin of the wing is slightly concave, and recurves strongly. The lower margin is sub-angled. The canal is directed straight forward, and is narrow, rather shallow, and not very prominent. A plane placed on the middle of the shell at right angles to the axis does not halve the wing; on the contrary, the wing approaches the lower end of the shell, as it corresponds only to the last whorl.

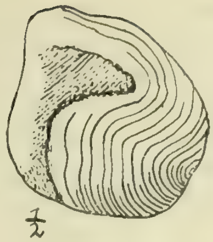

FIG. 2.—Hector's figure of *Conchothyra parasitica.*

Dimensions of Adult Shells :—

	Height. Mm.	Breadth. Mm.	Diameter. Mm.	Locality.
No. 1	52	50	35	589
No. 2	46	50	33	589
No. 3	48	49	33	589
No. 4	49	52	34	23
No. 5	36	35	21	277

From these measurements it is evident that the dimensions vary in their proportions.

Young specimens exhibit the type of a normal Gastropod shell, owing to the want of the lamellar body-whorl and the strong incrustation of the inner lip.

Young shells (Plate III, figs. 5 *a*, *b*, 6 *a*, *b*; Plate IV, figs. 1 *a–c*, 2 *a*, *b*) show the following characters :—

When the outer lip begins to thicken, the shell consists of 5 whorls. The first one is rounded, but the second shows already a keel, and, from its middle, nodes also. Somewhat later there appear spiral ribs. On the third whorl are about 13 nodes and, above the keel, 5 spiral ribs. Sharp growth-lines appear also. Above the keel the whorl is concave, the suture is not impressed. On the fourth whorl the keel, as such, is missing, and its place is taken by the nodes. These nodes are rounded, but in several specimens, owing to the growth-lines curving forward beneath them, they become obliquely lengthened. In specimens which, owing to damage, end with the fourth whorl, this shows a spiral depression below the nodes, and beneath this a rounded keel, which is narrower than the node-ridge. Below this second keel is observed a further depression. The shell then is suddenly contracted towards the lower end, and is covered with many fine spiral striæ (Plate III, fig. 6*b*). One specimen shows regular alternation of stronger and narrower ones. The spire is conical and not very narrow.

After the shell has formed 5 whorls the inner lip becomes callous. This callosity has been caused by the animal spreading out considerably, depositing a calcareous crust upon the columella and the shell up to the third whorl. This whorl is covered by it as far as the upper margin of the node-keel. The incrustation shows a concave upper margin. It spreads over the body of the shell and descends to the base, where it forms a thick intumescence on the reduced part of the shell and then thins off suddenly. The outer edge of the inner lip curves without being parallel to the growth-lines. The latter are very distinct on the fifth whorl; in the upper portion they are axial. They curve strongly forward from the node-ridge, reach the second keel, then a third one (which has developed in the meantime), and then recurve energetically. The nodes of the fifth whorl (which forms about two-thirds of the height of the whole shell) are not situated at equal intervals in all specimens, and in part are furrowed or even dissected by the growth-lines. At the end of the fifth whorl the animal formed an outer lip, developing wing-shaped. The node-ridge terminates towards this wing. The second keel forms some nodes lengthened in the direction of the growth-lines. The last node is situated a little more outward than the last one of the chief

(1) The figure of *Conchothyra parasitica* given by Hector (here reproduced, see fig. 2) is upside down, so that the shell appears sinistral.

node-keel. Even on the third keel may be observed several nodes of only slight height. The two lower keels become lower and smoother on the wing, while the spiral sculpture continues to the thickened margin of the wing. Only in the angle which is formed by this margin is the spiral sculpture overwhelmed by the growth-lines. This spiral sculpture covers the whole surface. The margin of the wing is turned to the surface. All following laminæ doing the same, there results the singular structure of the body-whorl described above. In this way originates a callous margin, bounded behind by a furrow. The shape of the wing is not the same in all specimens. In the younger ones the wing ends above in a short blunt hook, and the upper margin is concave, the external convex; the latter passes over into the lower margin without any boundary, and the lower margin into the short channel, which forms only a shallow groove curved a little to the right. The angle between the upper and the external margin of the wing is acute in young specimens, but is a right angle in adult ones. There is only one young specimen (Plate III, figs. 6 *a*, *b*) the wing of which is formed like that of an adult.

Casts of young specimens show rounded whorls. Only on the last whorl the node-ridges and the depression below it are just visible.

Dimensions of a Young Shell (nearly perfect, the first whorl only wanting).—Height, 26 mm.: breadth, 23 mm.; diameter, 15·5 mm.

Localities.—Loc. 13 (Lower Amuri Group, west wing of Amuri Bluff), 10 specimens; loc. 23 (Selwyn Rapids beds, Selwyn River, Malvern Hills), 9 specimens, adult (Haast *leg.*, 1872); loc. 589 (the same, McKay *leg.*, 1896), 29 adult and 32 young specimens; loc. 149 (McKay's Creek, Middle Waipara, *Ostrea* bed), 1 specimen; loc. 277 (Upper Waipara Gorge and Boby's Creek, *Ostrea* bed), 13 specimens; loc. 754 (*Ostrea* bed, Malvern Hills), 2 fragmentary specimens; loc. 762 (Middle Waipara, *Ostrea* bed), 8 specimens.

Remarks regarding the Definition of the Genus.—I have to make the following remarks regarding the diagnosis of the genus given by Hutton(1): In the early stage the shell, before forming the wing, is short and spindle-shaped.' The spire is not acute, but more blunt-conical. In the adult specimens the inner lip does not cover the whole shell at all. If this were the case the shell ought to be perfectly incrusted with laminæ parallel to the surface. In reality the greater portion of the shell is formed by laminæ, all curving outward, deposited on the inner side of the wing. By this means the closely crowded growth-lines result.

Furthermore, I have to mention that in *Conchothyra parasitica* the spire consists of 5 (not 4) whorls. Hutton says that the incrustation is smooth on the aperture. This is true; but at the outer lip there is no incrustation; therefore it cannot be coarse there.

The diagnosis of the genus *Conchothyra* may be given as follows:—

Conchothyra (McCoy MS.) Hutton.

Shell thick, of medium size, right-handed, short spindle-shaped, and with a blunt-conical spire, when young. The 5 whorls of the spire are sculptured with a spiral series of rounded nodes. Besides this there is a second and, on the fifth whorl, a third slighter and rounded keel. The whole shell down to the fifth whorl is covered with spiral ribs. The sixth and last whorl envelopes the spire and gives a semi-globose form to the adult shell. Aperture narrow, rectangular, with parallel lips, broadly carved out above and ending in a short canal. Inner lip very callous, ending in a thick knotty mass below. Outer lip wing-shaped, nearly symmetrically formed above and below, rounded at its end.

Relations.—Hutton says that *Conchothyra* may be perhaps identical with *Pugnellus*, mentioning as differences from the latter genus the curved columella of the adult, the want of a prolonged channel, and the much stronger incrustation. Without knowledge of Hutton's paper I also have

(1) F. W. Hutton, On *Conchothyra parasitica*. Trans. and Proc. N.Z. Inst., xxvi, p. 359.

compared *Conchothyra* with *Pugnellus*(1). Later on I remarked(2) that I was not quite sure whether there was really a difference between the two genera or not. But now, as I can better judge this question on the basis of the great amount of material of *Conchothyra* in my hands, I consider the retention of the two genera well founded. *Conchothyra* has not the inward-curving channel of *Pugnellus,* while this genus is destitute of the coarse growth-lines and lamellæ of *Conchothyra.* The inner lip of *Pugnellus* spreads wider over the shell than in *Conchothyra.* In nearly all species of *Pugnellus* the nodes or ribs are lengthened in an axial direction, and the wing is more dismembered from the shell.

Certainly there is a resemblance in the whole appearance of these two Gastropods. The form most like *Conchothyra* is *Pugnellus hauthali* Wilck.(3) from the Upper Senonian of South Patagonia, but there are many differences in the shape of the wing and of the channel, in the sculpture of the spire, and in the structure of the body-whorl. *Pugnellus densatus* Conr.(4), from the Ripley Group of the Cretaceous of Texas, has a similar channel, but quite a different sculpture. Perhaps one may clear up the relations between *Conchothyra* and *Pugnellus* by starting from the older whorls.

Being forced to set aside this problem, we are able, on the contrary, to show that *Conchothyra* probably did not become extinct with the close of Cretaceous time, but had descendants in the older Tertiary of the South Pacific region. The Swedish Antarctic Expedition has discovered in the Tertiary of Seymour Island (Grahamland) a single specimen of a Gastropod, determined hitherto as *Struthiolarella nordenskjöldi* O. Wilck.(5). However, it appears to me very doubtful if this determination is correct. The Gastropod in question has a blunt-conical spire, which afterwards becomes incrusted by laminæ, a laminate structure of the last whorl being thus produced. In order to recognize the resemblance it is necessary to compare the Antarctic form with specimens of *Conchothyra* which are of equal size and damaged in the same manner. The course of the growth-lines is absolutely the same in the so-called *Struthiolarella nordenskjöldi* and in *Conchothyra parasitica.* Apparently the shell of the former was covered by the growth-lamellæ of the body-whorl up to the apex. In the typical *Str. nordenskjöldi* (*l.c.*, pl. 1, figs. 26 *a*, *b*) these characteristics seem to be developed in another manner. The upper margin of the outer lip is essentially different in shape from that of *Conchothyra.* Perhaps the discovery of a perfect specimen of the Antarctic Gastropod some day will solve this interesting problem.

Remarks.—Trechmann has described young specimens of *Conchothyra parasitica* under the name of *Pugnellus marshalli.* I think that his *Pugnellus waiparaensis* is only a variety of *Conchothyra parasitica,* and *Pugnellus australis* Marsh. also.

Struthiolariopsis O. Wilck.

Struthiolariopsis similis sp. nov. (Plate IV, fig. 6.)

Description.—The shell is spindle-shaped. The number of the whorls is unknown. The spire is lower than one-half of the whole shell. Its whorls bear a nodose keel lying immediately above the suture. Above the nodes the whorls show a slight depression. The surface is ornamented with spiral ribs, the number of which on the penultimate whorl is about 10. Above the nodes these spiral ribs are more distant than on the nodes themselves. The last whorl still shows a second sharp keel below the nodose one. By this means the body-whorl is divided into three segments, which are all depressed, especially the lowest. Towards the margin of the outer lip the lower keel becomes nodose too. The spiral ribs of the body-whorl are of varying strength,

(1) O. Wilckens, Revision d. Fauna d. Quiriquinaschichten. N. Jahrb. f. Min. Geol. u. Pal., Beil.-Bd. xviii, p. 207. I make the mistake in this paper of saying that the shell of *Conchothyra parasitica* is incrusted by thick layers of a callous calcareous mass. It would be more correct to say, is *formed.*

(2) O. Wilckens, D. Lamellibr., Gastr. &c., d. ob. Kreide Südpatagoniens. Ber. Nat. Ges. Freiburg i. B. 15, p. 20, annotation.

(3) O. Wilckens, *ibidem*, p. 18, pl. iv, figs. 2 *a*, *b*.

(4) See figs. 4, 5 in Cossmann, Essais de paléoconchologie comp., Livr. 6, pl. vii.

(5) O. Wilckens, Die Mollusken der antarktischen Tertiärformation. Wiss. Ergebn. d. Schwed. Südpol.-Exped. 1901–3, iii, Lief. 13, p. 24, pl. 1, figs. 25 *a*, *b*.

and, in part, undulate a little. The growth-lines are strong; they recurve above the node-keel. The inner and the outer lip are not preserved. One cannot tell if a channel existed.

Locality.—Loc. 13 (Lower Amuri Group, west wing of Amuri Bluff), 1 specimen.

Relations.—The sculpture of this shell resembles very much that of *Struthiolariopsis ferrieri* Phil. sp.(1) from the Upper Senonian of Quiriquina and Tomé (Chile), but differs by the existence of a second keel on the last whorl, which produces another shape of the latter. Unfortunately, the only specimen of the material is very badly preserved. Certainly it is not by accident that this genus occurs only in rare specimens, as well in the Cretaceous of Chile as in that of New Zealand. Probably it is not peculiar to the facies of these occurrences, and was only occasionally washed in as an empty shell.

Protodolium gen. nov.

Protodolium speighti Trechm. sp. (Plate IV, figs. 3 *a*, *b*, 4 *a*, *b*, 5.)

1917. *Neritopsis speighti*, Trechmann, C. T., Cret. Moll. from N.Z., Geol. Mag., n.s., dec. vi, vol. iv, p. 300, pl. xix, figs. 12–15.

Description.—The thick shell is semi-globular, and consists of about 4 whorls. The spire is low, flat-conical; its height is about one-ninth of the whole shell. The two initial whorls are rounded and smooth. Spiral ribs appear in the middle of the third whorl; at the same time the whorls become flattened above. The suture above the last whorl is impressed. The body-whorl is very large, a little flattened above, and spirally ribbed by 13 broad furrows. The rounded ridges between these furrows are almost one and a half times as broad as the furrows, and the uppermost flattened portion of the whorl is almost twice as broad as the other spiral ridges. The fine growth lines and furrows cross almost rectilinearly the spiral sculpture, and recurve only at the base of the shell. They are much more distinct in the spaces between than on the ridges. The umbilicus is faint. A furrow runs downward from the umbilicus, directed obliquely to the ribs. By this means the lower portion of the shell appears to be broken off by a step. The inner lip with its greatest upper portion covers the shell; it is thick and callous. The outer lip and the aperture is not preserved in any specimen.

The cast shows rounded, rapidly increasing, whorls and deep sutures.

Dimensions :—	Height. Mm.	Breadth. Mm.	Diameter. Mm.
No. 1	41	40	34
No. 2	35	32	23
No. 3	11·5	9	8

In the larger specimens the initial whorls are a little worn.

Localities.—Loc. 13 (Lower Amuri Group, west wing of Amuri Bluff), 7 specimens, in most part casts (the largest specimen has a transverse sculpture on the body-whorl, consisting of ribs, which run with the growth-lines and extend from the suture down to the lower end of the shell); loc. 23 (Selwyn Rapids beds, Selwyn River, Malvern Hills), 1 cast; loc. 589 (*idem.*, McKay *leg.*, 1896), 18 large specimens, 4 young, 1 cast, and 2 fragments; loc. 761 (Saurian beds, Middle Waipara), 2 specimens.

Relations.—The form of the shell and the coarse spiral sculpture are quite those of the genus *Dolium*. K. Martin(2) has described several similar Gastropods from the Miocene of Java, none of which fully agrees with our form: either the whole shape, or the number, or the breadth of the spiral ribs differ. Likewise, the callous inner lip and the great breadth of the top smooth portion of the shell above the uppermost spiral furrow are missing in all species of *Dolium* from the Java Tertiary. The most similar form is *Dolium costatum* Desh.(3),

(1) O. Wilckens, Revision der Fauna d. Quiriquinaschichten. N. Jahrb. f. Min., Geol. u. Pal., Beil.-Bd. xviii, p. 208, pl. xviii, fig. 5.

(2) K. Martin, Die Tertiärschichten auf Java, and Die Fossilien von Java, Bd. i, Gasteropoden (Sammlungen d. Geol. Reichs-Mus. in Leiden, N.F., Bd. i, Abt. i).

(3) Martin, Tertiärschichten, p. 40, pl. vii, figs. 9, 10: Fossilien v. Java, i, Gastr., p. 161, pl. xxv, figs. 371–73.

figured by Martin in plate xxv, fig. 371, but the spire is higher. As this character varies in the New Zealand form we need attach no importance to it. The number of the chief spiral ribs (13–14) is the same in both species. The figure of *Dolium costatum* given by Reeve(1) shows ridges, which are very narrow in proportion to the furrows, so that the whole appearance differs much from *Protodolium speighti.* The same is to be said of *Dolium lischkeanum* Küster(2), identified by Martin with *D. costatum. Dolium losariense* K. Mart.(3) has a thin shell with 14–15 spiral ridges, which are narrower than the furrows between them.

Trechmann(4) mentions five genera which in his opinion show a sculpture resembling that of our New Zealand Gastropod here in question. He says even that there are many others which develop parallel spiral furrows in a similar manner. I venture to say that none of the genera mentioned by Trechmann has any nearer relation to *Protodolium speighti* than *Dolium. Vanikoro kiliana* O. Wilck. is quite different. *Fossarus* is out of the question, and so are *Cinulia* and *Pyrula. Neritopsis* is characterized by the broad angular emargination of its inner lip, not present in *P. speighti.*

In my opinion it is almost certain that our Gastropod is the ancestor of *Dolium.* If I do not give this name to it it is because in the Cretaceous form the channel of *Dolium* has not yet developed. As Trechmann's specimen showing the lips is broken at the margins of the aperture, we do not know whether the outer lip was crenulated. In any case, the New Zealand shell has a remarkable resemblance to *Dolium* in shape, sculpture, growth-lines form of the aperture, and in the furrow running downward from the umbilicus.

Among the living species of *Dolium* none more resembles *Protodolium speighti* than *D. galea* L.(5), from the Mediterranean Sea; only this species is somewhat larger.

Perhaps there exists a relationship between *P. speighti* and the Gastropod described by K. Martin(6) under name of *Vanikoroia javana,* from the Eocene of Kali Puru, Java.

I cannot affirm with full certainty whether *Cinuliopsis typica* Whiteaves(7) is related. This species was discovered in the productive coal-measures, division A, of the Sucia Islands (Vancouver). The shape and the sculpture are very similar; the aperture and the inner lip differ.

Until now a true *Dolium* has not been known from Cretaceous deposits. J. Sowerby(8) has described such a one, it is true; and this Cretaceous *Dolium* still haunts palæontological treatises and monographs(9), although d'Orbigny(10) has pointed out that this Gastropod was a *Strombus,* and Pictet and Campiche(11) determined it as a *Pteroceras.* Dall(12) in 1905 declared that *Dolium* was unknown in the fossil state, apparently overlooking Martin's publication; and Ortmann(13) in 1903 was of the opinion that the occurrence of a *Dolium* in the Patagonian Formation was a sign of a Neogene age of these beds. Now, the Upper Senonian of the Pacific borders has yielded two forms which may well be considered as older members of the family of Doliidæ.

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(1) Reeve, Conchologia iconica, v, *Dolium,* pl. v, sp. 8.
(2) Martini and Chemnitz, Syst. Conchylienkab., iii, 1*b*, pl. 62, fig. 1.
(3) K. Martin, D. Foss. v. Java, i, Gastr., p. 163, pl. xxv, figs. 377, 378.
(4) C. T. Trechmann, Cret. Moll. from N. Zeal. Geol. Mag., n.s., dec. vi, vol. iv, p. 300.
(5) See the figure in Kiener, Spec. gen. et icon. des coq. viv., viii, pl. 2, fig. 2.
(6) K. Martin, Die Fauna des Eocäns von Nanggulan auf Java. Sammlungen d. Geol. Reichs-Mus. in Leiden, N.F., Bd. ii, Heft iv, p. 170, pl. vi, figs. 148, 148*a*.
(7) J. F. Whiteaves, On the Fossils of the Cretaceous Rocks of Vancouver and Adjacent Islands in the Strait of Georgia. Mesozoic Fossils, vol. i, pt. ii, p. 131, pl. 16, figs. 7, 7*a*, 7*b*.
(8) J. Sowerby, Mineral Conchology of Great Britain, vol. v, p. 34, pls. 426, 427.
(9) Zittel (Handbuch d. Paläontologie, ii, p. 263) and Zittel-Eastman (Text-book of Palæontology, 2 ed., p. 255) mention *Dolium* from the Cretaceous with a mark of interrogation. I think that when doing so they mean the Cretaceous "*Dolium*" of Sowerby. See, furthermore, M. Cossmann, Ess. de paléoconch. comp., Livr. 5, p. 136; and W. H. Dall, Contributions to the Tertiary Palæontology of the Pacific Coast, i, The Miocene of Astoria and Coos Bay, Oregon (U.S. Geol. Surv. Prof. Pap. 59), p. 69.
(10) A. d'Orbigny, Prodrome de Paléontologie, ii, p. 154.
(11) Pictet et Campiche, Foss. du terr. crét. de Sainte-Croix, ii, p. 583.
(12) *L.c.*, p. 69, note 2.
(13) A. E. Ortmann, Tertiary Invertebrates. Rep. Princeton Univ. Exp. to Patagonia, iv, p. 204.

Remark.—The diagnosis of the new genus *Protodolium* may be given as follows :—

Shell of medium size (consisting of few whorls), spire short, whorls rounded, body-whorl large (giving a semi-globular form to the shell). Sculpture: spiral ridges and furrows as in *Dolium*. Growth-lines straight. Aperture ovate, rounded above and below. Inner lip thick, covering the columella. Umbilicus faint. A furrow runs obliquely from the umbilicus to the base. Probably related to *Cinuliopsis* Whiteaves, and ancestor of *Dolium*. Upper Senonian, New Zealand.

Tudicula Link.

Tudicula alta sp. nov. (Plate IV, figs. 7, 8, 9 *a*, *b*, 10, 11.)

Description.—I consider two small shells (damaged at the aperture and at the base, but, as for the rest, well preserved) to be young individuals of this species (Plate IV, figs. 7, 8). The smaller one shows $3\frac{1}{4}$ whorls, the first of which is rounded and smooth, while the following are sloped above and spirally striate. The last whorl preserved shows two angles; above the upper one the whorl gently slopes, then it becomes vertical and slightly concave. The shell tapers rapidly to the base. Both keels bear nodes, which are intumescences of the axial ribs. The spiral sculpture consists of strong liræ—3 on the shoulder, 2 (sometimes with a fine third) on the nodes of the upper keel, 3 on the vertical slope (thickened where they cross the axial rib), 2 on the lower edge, 4 on the base. In some places there appear fine interstitial liræ between the coarser ones. The larger specimen shows 6 liræ on the shoulder, 3 on the upper keel, 3 or 4 on the vertical slope, and 8 on the base.

Besides these young individuals the material contains several casts of the later whorls, which casts are essentially larger. As the channel is missing, these specimens are top-shaped. The whorls are about 5 in number; they increase regularly, show a flat shoulder and then a vertical slope. A second angle is formed by the sudden contraction of the shell. One cast is covered with a fine spiral striation. Aperture and channel are not preserved.

Dimensions of the Larger Specimens.—No. 1: Height, 28 mm.; breadth, 30 mm.; diameter, 31 mm. No. 2: Height, 21 mm.; breadth, 26 mm.; diameter, 22 mm.

Localities.—Loc. 13 (Lower Amuri Group, west wing of Amuri Bluff), 4 adult specimens and 2 small ones; loc. 14 (Amuri Group, Oaro Creek, west wing of Amuri Bluff), 1 specimen.

Relations.—As the channel is not preserved it is impossible to determine the subgenus to which this shell belongs. *Tudicula (Hercorhynchus) cancellata* Sow. sp.(1) from the Trichinopoli Group shows a certain resemblance. The genus *Tudicula (Pyropsis)* is common in the Upper Senonian of the Pacific region, but there is no form similar to this species of New Zealand.

Remark.—I suppose that the species here described is identical with Hector's *Tudicula biangulata*(2).

Tudicula ex. aff. tumida O. Wilck. (Plate IV, figs. 12 *a*, *b*.)

Description.—The material contains only casts of this Gastropod. The largest of these is double-cone-shaped, and consists of $3\frac{1}{2}$ whorls. The initial whorl seems to be rounded and smooth. Nodes appear in the middle of the second whorl. The penultimate whorl bears acute nodes or short transverse ribs close to the upper suture, which is strongly impressed and slightly undulating. Above these nodes the whorls are gently sloped. The ribs of the body-whorl are more rounded, and most prominent in the middle of the whorl. On the lower half of the body-whorl the ribs are somewhat oblique and retrocurrent. The aperture is ovate, but angled above. A canal is not preserved. A fragment of the shell preserved in the suture above the body-whorl shows spiral striæ.

Dimensions.—Height, 27 mm.; breadth, 25, 18 mm. diameter, 21, 14 mm.

Localities.—Loc. 23 (Selwyn Rapids beds, Selwyn River, Malvern Hills), 3 casts; loc. 761 (Saurian beds, Middle Waipara), 1 specimen (cast).

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(1) F. Stoliczka, Cret. Fauna of S. India, ii, Gastropoda, pl. xii, figs. 13, 14. See also M. Cossmann, Essais de paléoconchologie comp., Livr. 4, p. 74.

(2) Catal. Ind. and Col. Exhib., London, p. 58, fig. 20, No. 6, 1886.

Relations.—Casts of Gastropods, the aperture of which is not preserved, are generally not determinable. The species in question shows resemblance to a form from the Upper Senonian of South Patagonia, described under the name of *Struthiolariopsis? tumida* O. Wilck.(1). It is true that in this species the ribs are somewhat antecurrent below, while retrocurrent in the New Zealand form. I take these two species for *Tudicula* on account of their similarity to *Tudicula monheimi* Müller sp.(2). Besides this species I know only *Fusus clementinus* d'Orb.(3) as a form which may be compared with it. In conclusion, I mention as a similar fossil *Turbinella? verticalis* Whitf.(4), a cast from the lower greensand-marls of New Jersey.

Although I must leave the determination of this Gastropod in absolute uncertainty, it is remarkable that a related form occurs in the Upper Senonian of South Patagonia. I have said elsewhere(5) that *T. tumida* also occurs in the Roca beds of Argentina. This Roca form is certainly not identical with that from New Zealand.

Cryptorhytis Meek.

Cryptorhytis vulnerata sp. nov. (Plate IV, figs. 13 *a*, *b*.)

Description.—The material contains only two sculptured casts, one of which consists of two middle whorls, while the other is only a poor fragment. The upper portion of the whorl slopes gently, the lower very abruptly. The sculpture consists of axial ribs, developed by far the strongest on the vertical portion of the whorl. These ribs are broad, and are crossed by strong spirals, which seem to be present likewise above and beneath the transverse ribs. The aperture apparently was long and narrow.

Relations.—Related forms are *Cr. rigida* Baily sp.(6) from Southern India, and *Cr. philippiana* O. Wilck.(7) from the Antarctic Upper Senonian. In the latter the shoulder is shorter than in the New Zealand species.

Procancellaria gen. nov.

Procancellaria parkiana sp. nov. (Plate V, figs. 1, 2.)

Description.—The rather small shell is thin, ovate, and consists of 5 whorls. The height of the spire is one-fifth of that of the whole shell. Only the first whorl is rounded and smooth: the second is flattened above and then slopes abruptly; the sculpture begins in this second whorl. In the third whorl the sculpture consists of spiral furrows and ribs, but the axial elements are more conspicuous. On the last whorl the axial and the spiral sculpture counterbalance each other, so that the shell appears granulated by numerous fine knobs. The body-whorl is flattened or even a little impressed in its upper portion; its uppermost spiral rib is mostly divided by a furrow into an upper, narrower, and a lower, broader ridge. The following 9 ribs are somewhat narrower than the interstices between them. The transversal ribs are not absolutely axial, but rather a little retrocurrent in the lower portion of the shell. The aperture is not quite circular (as the cross-section of the body-whorl), but ovate owing to the outward flexion of the inner and lower margins. The aperture is angled above; the peristome is continuous. In no specimen is the outer lip fully preserved. The aperture shows a flat expansion at the base, and a channel projecting very little in front of the remaining inferior margin. There is no umbilicus.

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(1) O. Wilckens, Die Lamellibranchiaten, Gastropoden, &c., d. ob. Kreide Südpatagoniens. Ber. Nat. Ges. Freiburg i. B. 15, p. 116 (20), pl. iv, figs. 3, 4.

(2) E. Holzapfel, Die Moll. d. Aachener Kreide, Palæontogr., xxxiv, p. 106, pl. xi, fig. 7.

(3) As figured in Pictet et Campiche, Fossiles du terr. crét. de Ste. Croix, ii, pl. xcv, figs. 4 *b*, *c*. The figure of d'Orbigny (Pal. franç. Terr. crét. ii, pl. 223, fig. 8) has much less resemblance, the ribs appearing much longer.

(4) R. P. Whitfield, Gasteropoda and Cephalopoda of the Raritan Clays and Greensand Marls of New Jersey. U.S. Geol. Surv. Monogr. xviii, p. 82, pl. iii, figs. 14, 15.

(5) O. Wilckens, Die Meeresablagerungen der Kreide und der Tertiärformation in Patagonien. N. Jahrb. f. Min., Geol., Pal., Beil.-Bd. xxi, p. 143.

(6) F. Stoliczka, Cret. Fauna of S. India, ii, Gastropoda, p. 109, pl. x, figs. 10–16.

(7) O. Wilckens, Die Anneliden, Bivalven, und Gastropoden der antarktischen Kreideformation. Wiss. Erg. d. Schwed. Südpol.-Exp. 1901–3, iii, Lief. 12, p. 94, figs. 20, 21.

Dimensions :—	Height Mm.	Breadth. Mm.	Diameter. Mm.
No. 1	13	10	8
No. 2	16	12	..
No. 3	14	10	..
No. 4	15	13	12
No. 5	19	..	..

Locality.—Loc. 5 (calcareous conglomerate, Lower Amuri Group, east wing of Amuri Bluff), 39 specimens, in part fragmentary.

Remarks on the Genus Procancellaria.—The genus *Cancellaria* is characterized by a number of properties, one or another of which may regress or even be altogether wanting. The folds of the columella are the most significant character, but they are developed in a very different manner. The cancellate sculpture, the umbilicus, the folds on the inner side of the outer lip may be present or wanting, and the channel is often only very slightly developed.

The shell here in question does not show the folds of the columella and the folds of the outer lip; it is therefore impossible to determine it as a *Cancellaria*. On the contrary, all other qualities agree very well with those of *Cancellaria*. So I am obliged to establish a new genus for this form. I name it *Procancellaria*, suggesting that this genus may be the ancestor of *Cancellaria*, or at least of a part of the forms named *Cancellaria*. Geologically speaking, *Cancellaria* is a younger genus by predominance. *Procancellaria parkiana* shows the typical cancellate sculpture, the shape of and an aperture like *Cancellaria*. The channel is *in statu nascendi*. The folds of the columella and of the outer lip have not yet made their appearance.

The diagnosis of *Procancellaria* gen. nov. may be given as follows :—

Shell small, ovate; spire short, acute; last whorl large, much higher than the spire. Protoconch smooth; the following whorls with cancellate sculpture, rounded except the upper portion, which is flattened. Aperture ovate, with continuous peristome, angled above. Outer lip sharp (?), inner lip spreading over the body. Inferior margin of the aperture flattened, and forming a small shallow channel; to the right of this the margin is slightly sinuate. Columella somewhat twisted.

Relations.—*Aneuristoma dufouri* Grat.(1) from the Upper Tertiary has a sculpture similar to that of *Procancellaria parkiana*. The same is the case with *Cancellaria asperella* Gmel., described by K. Martin from the Tertiary of Java(2).

Up to the present time no forms resembling our species are known from the Cretaceous of Southern India, Grahamland, Patagonia, and Chile, if we omit *Vanikoro kiliani* O. Wilck.(3), which exhibits a similar granulate sculpture.

Whitfield(4) figures two Gastropods from the lower greensand marls (Senonian) of New Jersey showing a certain similarity to our species: *Morea naticella* Gabb and *Cancellaria (Merica) subalta* Conr. According to Cossman(5) the former does not belong to the family of the Cancellaridæ; but his argument does not stand the proof, for he says that Cancellaridæ exist only in Tertiary strata, whilst we may discover unexpected forms in every new fauna. *Merica subalta* Conr., according to Cossmann, is an *Uxia*, but the determination is doubtful.

Among living Cancellaridæ the following present a sculpture similar to that of *P. parkiana*: *Cancellaria australis* Sow. (New South Wales) and *C. candida* Sow. (Polynesia)(6). The granulate sculpture also occurs, it is true, in *Litorina*—*e.g.*, in *L. reticulata* Phil. from Mauritius and Sumatra(7).

(1) See figure in M. Cossmann, Ess. de paléoconchologie comp., Livr. 3, pl. i, figs. 23–24. On the contrary, there is not much resemblance to the figure of this species in R. Hörnes, Die fossilien Mollusken des Tertiärbeckens von Wien. i, Univalven, pl. 34, fig. 9.

(2) K. Martin, Die Fossilien von Java, i, Gasteropoda, pl. vii, fig. 114 (*nec.* 113). This, I think, is a different species and not *C. asperella* Gmelin.

(3) O. Wilckens, Annel., Gastr., Bivalv. antarkt. Kreideform. Wiss. Erg. Schwed. Südpolar-Exp. 1901–3, Lief. 12 des iii. Bandes, pl. 3, figs. 28 *a*, *b*.

(4) Gasteropoda and Cephalopoda of the Raritan Clays and Greensand Marls of New Jersey. Mono. U.S. Geol. Surv. xviii, pl. xx, figs. 19, 20, 24, 25.

(5) Essais de paléoconchologie comp., Livr. 3, pp. 6–7.

(6) Reeve, Conchologia iconica, x, *Cancellaria*, pl. x, figs. 44, 46.

(7) v. Martens und Thiele, Die beschalten Gastropoden der deutschen Tiefsee-Expedition auf d. Dampfer Valdivia. Wiss. Erg. d. Deutsch. Tiefsee-Exp., &c., Bd. 7, pl. iv, fig. 14.

In conclusion, it may be mentioned that Zittel(1) describes a "*Neritopsis* sp. indet.," the sculpture of which resembles much that of *Procancellaria parkiana*. This "*Neritopsis*" comes from the older Tertiary of Papakura, near Auckland (North Island). As the peristome is not preserved it is not perfectly determinable. The number of its spiral ribs is 8; in our species it is 10. May I presume that the locality Papakura furnishes not only Tertiary but likewise Cretaceous fossils? Clarke(2) does not mention the "*Neritopsis*" of Zittel, and ascribes the locality to the Tertiary. According to Thomson's(3) "List and Index of Fossil Localities" Papakura has yielded to Park "Cretaceo-Tertiary." As the fossils described in this bulletin are of Cretaceous age, and formerly were ascribed to the so-called "Cretaceo-Tertiary," it is possible that the named locality is partially Cretaceous.

Remark.—I dedicate this species to Professor James Park, of the University of Otago, Dunedin.

Conus sp.? (Plate V, fig. 3.)

The material from loc. 9 (boulder-sands, Saurian beds, east wing of Amuri Bluff; McKay, 1873 and 1876) contains a cast of the body-whorl of a Gastropod which may be a *Conus* (*Conospira*). The shape is cylindrical, the aperture long and narrow; the spire is wanting. The specimen resembles *Conus (Conospira) deperditus* Suter(4) from the Miocene of Brewery Creek, Mokihinui River, western Nelson, but is too poorly preserved to allow of any certain statement.

Eriptycha Meek.

Eriptycha punamutica sp. nov. (Plate V, figs. 5 *a–c*.)

Description.—The small shell is globular, the spire inconspicuous. The number of the whorls is 2½–3. The sculpture of the whorls consists of spiral liræ. The body-whorl is strongly enlarged and ornamented by 25 punctate lines. The aperture is narrow, high-ovate, angled above, rounded below, oblique to the axis of the shell; at the base it shows a shallow channel. The outer lip is thickened by a strong reflexion, which reaches up to half the height of the penultimate whorl. The columella has two plications.

Dimensions.—Height, 6 mm.; breadth, 6 mm.; diameter, 4·5 mm.

Localities.—Loc. 2 (calcareous conglomerate, Lower Amuri Group, east wing of Amuri Bluff), 2 specimens; loc. 13 (Lower Amuri Group, west wing of Amuri Bluff), 2 specimens, and in addition 5 or 6 little shells of 1·5–2 mm. height.

Relations.—The genus *Eriptycha* is common in the Upper Cretaceous, and occurs in all Upper Senonian districts of the Pacific border(5). Nevertheless the species from Grahamland, South Patagonia, and Chile(6) do not show near relations to our form. Likewise *Eriptycha perampla* Woods(7) from the Senonian of Pondoland is different, being bigger and having a higher spire. Perhaps *Cinulia pusilla* Whiteaves(8) from the south island of Queen Charlotte Islands is the most closely related form.

Note.—The material contains a body-whorl (sculptured cast) of a *Cinulia* or an *Eriptycha* from loc. 761 (Saurian beds, Middle Waipara). It is nearly twice as large as *E. punamutica*, and the number of spiral striæ is at least 32. The bad state of preservation prevents its determination. In the list of fossils (p. 26) I mention this form as "*Cinulia* sp."

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(1) K. A. Zittel, Fossile Mollusken und Echinodermen aus Neu-Seeland. Reise der Novara. Pal. v. N. Seeland, p. 43, pl. ix, fig. 4.

(2) E. de C. Clarke, The Fossils of the Waitemata and Papakura Series, Trans. N.Z. Inst., xxxvii, p. 413–21, pl. 32 (1905).

(3) J. A. Thomson, Materials for the Palæontology of New Zealand. N.Z. Geol. Surv., Pal. Bull. No. 1, p. 90.

(4) H. Suter, Description of new Tertiary Mollusca occurring in New Zealand, &c., Part I. N.Z. Geol. Surv. Pal. Bull. No. 5, pl. xii, fig. 26.

(5) O. Wilckens, Rev. d. Fauna der Quiriquinaschichten. N. Jahrb. f. Min., Geol., Pal., Beil.-Bd. xviii, p. 220.

(6) *Cinulia* sp. from Grahamland (O. Wilckens, Annel., Biv., Gastr. antarkt. Kreideformation, p. 95, pl. 4, fig. 19); *Cinulia pauper* O. Wilck. (Lamell., Gastr., &c., d. ob. Kreide Südpatag., pl. iv, figs. 6 *a*, *b*); *Eriptycha chilensis* d'Orb. (O. Wilckens, Rev. Fauna Quiriquinaschichten, p. 218, pl. xviii, fig. 10).

(7) H. Woods, The Cretaceous Fauna of Pondoland. Annals of the South African Museum, vii, p. 329, pl. xli, fig. 2.

(8) J. F. Whiteaves, On the Fossils of the Coal-bearing Deposits of the Queen Charlotte Islands, collected by Dr. G. M. Dawson in 1878. Mesozoic Fossils, i, pt. iii, p. 217, pl. 28, fig. 5.

Cylichna Lovén.

Cylichna thomsoniana sp. nov. (Plate V, figs. 6, 7.)

Description.—The shell is cylindrical and, the spire being entirely involved, umbilicated above. The sculpture consists of spiral lines with rather wide interstices. The breadth of the aperture is about one-third that of the shell. The aperture seems to be angled above and rounded below. The outer lip curves a little. It is impossible to state whether the spire is visible in the umbilicus, or whether the species belongs to *Bullinella* or to *Cylichnina*(1).

Dimensions.—No. 1 : Height, 10 mm. ; diameter, 5 mm. No. 2 : Height, 8 mm. ; diameter, 3 mm. No. 3 : Height, 2·5 mm. ; diameter, 1·5 mm.

Locality.—Loc. 13 (Lower Amuri Group, west wing of Amuri Bluff), 6 specimens(2).

Relations.—There are several forms which are comparable with our species, but all are different : *Cylichna chilensis* d'Orb. sp.(3), from the Quiriquina beds ; *C. inermis* Stol.(4), from the Ariyalúr Group of Southern India ; *C.* ? *volvaria* Meek(5), from the Fox Hill beds of Missouri ; *C. jogjacartensis* K. Mart.(6), from the Upper Eocene of Nanggulan, Java ; *Bulla arenaria* v. Ih.(7) and *Bulla patagonica* v. Ih.(8), from the Patagonian ; and *Bulla remondi* Phil.(9), from the older Tertiary of Chile.

Remark.—I wish to dedicate this species to Dr. J. A. Thomson, formerly Palæontologist to the New Zealand Geological Survey.

(*b.*) Scaphopoda.

Dentalium L.

Dentalium (Lævidentalium) morganianum sp. nov. (Plate V, figs. 8, 9.)

1917. *Dentalium* sp. Trechmann, T. C., Cret. Moll. from New Zealand, Geol. Mag., n.s. dec. vi, vol. iv, p. 299, pl. xxi, fig. 10.

Description.—Shell large, thick, gently curved, mostly in the upper (thinner) end. Section circular, but slightly flattened laterally in a very large specimen from loc. 5. The sculpture consists exclusively of the growth-lines, which do not cross the shell-surface in an exactly transverse direction, but curve down a little on the front-side (*i.e.*, the concave side). They are not equally strong ; by this means a wrinkled surface is caused. The two apertures are not preserved in any of the specimens.

Dimensions.—A nearly complete specimen from loc. 13 (Plate V, fig. 9) has a length of 75 mm., with a greatest diameter of 8 mm. and a least of 1·5 mm. A large but incomplete example from loc. 5 is 73 mm. long, and at the larger end 11 mm. in diameter. A small specimen from loc. 13 shows a length of 26·5 mm., with a greatest diameter of 4·5 mm. and a least of 1 mm. The smallest specimens have, at the thin end, a diameter of 0·5 mm. The examples from loc. 589 are all smaller than those from Amuri Bluff.

Localities.—Loc. 5 (calcareous conglomerate, Lower Amuri Group, east wing of Amuri Bluff), 28 specimens, and 3 quite young individuals ; I mention that the greater part of the specimens from this locality are still in the matrix, and that these places contain, besides the *Dentalium*, some Bivalves, but no Gastropods. Loc. 589 (Selwyn Rapid beds, Selwyn River, Malvern Hills), 12 specimens.

Relations.—I do not know any Cretaceous *Dentalium* related to our species, as this has not the fine axial sculpture found in all species which resemble it in form and size. It is

(1) See M. Cossman, Essais de paléoconchologie comp., Livr. 1, p. 96.
(2) The material also contains an indeterminable cast of a Gastropod, which is figured in pl. v, fig. 4.
(3) O. Wilckens, Rev. d. Fauna d. Quiriquinaschichten. N. Jahrb. f. Min., Geol., Pal., Beil.-Bd. xviii, p. 220.
(4) F. Stoliczka, Cret. Fauna S. India, ii, Gastropoda, p. 431, pl. xxvii, fig. 20.
(5) Meek, A., Report on the Invertebr. Cret. and Tert. Fossils of the Upper Missouri Country. Rep. U.S. Geol Surv. Territories, ix, p. 275, pl. 31, fig. 2*a*.
(6) K. Martin, Die Fauna des Obereocäns von Nanggulan auf Java. Samml. d. Geol. Reichsmuseums Leiden, N.F. ii, Heft 4, pl. i, fig. 2.
(7) H. v. Ihering, Les mollusques fossiles du Tertiaire et du Crétacé sup. de l'Argentine. Anales Mus. Nac. Buenos Aires, xiv (3*a* ser.), p. 339.
(8) A. E. Ortmann, Tertiary Invertebrates. Rep. Princeton Univ. Exp. to Patagonia, iv, p. 246, pl. xxxvii, fig. 8.
(9) R. A. Philippi, Die tertiären und quartären Versteinerungen Chiles, p. 109, pl. 13, fig. 7.

worthy of notice that *D. morganianum* has been found in great number at two localities, while the other occurrences of the Upper Senonian in the South Pacific region have yielded only isolated specimens of *Dentalium*.

Remark.—I take the liberty of dedicating this interesting species to Mr. P. G. Morgan, under whose able directorship the Geological Survey of New Zealand has arrived at many results of high scientific value.

(*c*.) Annelida.

TUBULOSTIUM Stol.

Tubulostium ornatum (Hector MS.) O. Wilckens. (Plate V, figs. 10 *a–c*, 11 *a*, *b*, 12.)

Description.—The thick sinistral shell is spirally enrolled almost in one plane, and consists of $3\frac{1}{2}$–4 whorls, the first ones being, as a rule, worn off or damaged. This must be considered as an indication that the shells were attached ; it would seem that afterwards they became free, for the shells lie in the matrix in all directions. The older whorls are involved by the younger ones. The surface of the older whorls lies in the same plane as that of the later ones. As the shell is enrolled after the mode of a Gastropod shell, one on looking at the base sees scarcely more than the last whorl. This is flattened and narrow above, and forms a marginal arch, above which there runs an indistinct furrow. The base is arched. The last whorl is highest near the aperture, but it becomes lower immediately in front of the aperture, the portion above and beneath the arch becoming flatter, while the arch retains the same dimensions. The older whorls are ornamented with three keels produced by two furrows. The lowest keel may be situated near the two others at the periphery of the whorl or at the base ; therefore the shape of the outer margin of the whorls varies greatly. The inside of the whorls is circular. In no specimen is the aperture well preserved. The shell shows coarse growth-lines, which undulate a little. In some places there are deeper furrows and irregular cavities on all whorls. The shell consists of two layers, the inner layer being dark-coloured and the outer layer lighter-coloured and bigger.

Dimensions.—Diameter of larger specimens, 18–20 mm. Shells with a diameter of 18 mm. have a height of 7 mm.

Localities.—Loc. 5 (calcareous conglomerate, Lower Amuri Group, east wing of Amuri Bluff), 25 specimens ; loc. 6 (*idem*), 1 specimen ; loc. 8 (black grit, east wing of Amuri Bluff), 13 specimens ; loc. 13 (Lower Amuri Group, west wing of Amuri Bluff), 43 specimens.

Remarks regarding Nomenclature.—Two specimens from loc. 13 are attached to a paper and labelled " 6. *Rotella ornata* Hector (MS.), Catal. Col. Mus. 1870, p. 192. Chirotypes." I have figured these two small and young specimens on Plate V, figs. 11 *a*, *b*.

Relations.—I have already had the opportunity to speak about the reference of the genus *Tubulostium* to the Annelida in another place(1). The most closely related form is *T. fallax* O. Wilck.(2) from the Antarctic Senonian. The want of the three-edged keel on the last whorl of *T. ornatum* constitutes the chief difference ; furthermore, the latter is more arched on the base. *T. callosum* Stol. sp. from the Utatúr Group has a conical shell, *T. damesi* Noetl. from the Baltic Cenomanian has no keel at all.

(*d*.) Crustacea.

The material contains a single poor fragment of a Crustacean. It is the member of a chela of a decapod Crustacean from loc. 754 (*Ostrea* bed, Malvern Hills). The fragment is 16 mm. long, and has a triangular section. One side is smooth and slightly arched, the second slightly concave and granulate, the third is furrowed. The distal end is acute, the proximal open. The determination is impossible. Perhaps the fossil belongs to *Hoploparia*, a genus which occurs in the Upper Senonian of South Patagonia. A similar object is figured in H. B. Geinitz, Das Elbtalgebirge in Sachsen (Palæontographica xx, pl. 64, fig. 10).

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(1) O. Wilckens, Die Anneliden, Bivalven und Gastropoden d. antarkt. Kreideformation. Wiss. Erg. d. Schwed. Südpol.-Exp. 1901–3, iii, Lief. 12, p. 10.
(2) *Ibidem*, pp. 7–11, pl. 1, figs. 3*a–c*.

III. GENERAL RESULTS.

1. The Distribution of the Upper Senonian Gastropods and Annelida in the Series of Strata and at the Localities.

The following table contains all species described in this bulletin. The localities are arranged in the same order as in Mr. H. Woods's memoir (Pal. Bul. No. 4), p. 17. The only difference is that I have grouped localities 13 and 14 in a separate column. This was done because, according to a kind communication from Dr. Thomson, these localities, ascribed by Mr. Woods to the "calcareous conglomerate," comprise fossils from the whole series of strata—from the calcareous conglomerate up to the "concretionary greensands."

Table of Distribution of Species of Gastropoda, Annelida, etc., in the Upper Senonian Beds at Amuri Bluff, Waipara, and the Malvern Hills.

—		Amuri Bluff.				Waipara.		Malvern Hills.	
		Amuri Group.		Greensand Group.					
		a.	b.	a.	b.				
	Loc. 13 and 14.	Calcareous Conglomerate.	Black Grit.	Saurian Beds.	Concretionary Greensands.	*Ostrea* Bed.	Saurian Beds.	*Ostrea* Bed.	Selwyn Rapids Beds.
A. Gastropoda.									
1. *Pleurotomaria maoriensis* nov. sp.	x	x	..	..	..	..	..	..	..
2. *Pleurotomaria woodsi* nov. sp.	..	x	..	..	..	..	..	..	..
3. *Delphinula ?* sp.	x	..	..	..	..	..	..	..	x
4. *Calliostoma decapitatum* nov. sp...	x	x	..	..	..	..	..	..	..
5. *Patella ? amuritica* nov. sp.	x	..	..	..	..	..	..	..	..
6. *Crepidula hochstetteriana* nov. sp.	x	..	..	..	..	..	..	..	..
7. *Calyptræa solitaria* nov. sp.	..	..	..	..	..	x	..	..	..
8. *Natica selwyniana* nov. sp.	..	..	..	..	..	..	x	..	x
9. *Natica ingrata* nov. sp.	..	..	..	..	..	..	..	..	x
10. *Scalaria (Cirsotrema ?) pacifica* nov. sp.	x	..	..	..	..	..	..	..	x
11. *Cerithium inæquicostatum* nov. sp.	..	..	x	x	..	..	..	..	..
12. *Arrhoges haastianus* nov. sp.	x	..	..	..	..	x	x	..	x
13. *Perissoptera waiparaensis* (Hect. MS. sp.).. ..	x	..	x	x	..	..	..	..	..
14. *Perissoptera novo-seelandica* nov. sp.	x	..	..	..	..	..	..	..	x
15. *Conchothyra parasitica* (McCoy MS.) Hutt. ..	x	..	..	..	..	x	..	x	x
16. *Struthiolariopsis similis* nov. sp...	x	..	..	..	..	..	..	..	..
17. *Protodolium speighti* Trechm. sp.	x	..	..	..	..	..	x	..	x
18. *Tudicula alta* nov. sp.	x	..	..	..	..	..	..	..	..
19. *Tudicula* ex aff. *tumida* O. Wilck.	..	..	..	..	..	..	x	..	x
20. *Cryptorhytis vulnerata* nov. sp.	..	..	..	..	..	..	..	..	x
21. *Procancellaria parkiana* nov. sp...	x	x	..	..	..	..	..	..	..
22. *Conus* sp.	..	..	..	x	..	..	..	..	..
23. *Eriptycha punamutica* nov. sp.	x	x	..	..	..	..	..	..	..
24. *Cinulia* sp.	..	..	..	..	..	..	x	..	..
25. *Cylichna thomsoniana* nov. sp.									
B. Scaphopoda.	x	..	..	..	..	..	..	..	..
26. *Dentalium morganianum* nov. sp.	x	x	..	..	..	..	..	..	x
C. Annelida.									
27. *Tubulostium ornatum* (Hect. MS. sp.)	x	x	x	..	..	..	..	..	..
D. Crustacea.									
28. *Hoploparia ?*	..	..	..	..	..	..	..	x	..
E. Brachiopoda.									
29. *Discina* sp.	x	..	..	..	..	..	..	..	..

It follows from this table that the different localities have furnished materials of unequal variety. This will be seen from the following :—

List of the Localities, and Fossils there collected.

Loc. 2 (calcareous conglomerate, east wing of Amuri Bluff ; McKay, 1876) : *Calliostoma decapitatum, Eriptycha punamutica, Tubulostium ornatum.*

Loc. 5 (*idem*) : *Pleurotomaria maoriensis, *Pleurotomaria woodsi*(1), *Procancellaria parkiana Dentalium morganianum.*

Loc. 6 (*idem ;* McKay, 1873 and 1876) : *Pleurotomaria maoriensis, Tubulostium ornatum.*

Loc. 8 (black grit, east wing of Amuri Bluff ; McKay, 1873 and 1876) : *Cerithium inæquicostatum, Perissoptera waiparaensis, Tubulostium ornatum.*

Loc. 9 (boulder-sands, Saurian beds, east wing of Amuri Bluff ; McKay, 1873 and 1876) : *Cerithium inæquicostatum, Perissoptera waiparaensis, *Conus ?* sp.

Loc. 13 (west wing of Amuri Bluff, all beds from calcareous conglomerate up to the concretionary greensands ; McKay, 1873 and 1876) : *Pleurotomaria maoriensis, Delphinula* sp., *Patella ? amuritica, *Crepidula hochstetteriana, Scalaria pacifica, Arrhoges haastianus, Perissoptera waiparaensis, Perissoptera novo-seelandica, Conchothyra parasitica, *Struthiolariopsis similis, Protodolium speighti, Tudicula alta, Procancellaria parkiana, Eriptycha punamutica, *Cylichna thomsoniana, Dentalium morganianum, Tubulostium ornatum.*

Loc. 14 (Oaro Creek, west wing of Amuri Bluff, all Cretaceous beds ; McKay, 1873 and 1876) : *Calliostoma decapitatum; Tudicula alta, Discina* sp.

Loc. 23 (Selwyn Rapids beds, Selwyn River, Malvern Hills ; Haast, 1872) : *Delphinula* sp., *Conchothyra parasitica, Protodolium speighti, Tudicula* ex aff. *tumida.*

Loc. 149 (McKay's Creek, Middle Waipara district ; McKay, 1874) : *Arrhoges haastianus, Conchothyra parasitica.*

Loc. 277 (Boby's Creek, Middle Waipara ; Hector, 1867) : **Calyptræa solitaria, Conchothyra parasitica.*

Loc. 589 (Selwyn Rapids beds, Selwyn River, Malvern Hills ; McKay, 1896) : *Natica selwyniana, *Natica ingrata, Scalaria pacifica, Arrhoges haastianus, Perissoptera novo-seelandica, Conchothyra parasitica, Protodolium speighti, Dentalium morganianum.*

Loc. 754 (*Ostrea* bed, Malvern Hills) : *Hoploparia ?* (fragment of chela), *Conchothyra parasitica.*

Loc. 761 (Saurian beds, Middle Waipara) : *Natica selwyniana, Arrhoges haastianus, Protodolium speighti, Tudicula* ex aff. *tumida, Cinulia* sp.

Loc. 762 (Coal-beds—*i.e.*, probably *Ostrea* bed above the coal-bearing sands, Middle Waipara) : *Conchothyra parasitica.*

For the most part the fossils occur not only at one locality, but generally in several places. Those localities which have yielded the same fossils may without hesitation be considered as of the same age, geologically speaking. The fact that single forms appear only at one locality may be easily understood on considering that naturally not all the elements of a fauna exist at the same time at the same spot, even if in the whole region there are the same biological and physical conditions. Even then one species finds the most favourable conditions for life in this, another in that place. The localities of occurrence of the various species are as follows :—

(*a.*) Common to all three districts (Amuri Bluff, Waipara River, and Malvern Hills) are only *Arrhoges haastianus, Conchothyra parasitica,* and *Protodolium speighti.*

(*b.*) In the material examined there are apparently no species common to Amuri and Waipara which are absent from the Malvern Hills.

(*c.*) Common to Waipara and Malvern Hills, but failing in the Amuri district : *Natica selwyniana, Arrhoges haastianus, Tudicula* ex aff. *tumida.*

(*d.*) Common to Amuri and Malvern Hills, but failing in Waipara : *Delphinula ?* sp., *Scalaria pacifica, Perissoptera novo-seelandica, Dentalium morganianum.*

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(1) Species marked with an asterisk (*) occur at this locality only.

(*e.*) Limited to the Amuri Bluff are *Pleurotomaria maoriensis, Pl. woodsi, Calliostoma decapitatum, Patella ? amuritica, Crepidula hochstetteriana, Cerithium inæquicostatum, Perissoptera waiparaensis, Struthiolariopsis similis, Tudicula alta, Procancellaria parkiana, Eriptycha punamutica, Cylichna thomsoniana, Tubulostium ornatum.*

(*f.*) Discovered only in the Waipara district are *Calyptræa solitaria, Cinulia* sp.

(*g.*) Confined to the Malvern Hills is *Cryptorhytis vulnerata.*

Conchothyra parasitica is the typical leading fossil for the three districts. To all appearance this Gastropod occurs only in the lowest portion of the beds—viz., in the calcareous conglomerate of Amuri Bluff and in the *Ostrea* bed of Waipara and of the Malvern Hills.

The vertical distribution of the Gastropods is hardly made out. It is not known which fossils from loc. 13 come from the calcareous conglomerate and which from the higher beds. If we leave the fossils from this locality out of the question there is, in the Amuri district, only the Annelid *Tubulostium ornatum*, which occurs in the whole series from the calcareous conglomerate up to the black grit. As the Selwyn Rapids beds are stratigraphically equivalent to the Upper Amuri Group, one may presume that all species common to the Amuri district and the Malvern Hills, which occur in the calcareous conglomerate there and in the Selwyn Rapids beds here, are common to the Lower and to the Upper Amuri beds. *Cerithium inæquicostatum* (only imperfectly known) and *Perissoptera waiparaensis* occur, in the Amuri district, not only in the Upper Amuri beds, but also in the Saurian beds. *Arrhoges haastianus*, in the Waipara district, is common to the *Ostrea* bed and to the Saurian beds. It is evident, of course, that the lower portions of the stratigraphical sequence are older than the upper ones, but, as judged by the fossil Gastropods, all beds from the calcareous conglomerate up to the Saurian beds belong to the same stratigraphical unit. The concretionary greensands have not yielded Gastropods.

2. The Age of the Fauna and its Relations to that of Other Regions.

(*a.*) The Age of the Fauna inferred from its General Character.

There are several forms among the Gastropods which speak for a Mesozoic and especially for a Cretaceous age. Others might be from other formations. Some of the genera are worthless for stratigraphical determinations.

Perissoptera, Struthiolariopsis, Cryptorhytis, Eriptycha, and perhaps *Conchothyra* (if regarded as related to *Pugnellus*) are confined to the Cretaceous (as far as we know).

Arrhoges and *Tudicula* appear first in the Senonian, and exist up to recent times. This is also true of *Cylichna.*

The *Pleurotomariæ* with more probability indicate Mesozoic age, as this genus is much more common in beds of this age than in Tertiary strata. *Procancellaria* and *Protodolium* are considered here as ancestors of Tertiary forms, and therefore may be regarded as probably Cretaceous.

Tubulostium, Crepidula, and *Calyptræa* occur in the Cretaceous as well as in the Tertiary. Worthless for the determination of the age are *Patella, Natica, Cerithium, Dentalium.*

Delphinula sp. and *Calliostoma decapitatum* are so poorly preserved that they are out of the question.

The material contains no form confined to the Tertiary.

From this grouping it becomes evident that the general character of the fauna is clearly Cretaceous, and probably Senonian. A consideration of the relationships of each species to those of other regions will confirm this statement and allow a still more exact determination of the age.

(*b.*) The Relations of the Fauna to those of other Regions, and the Stratigraphical Position of the same.

For a long time it has been usual in descriptions of fossil faunas to add to the account of each species some remarks about its relation to other similar forms. In an older period of scientific work this proceeding was not customary, but to-day we are no longer satisfied by merely describing and figuring a species. Now we try, where the material permits, to show the relationships of the species to others not only of the same age, but also of older and younger date. The latter endeavours form an important part of the phylogenetic tasks of palæontology, which is obliged to omit no means of elucidating the development of life on the basis of fossil documents. If a species shows similarities to older and younger ones of the same tribe one is inclined to regard these forms as ancestors and descendants, provided that the distribution of the forms in space and time allows this supposition.

It is not so with isochronic similar forms. In palæontological descriptions great importance generally is attached to such forms. Even to-day many palæontologists examining a fauna reject all literature except that dealing with just that geological formation from which the material examined comes. Palæontologists who have started from zoology may take exception to many faunal descriptions, which have an exclusive interest in the determination of the age of the beds in which the fossils occur, not considering these as documents of the history of organic evolution. It is absurd to generalize this criticism and to apply it to all geologist-palæontologists, as if such imperfect work were not also to be met with in zoologist-palæontologists.

We have now to put the question: What is the meaning of the similarity of isochronic fossil forms, which cannot be regarded as ancestors and descendants, because they are contemporaneous or because their palæogeographical distribution prevents the supposition of descent? It is perhaps necessary to mention this matter, because palæontologists, although following the general custom of enumerating similar and related forms, usually do not say a word about the principles of this method.

The resemblance of a species to another of the same or about the same age may originate in different ways. Either each one is a variety of the same form, or the one is the mutation of the other. Furthermore, a species may be the still existing ancestor of a similar descendant, or the two similar species are descendants of the same ancestor. The latter explanation seems applicable to the existence of vicarious species, which represent a genus or family in different habitats at the same time. Consequently the "similarity" always tacitly implies a real affinity of some kind. No palæontologist, when discussing "related forms" of a species described, will mention an *accidental* similarity, except in specimens of bad preservation, which makes determination doubtful. The real degree of affinity and the meanings of similarity in most cases cannot be perfectly elucidated. It is possible, *e.g.*, that one character or another may develop in a tribe at about the same time in different genera. For instance, siphonostomy in Gastropods and complication of the sutures in Ammonites are characters which have developed independently in the younger forms of quite different families.

The meaning of the term "similar forms" may be finally explained on the basis of the material here in question. *Pleurotomaria maoriensis*, *e.g.*, was compared with *P. arnoldi* Wollem., from the North German Aptian. What does this resemblance mean? Scarcely that the North German species is the ancestor of that of New Zealand, or that the European form has immigrated into the Pacific between Aptian and Senonian. We do not know the faunas which, in pre-Senonian Cretaceous times, lived in the south-eastern Pacific in the facies represented by the Senonian of New Zealand. Possibly, in pre-Senonian times there already existed similar *Pleurotomariæ* hitherto unknown to us. It is conceivable that *Pl. maoriensis* and *Pl. arnoldi* are descended from a common ancestor and have preserved the characters of that ancestor, or in the course of development have gained similar characters. We have no certain knowledge about these things; but one will consider always the pertaining to the same group of forms as a relationship.

We have mentioned *Perissoptera monodactyla* O. Wilck. from the Patagonian and *P. nordenskjöldi* O. Wilck. from the Antarctic Upper Senonian as forms resembling *Perissoptera waiparaensis.* This resemblance probably means descent from the same ancestor. One regards the conformity of these three species occurring in regions of equal geological development as a proof of the isochronism of the beds in which these fossils occur.

Having explained the meaning of "related forms," I give a list of those Gastropods to which related forms can be found. We mention the most similar forms from the neighbouring regions in which the Upper Senonian occurs—viz., Chile, Patagonia, Grahamland, Southern India. Only where these are lacking, related species from other parts of the world are cited. Some exceptions are made—viz., where the resemblance to forms of the Cretaceous of other than Pacific regions is exceedingly striking.

Pleurotomaria maoriensis ..	*Pl. larseniana* O. Wilck. (Upper Senonian, Grahamland); *Pl. arnoldi* Wollem. (Aptian, North Germany).
Calliostoma decapitatum ..	*C. zizyphinus* (living); ? *Tectus tamulicus* Stol. (Ariyalúr Group, Southern India).
Patella ? amuritica ..	*Nacella ? (Anisomyon ?) ovata* O. Wilck. (Upper Senonian, Grahamland).
Crepidula hochstetteriana ..	*C. incurva* Zitt. (Tertiary, New Zealand) (= *C. gregaria* Sow.)(1).
Natica selwyniana ..	*N. (Mammilla) carnatica* Stol. (Ariyalúr Group, Southern India); *N.* cf. *subtenuis* v. Iher. (Tertiary, Grahamland).
Natica ingrata	*N. australis* d'Orb. (Upper Senonian, Quiriquina); *N. (Mammilla) carnatica* Stol. (Ariyalúr Group, Southern India); *N. subtenuis* v. Iher. (Tertiary, Patagonia); *N.* cf. *subtenuis* v. Iher. (Tertiary, Grahamland); *N. darwini* Hutt. (Tertiary, New Zealand).
Scalaria pacifica ..	*S. lyrata* (= *browni*) Zitt. (Tertiary, New Zealand); *S. steinmanni* Mör. (Upper Senonian, Quiriquina); *S.* "*striato-costata* Müll." Stol. (Ariyalúr Group, Southern India); *S.* sp. (Upper Senonian, South Patagonia).
Cerithium inæquicostatum ..	*C. talahabense* K. Mart. (Tertiary, Java).
Arrhoges haastianus ..	*A. gregarius* O. Wilck. (Upper Senonian, South Patagonia).
Perissoptera waiparaensis ..	*P. monodactyla* O. Wilck. (Upper Senonian, South Patagonia); *P. nordenskjöldi* O. Wilck. (Upper Senonian, Grahamland); *P. marginata* Sow. sp. (Gault, England).
Conchothyra parasitica ..	? Related to *Pugnellus hauthali* (Upper Senonian, South Patagonia); "*Struthiolarella nordenskjöldi*" O. Wilck. (Tertiary, Grahamland).
Struthiolariopsis similis ..	*S. ferrieri* Phil. sp. (Upper Senonian, Quiriquina).
Protodolium speighti ..	*Dolium* sp. div. (Tertiary, Java); *Dolium galea* (living, Mediterranean Sea).
Tudicula alta	*T. cancellata* Sow. sp. (Trichinopoli Group, Southern India).
Tudicula ex. aff. *tumida* ..	*T. tumida* O. Wilck. sp. (Upper Senonian, Grahamland).
Cryptorhytis vulnerata ..	*C. philippiana* O. Wilck. (Upper Senonian, Grahamland).
Procancellaria parkiana ..	*Cancellaria asperella* Gm. (K. Mart.) (Tertiary, Java).
Eriptycha punamutica ..	*E. chilensis* d'Orb. (Upper Senonian, Quiriquina); *Cinulia pauper* O. Wilck. (Upper Senonian, South Patagonia); *Cinulia* sp. (Upper Senonian, Grahamland).
Cylichna thomsoniana ..	*C. chilensis* d'Orb. (Upper Senonian, Quiriquina).
Tubulostium ornatum ..	*T. fallax* O. Wilck. (Upper Senonian, Grahamland).

From this list the following results are to be recorded:—

(1.) The following species show relationships to forms of the Quiriquina beds of the district of Concepcion, Chile: *Natica ingrata, Scalaria pacifica, Struthiolariopsis similis, Eriptycha punamutica, Cylichna thomsoniana.*

(2.) The following species are related to forms of the Upper Senonian of Patagonia: *Arrhoges haastianus, Perissoptera waiparaensis, Conchothyra parasitica* (doubtful), *Tudicula* ex aff. *tumida, Eriptycha punamutica.*

(3.) The following species are similar to forms of the Antarctic Upper Senonian: *Pleurotomaria maoriensis, Patella ? amuritica, Perrissoptera waiparaensis, Cryptorhytis vulnerata, Eriptycha punamutica.*

(4.) The following species show resemblance to forms of the South Indian Ariyalúr Group: *Calliostoma decapitatum* (doubtful), *Natica selwyniana, N. ingrata, Tudicula alta.*

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(1) See H. Suter, Revision of the Tertiary Mollusca of New Zealand (N.Z. Geol. Surv. Pal. Bull. No. 2), p. 20. It seems that Suter was not fully convinced of the identity of these two species of *Crepidula.*

It follows that the general character of the Gastropod fauna agrees with that of other faunas of the South Pacific Upper Senonian. Nearly all genera of the Upper Senonian of South Patagonia are represented. Both in New Zealand and in Patagonia *Perissoptera* and *Arrhoges* are the most frequent Gastropods (except *Conchothyra parasitica*, a typical New Zealand form). The genus *Pugnellus* (which may be considered as related to *Conchothyra* only with much hesitation) occurs in the Quiriquina beds and in South Patagonia. The genus *Tubulostium* occurs in New Zealand as well as in Grahamland. In the latter region *Perissoptera nordenskjöldi* is a species nearly related to *P. waiparaensis*. The peculiar genus *Struthiolariopsis* occurs in the Quiriquina beds and in the Cretaceous of New Zealand, but, unfortunately, only in badly preserved specimens. *Scalaria*, *Dentalium*, and *Cinulia (Eriptycha)* are common to all four regions.

Certainly the Upper Senonian of New Zealand is distinguished by peculiar forms: *Pleurotomaria woodsi*, *Conchothyra parasitica*, *Procancellaria parkiana*, *Protodolium speighti*.

I can only endorse the results concerning the stratigraphical position of the fauna of the Upper Senonian of New Zealand obtained by Mr. Woods from the study of the Cephalopods and Lamellibranchs. The faunal relations between the Upper Senonian of New Zealand and that of Chile (district of Concepcion), South Patagonia, and Grahamland (Snow Hill, Seymour Island) are very close. As the facies of the beds here in question is that of a shallow sea, in which Gastropods and Lamellibranchs absolutely predominate—in this point the four regions mentioned also agree—one must draw the conclusion that there was a land connection between these regions(1), for there was evidently an exchange of forms. This connection, according to all we know, existed in the Antarctic; there was a coast, offering a way for the faunal exchange. I have endeavoured to show(2) that the cordillera of the South Island of New Zealand, which on the east coast of Otago is apparently transversely cut off, found its continuation in the so-called "Antarctandes" of Grahamland. I presume there was a coast following in some way the direction of this mountain-range, which was already dismembered, it is true, in Upper Senonian times, but certainly not yet entirely submerged(3). As the Upper Senonian deposits of South Patagonia and of Grahamland are found on the eastern side of the South American cordillera, the question arises whether the sea of that time covered the region of the New Zealand cordillera, or whether there was only a bay where now lies Foveaux Strait, so that the sea had access to the cordilleran region from the east; this problem cannot yet be fully solved. The purely marginal overlap of the Quiriquina beds over the Chilean coast cordillera shows that this was not quite inundated. The mode of occurrence of the Upper Senonian of South Patagonia and Grahamland seems to prove the existence of a coast in the west; but probably there was a large land-mass in the east also. This may be assumed from the Pacific character of the fauna and from the general history of the Southern Hemisphere. In any case, the Pacific in South Patagonia and in Grahamland extended to the region east of the present cordillera. This must be concluded from the Indo-Pacific character of the fauna of the Upper Senonian. If there were land in the region of the present cordillera it can only have had the form of a small peninsula, possibly like the Grahamland of to-day, and there must have been a broad gap of about the same kind as exists to-day between South America and Grahamland.

(c.) The Invertebrate Fauna of the Upper Senonian of New Zealand.

In the following list I have compiled the Molluscs discovered in the Upper Senonian of New Zealand, the Lamellibranchs and Cephalopods according to H. Woods, and the Gastropods

(1) J. A. Thomson (Diastrophic and other Considerations in Classification and Correlation, and the Existence of Minor Diastrophic Districts in the Notocene, Trans. N.Z. Inst., xlix, p. 413, 1917) says that land connections are not always essential for migration of Molluscs, as the free-swimming larvæ can cross the deep oceans in the surface currents. But in the case here in question the geological facts are also in favour of the supposed connection of New Zealand and Antarctica.

(2) O. Wilckens, Die Geologie von Neu-Seeland. Geol. Rundschau, viii, p. 161.

(3) O. Wilckens, Die Kreideformation von Neu-Seeland. Geol. Rundschau, xi, p. 189.

after C. T. Trechmann's and my own researches. The list of the Lamellibranchs is revised according to the corrections of some determinations of Mr. Woods published by me elsewhere(1).

The stratigraphical distribution of the species is marked by letters: A means Amuri Bluff; AC = calcareous conglomerate; AB = black grit; AS = Saurian beds; AG = concretionary greensands. Following the example of Mr. Woods, I classify the fossils from loc. 13 with AC, although there are among them fossils from higher strata (see p. 2). W means Waipara district; and WO = *Ostrea* bed, WS = Saurian beds, of the Waipara district. M means Malvern Hills; and MO = *Ostrea* bed, MS = Selwyn Rapids beds, of the Malvern Hills district. Furthermore, I note in parentheses the beds which have yielded forms related to those of New Zealand: Q means Quiriquina beds; P = South Patagonia; G = Grahamland; I = Ariyalúr Group of Southern India.

I. Crustacea.

Hoploparia ? MO (P).

II. Cephalopoda.

Nautilus sp. AC.
Kossmaticeras (Madrasites) haumuriense Hect. sp. AC (I).
Holcodiscus (Kossmaticeras) gemmatus Hupé. MS (Q, G).
Gaudryceras sp. ex aff. *jukesi*.
Hamites sp. AC (I).
Baculites sp. cf. *vagina* Forbes. AC (Q, I).
Belemnites lindsayi Hect. AC.

III. Gastropoda.

Pleurotomaria maoriensis O. Wilck. AC (G).
Pleurotomaria woodsi O. Wilck. AC.
Delphinula sp. AC, MS.
Calliostoma decapitatum O. Wilck. AC (I ?).
Chrysostoma selwynensis Trechm. MS.
Patella ? amuritica O. Wilck. AC (G ?).
Crepidula hochstetteriana O. Wilck. AC.
Calyptræa solitaria O. Wilck. WO.
Natica selwyniana O. Wilck. WS, MS (I, G).
Natica ingrata O. Wilck. MS (Q, P, G, I).
Scalaria pacifica O. Wilck. AC, MS (Q, P, I).
Cerithium inæquicostatum O. Wilck. AB, AS.
Arrhoges haastianus O. Wilck. WO, MS (P).
Perissoptera waiparaensis (Hect. MS.) O. Wilck. AC, AB, AS (P, G).
Perissoptera novo-seelandica O. Wilck. AC, MS (P ?).
Conchothyra parasitica (McCoy MS.) Hutt. AC, WO, MO, MS (P ?).
Struthiolariopsis similis O. Wilck. AC (Q).
Protodolium speighti Trechm. sp. AC, WS, MS.
Tudicula alta O. Wilck. AC (I).
Tudicula ex aff. *tumida* O. Wilck. WS, MS (P).
Cryptorhytis vulnerata O. Wilck. MS (G).
Procancellaria parkiana O. Wilck. AC.
Eriptycha punamutica O. Wilck. AC (Q, P, G).
Cinulia sp. WS.
Aplustrum ? selwynense Trechm. MS.
Cylichna thomsoniana O. Wilck. AC (Q).
Dentalium morganianum O. Wilck. AC, MS.

IV. Lamellibranchiata.

Nuculana amuriensis Woods. AC.
Nuculana sp. AC.
Malletia (Neilo) cymbula Woods. AC.
Barbatia mckayi Woods. AC.
Nordenskjöldia woodsi O. Wilck. WO (G).
Nordenskjöldia ("Arca") hectori Woods. WO (I).
Cucullæa zealandica. Woods. AC (G).
Pectunculus selwynensis. Woods. MS.
Pectunculus sp. AC.
Trigonia pseudocaudata Hect. AC, MO (P, I).
Trigonia hanetiana d'Orb. AC, WO, MO (Q).
Trigonia waiparaensis Woods. AC, WS, (P, G, I).
Modiola cf. *typica* Forbes. AC (I).
Modiola flagellifera Forbes. AC (I).
Dreissensia lanceolata Sow. sp. AC.
Ostrea cf. *dichotoma* Bayle. WO, MO.
Ostrea sp. AC.
Pecten (Syncyclonema) membranaceus Nilss. AC, AB, AG (G, I).
Pecten (Camptonectes) woodsi Morgan (2).
Pecten (Æquipecten) amuriensis Woods. AC.
Lima (Limatula) woodsi Suter (3). AC (G, I).
Inoceramus australis Woods. AC, AB.

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(1) O. Wilckens, Die Bivalvenfauna des Obersenons von Neu-Seeland. Centralbl. f. Min., Geol., und Pal., 1920, S. 260-65. As I have pointed out in this notice, the so-called *Trigonia pseudocaudata* must be named *T. pseudocaudata.* Afterwards I noticed that Hector in his "Catalogue" mentioned this error under "Errata."

(2) When Woods (N.Z. Geol. Surv. Pal. Bull, iv, p. 26) proposed *Pecten hectori* for this shell he overlooked a prior usage by Hutton, Cat. Tert. Moll. p. 30, 1873. Therefore I suggest *Pecten woodsi* for the Cretaceous shell.—P. G. Morgan.

(3) See *New Zealand Journal of Science and Technology*, ii, p. 59, 1919.

IV. Lamellibranchiata—*continued.*

Inoceramus steinmanni O. Wilck. AC (P).
Inoceramus sp. AC.
Pinna sp. AC, MS (P, G).
Astarte (Eriphyla) meridiana Woods. AC (1).
Astarte (Eriphyla) lenticularis Gf. sp. MS.
Anthonya elongata Woods. AC.
Lucina canterburiensis Woods. AC, AG, MS.
Tellina cf. *largillierti* d'Orb. MS (Q).
Tellina sp. MS.
Lahillia sp. MS.
Cultellus cretaceus Woods. AC.
Callista (Callistina) wilckensi Woods. AC (I, Q).
Callista (Callistina) thomsoni Woods. MS (I).
Callista sp. MS.
Dosinia sp. MS.
Dosinia sp. MS.
Cardium acuticostatum d'Orb. AC (Q).
Cardium sp. MS.
Panopœa clausa O. Wilck. AC (G).
Panopœa malvernensis Woods. MO, MS (Q).
Thracia haasti Woods. AC.
Thracia sp. WS.

V. Brachipoda.

Discina sp. AC.

VI. Annelida.

Tubulostium ornatum (Hect. sp. MS.) O. Wilck. AC (G).

The number of Crustacea is 1, with relation, perhaps, to Patagonia. The number of Cephalopoda is 7 ; relations exist—2 to Quiriquina, 1 to Grahamland, 3 to India. The number of Gastropoda is 27 ; relations exist—5 to Quiriquina, 8 to Patagonia, 7 to Grahamland, 5 to India. The number of Pelecypoda is 44 ; relations exist—6 to Quiriquina, 5 to Patagonia, 8 to Grahamland, 9 to India. The number of Brachiopoda is 1. The number of Annelida is 1, with relation to Grahamland.

On the whole, the number of invertebrate species is 81, 38 of which show no relationship to forms of the Indian and South Pacific Upper Senonian. But among these 38 species there are 13 which could only be determined generically, and not specifically.

From the preceding it becomes evident that the higher Cretaceous deposits of the north-eastern part of the South Island of New Zealand form a member of the overlapping Campanian stage of the Upper Senonian, which can be recognized on many of the coasts of the present Pacific Ocean. The fauna is of Indian - South Pacific character. Stress is to be laid upon the great number of relations to the Upper Senonian of Quiriquina, Patagonia, and Grahamland, consisting in the like petrographical character of the rocks, the like preservation of the fossils, the prevalence of Pelecypoda and Gastropoda in the fauna, the rarity of fossils other than Mollusca, the occurrence of Cephalopoda restricted to the lower beds, and the appearance of the genus *Lahillia* in the higher. The restriction of the Cephalopods to the lower beds is also recorded from the Senonian of the Pondichéry district.

The great resemblance of the faunas, in spite of the wide distances between the single occurrences, of the Upper Senonian of the Pacific region appears less puzzling if one considers the fact that the fauna in question is a Mesozoic one. Mesozoic faunas agree often to a great extent over large areas. The distance between Quiriquina and South Patagonia is 14½ degrees of latitude, or about 1,500 kilometres ; the distance between South Patagonia and Snow Hill and Seymour Island (Grahamland) is nearly the same ; and the distance from Amuri Bluff to South America is about 7,000 kilometres.

It is comprehensible that the relations of the Cretaceous of New Zealand point more to the east than to the west, for the Cretaceous is lacking on the west coast of the South Island. Probably New Zealand extended far more to the west in Upper Senonian times. Undoubtedly the sea in the youngest Cretaceous occupied a large area in the South Pacific, and its borders in the west (New Zealand) and in the east (Quiriquina, South Patagonia, Grahamland) extended far beyond its limits of to-day. In the south, according to my opinion, it was bounded by a coast far more to the north than the present coast of Antarctica.

B. THE GASTROPODA OF THE LOWER UTATÚR GROUP.

The Cretaceous deposits of the middle Clarence Valley, determined by H. Woods as Lower Utatûr Group (Vraconnian stage) have yielded only a small number of Gastropods, viz. :—

(*a.*) **Fossils of the Sawpit Gully Mudstones.**

Trochus L.

Trochus ? antipodum sp. nov. (Plate V, figs. 13, 14.)

Description.—The top-shaped shell is of medium size. The sutures are not impressed, and the sculpture is so uniformly distributed on the whorls that it is impossible to perceive the number of them, especially as the shell is covered with a matrix so solidly attached that this cannot be removed even in diminutive particles. The spire appears to consist of 3½ whorls, the whole shell of 4½. The whole surface of the shell is decorated with granulate spiral ribs. The furrows between the ribs are broader than these. On the body-whorl there are 5 ribs. The base is flattened and decorated with similar but slighter spiral ribs. The umbilicus, the aperture, and the lips are covered by the matrix. The cast shows rounded whorls.

Dimensions.—Height, 39 (31) mm. ; diameter of the base, 38 ? (30) mm.

Locality.—Sawpit Gully mudstones, Sawpit Gully, Coverham(1), about 150 ft. below the flint-beds of the Amuri limestone, 2 specimens.

Relations.—I do not know any similar forms from the Cretaceous. A certain resemblance is shown by Gastropods of the English Dogger—*e.g.*, *Amberleya (Turbo) milleri* (Wright MS.) Hudl., and *Littorina sulcata* Héb. et Desl. This Gastropod is useless for determining the age of the beds in which it occurs. A living form of similar shape and sculpture may be *Trochus annulatus* Martyn(2), and perhaps *Thalotia caffea* Gabb(3) is also related.

(*b.*) **Fossils of the Cover Creek Mudstones.**

Natica sp. (Plate V, figs. 15 *a, b.*)

A small *Natica* with low spire (thus different from *N. ingrata*). The umbilicus is covered by matrix, and therefore the determination is impossible.

Locality.—Loc. 615 (Cover Creek mudstones, Cover Creek, Coverham).

Perissoptera sp. (Plate V, fig. 16.)

The spire is of narrow-conical shape. The sutures are impressed. The whorls bear rounded nodes ; they are covered with a spiral sculpture besides. The outer lip forms a wing, which is semi-circularly sinuate above. It seems to end in a sabre-shaped digit of a form identical with that of the digit of *Perissoptera novo-seelandica.* Except for its smaller size this form greatly resembles *P. novo-seelandica.*

Localities.—Loc. 570 (conglomerate of Seymour River, Clarence Valley), 1 specimen (small fragment of one whorl) ; loc. 615 (Cover Creek mudstones, Cover Creek, Coverham), 2 imperfect specimens.

Dentalium sp.

Shell very little curved, surface not preserved. Determination impossible.

Locality.—Loc. 615 (Cover Creek mudstones, Cover Creek, Coverham), 1 specimen.

(*c.*) **Fossils of the Wharf Mudstones.**

The material contains a concretion with a bulbous surface, coming from the Wharf mudstones of Ouse River, Coverham, a quarter of a mile below the junction with the Wharf Stream(4). The roughness of the surface is caused by the protrusion of many little fossils,

(1) A sketch-map showing this locality faces page 5 of N.Z. Geol. Surv. Pal. Bull. No. 4.
(2) See L. C. Kiener, Spec. gén. et Iconogr. des coq. viv., xii, pl. 16, fig. 3.
(3) R. Arnold and R. Anderson, Geology and Oil Resources of the Santa Maria Oil District, S. Barbara Co. Calif. U.S. Geol. Surv. Bull. 322, pl. xxi, figs. 4, 5.
(4) See map facing page 5, N.Z. Geol. Surv. Pal. Bull. No. 4.

which, except a *Serpula*, are deprived of their calcareous shells. There are (1) a fragment of *Pinna*; (2) small Gastropods, probably belonging to *Turritella*; (3) a *Cinulia* (one specimen being a cast protruding far from the concretion, and a second one being an imprint showing clearly the shape and the sculpture). The interior of the concretion is crowded with diminutive Gastropod shells (*Turbo ?*, *Turritella ?*), visible only in sections.

The most frequent fossil on the surface is—

Serpula L.

Serpula wharfensis sp. nov. (Plate V, fig. 17.)

Description.—The small shell is curved, tapering at one end, with five angles, concave outer surfaces, and a circular inner cavity.

Dimensions.—Length, 8 mm. (measured in the chord of the arc); diameter, about 1·5 mm.

Locality.—Ouse River, Coverham, a quarter of a mile below junction with Wharf Stream. Wharf mudstones: numerous specimens on the surface of a concretion.

Relations.—This specimen agrees closely with *Serpula septemsulcata* Reich. and Cotta(1), which is somewhat larger and has different cross-section. *S. septemsulcata* occurs in the Saxonian Cenomanian, and is therefore of about the same age as the Cretaceous of the middle Clarence Valley (according to the determination of Woods).

C. GASTROPODA FROM HAPUKA RIVER (MARLBOROUGH) AND SHAG POINT (OTAGO).

The material sent to me contains some Gastropods from localities not mentioned in Woods's memoir. These are—

Turritella Lam.

Turritella solitaria sp. nov. (Plate V, fig. 20.)

Description.—The initial whorls are lacking in all specimens. The most perfect specimen consists of 6 whorls. The shell is narrow, turritate; the whorls are rounded, the suture is impressed. The sculpture consists of equal spiral ribs (9 on the largest whorl of a specimen). The growth-lines are very slight. Aperture not preserved.

Dimensions.—In specimens of 6·5 mm. height the diameter of the last preserved whorl is 3·5 mm.

Locality.—Loc. 293 (Hapuka River, eastern Marlborough; McKay, 1876). Note of McKay in the list of fossils of the Geological Survey (J. Hector, Director): "These beds are overlain by the Amuri limestones, and their position is therefore clearly determined." Several specimens.

Relations.—No similar *Turritella* occurs in the Senonian deposits of the South Pacific region. *Turritella nodosa* Roem.(2) from the Lower Senonian of Aachen, and the youth whorls of *T. multistriata* Reuss(2) as figured by Stoliczka(3), show a certain resemblance. Perhaps the *Turritella* sp. from the Selwyn Rapids described by Trechmann is identical with our species.

Pleurotoma Lam.

Pleurotoma otagoënsis sp. nov. (Plate V, figs. 18, 19.)

Description.—The shell is of medium size and spindle-shaped. The spire consists of 6 whorls, which are provided with a spiral keel bearing nodes. Above the keel the whorls slope gently, below they are contracted. Sutures not impressed. The body-whorl, if the long straight channel be included, is of about the same height as the spire. While the surface of the shell above the keel is decorated with fine spiral ribs, there are stronger ones below it on the last whorl. The uppermost

(1) H. B. Geinitz, Das Elbtalgebirge in Sachsen. Palæontographica, xx, p. 287, pl. 63, figs. 23, 24.
(2) E. Holzapfel, Die Mollusken der Aachener Kreide. Palæontographica, xxxiv, pl. xv, figs. 17, 18.
(3) F. Stoliczka, Cret. Fauna S. India, ii, Gastropoda, pl. xvii, figs. 10, 16.

of them protrudes keel-like. The aperture and the slit are not preserved. The growth-lines recurve strongly near the keel.

Dimensions.—Height, about 35 mm.; diameter of last whorl, 14 mm.

Locality.—Loc. 320 (Shag Point, Otago; Hector, 1865); a piece of rock with about a dozen specimens.

Relations.—*Pleurotoma* already appears in the Cretaceous, and is widely spread in the Tertiary. Therefore this Gastropod cannot be used for the determination of the age of the beds in which it occurs. A similar form is *Pl. subæqualis* Sow.(1), of the Patagonian Tertiary; but in the latter species there are two spiral ribs below the noded keel, which are much stronger developed than in *Pl. otagoënsis.* Hector has designated the beds from which this shell comes as Cretaceo-Tertiary; and these beds, in general, are really of Upper Senonian age.

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INDEXES.

I. GENERA AND SPECIES.

(The species described in this bulletin are in heavy type, the synonyms in italics.)

H.

I.

J.

K.

L.

M.

N.

O.

P.

Q.

R.

II. LOCALITIES AND GENERAL.

PLATES.

PLATE 1.

(The figures are of natural size.)

FOSSILS FROM THE UPPER SENONIAN.

Fig. 1. *Pleurotomaria maoriensis* sp. nov. Calcareous conglomerate, Amuri Group, east wing, Amuri Bluff. Cast, with fragments of the shell. (Page 2.)

Fig. 2. *Pleurotomaria maoriensis* sp. nov. Amuri Group, west wing, Amuri Bluff (loc. 13). Basal view. (Page 2.)

Fig. 3. *Pleurotomaria woodsi* sp. nov. Calcareous conglomerate, east wing, Amuri Bluff. (Page 4.)

Fig. 4. *Pleurotomaria woodsi* sp. nov. Calcareous conglomerate, east wing, Amuri Bluff. (Page 4.)

Fig. 5. *Delphinula ?* sp. Amuri Group, west wing, Amuri Bluff (loc. 13). 5*a*, ventral view; 5*b*, dorsal view of 5*a*; 5*c*, apical view of 5*a*. (Page 4.)

Fig. 6. *Calliostoma decapitatum* sp. nov. Calcareous conglomerate, Oaro Creek, west wing, Amuri Bluff (loc. 14). 6*b*, basal view of 6*a*. (Page 4.)

Fig. 7. *Calliostoma decapitatum* sp. nov. Calcareous conglomerate, Oaro Creek, west wing, Amuri Bluff (loc. 14). Cast. 7*b*, basal view of 7*a*. (Page 4.)

Fig. 8. *Patella ? amuritica* sp. nov. Amuri Group, west wing, Amuri Bluff (loc. 13). (Page 5.)

Fig. 9. *Crepidula hochstetteriana* sp. nov. Amuri Group, west wing, Amuri Bluff (loc. 13). Cast. 9*b*, lateral view of 9*a*. (Page 5.)

Fig. 10. *Calyptræa solitaria* sp. nov. Upper Waipara Gorge and Boby's Creek, Waipara. Cast (Page 6.)

PL. I.

R. SCHILLING ET A. BIRKMAIER. DEL.

London Stereoscopic Co. imp.

Cretaceous Gastropoda

PLATE II.

(The figures are of natural size, unless the amount of enlargement is stated.)

Fossils from the Upper Senonian.

Fig. 1. *Natica selwyniana* sp. nov. Selwyn Rapid beds, Selwyn River, Malvern Hills. 1*a*, ventral view; 1*b*, dorsal view of 1*a*. (Page 6.)

Fig. 2. *Natica ingrata* sp. nov. Selwyn Rapids beds, Selwyn River, Malvern Hills. 2*a*, ventral view; 2*b*, dorsal view; 2*c*, apical view. (Page 7.)

Fig. 3. *Scalaria pacifica* sp. nov. Amuri Group, west wing, Amuri Bluff (loc. 13). (Page 8.)

Fig. 4. *Cerithium inæquicostatum* sp. nov. Boulder-sands, Saurian beds, east wing, Amuri Bluff. (Page 8.)

Fig. 5. *Arrhoges haastianus* sp. nov. Selwyn Rapids beds, Selwyn River, Malvern Hills. 5*a*, dorsal view; 5*b*, ventral view. (Page 9.)

Fig. 6. *Arrhoges haastianus* sp. nov. McKay's Creek, Middle Waipara. Ventral view. (Page 9.)

Fig. 7. *Arrhoges haastianus* sp. nov. Selwyn Rapids beds, Selwyn River. (Page 9.)

Fig. 8. *Perissoptera waiparaensis* (Hect. MS. sp.) O. Wilck. Boulder-sands, Saurian beds, east wing, Amuri Bluff. Sculptured case. Hector's holotype. (Page 11.)

Fig. 9. *Perissoptera waiparaensis* (Hect. MS. sp.) O. Wilck. Boulder-sands, Saurian beds, east wing, Amuri Bluff. (Page 11.)

Fig. 10. *Perissoptera novo-seelandica* sp. nov. Amuri Group, west wing, Amuri Bluff (loc. 13). Dorsal view of an imperfect specimen (without wing). (Page 13.)

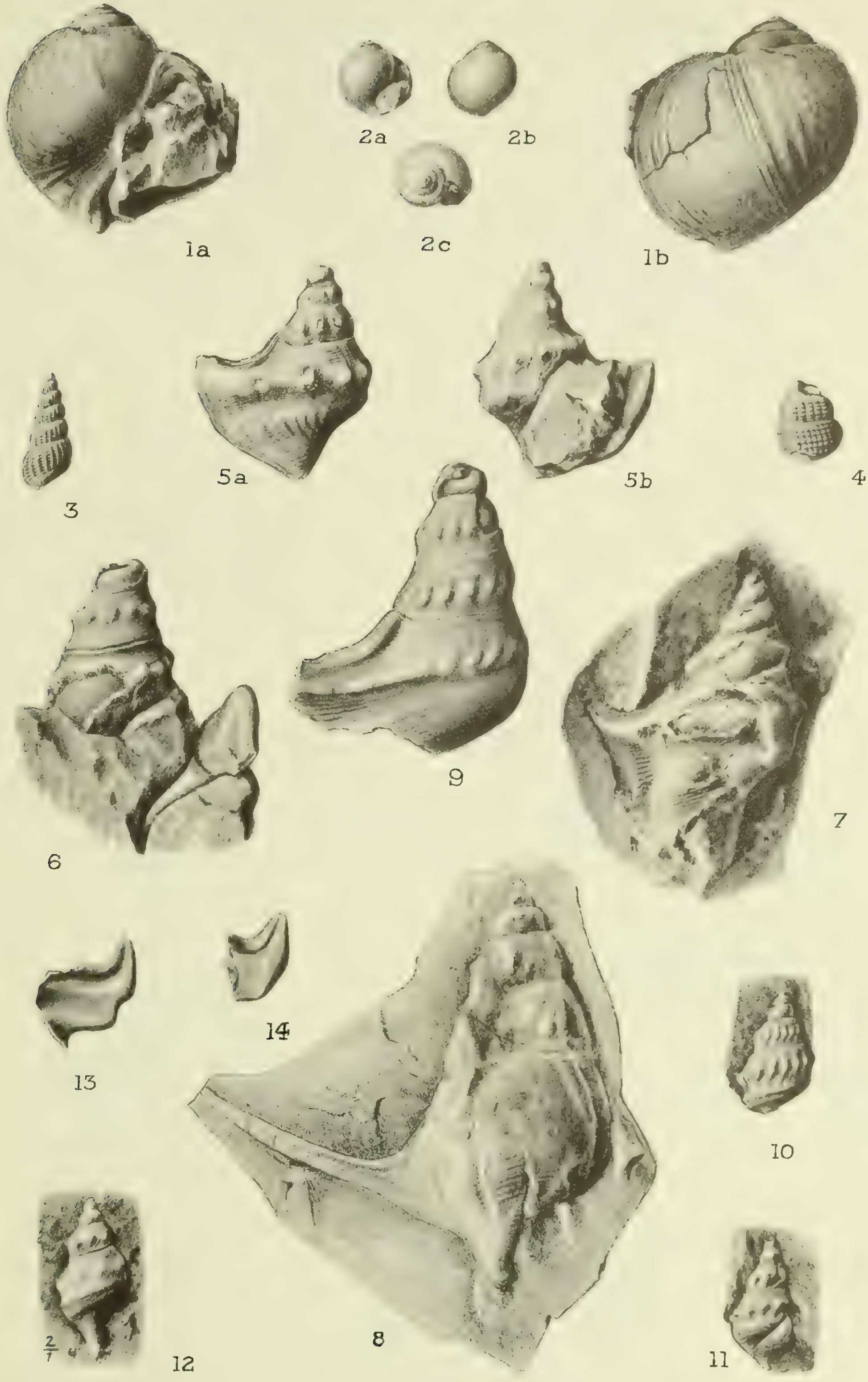
Fig. 11. *Perissoptera novo-seelandica* sp. nov. Amuri Group, west wing, Amuri Bluff (loc. 13). Ventral view of an imperfect specimen (without wing). (Page 13.)

Fig. 12. *Perissoptera novo-seelandica* sp. nov. Amuri Group, west wing, Amuri Bluff (loc. 13). Dorsal view of an imperfect young specimen; × 2. (Page 13.)

Fig. 13. *Perissoptera novo-seelandica* sp. nov. Amuri Group, west wing, Amuri Bluff (loc. 13). Inner view of the wing of the outer lip. (Page 13.)

Fig. 14. *Perissoptera novo-seelandica* sp. nov. Amuri Group, west wing, Amuri Bluff (loc. 13). Inner view of the wing of the outer lip. (Page 13.) Note.—On the plate, "17" is printed in mistake for "14."

PL. II.



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Cretaceous Gastropoda.

PLATE III.

(The figures are of natural size.)

Fossils from the Upper Senonian.

Fig. 1. *Conchothyra parasitica* (McCoy MS.) Hutt. Selwyn Rapids beds, Selwyn River, Malvern Hills. Largest specimen. 1*a*, dorsal view ; 1*b*, ventral view. (Page 14.)

Fig. 2. *Conchothyra parasitica* (McCoy MS.) Hutt. Selwyn Rapids beds, Selwyn River, Malvern Hills. 2*a*, dorsal view ; 2*b*, ventral view ; 2*c*, apical view ; 2*d*, frontal view, of the same specimen. (Page 14.)

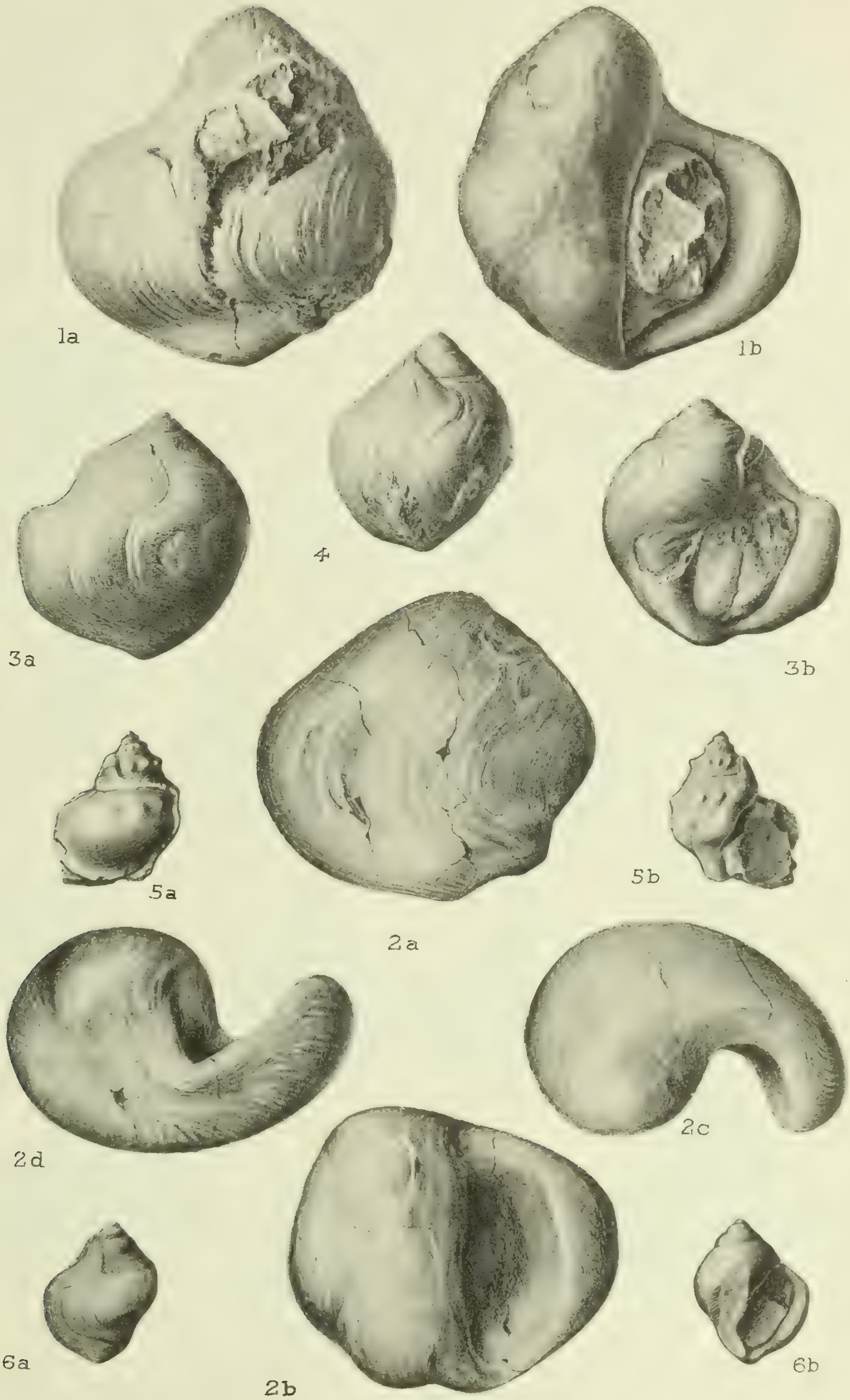
Fig. 3. *Conchothyra parasitica* (McCoy MS.) Hutt. *Ostrea* bed, Upper Waipara Gorge and Boby's Creek. 3*a*, dorsal view ; 3*b*, ventral view, of a younger specimen. (Page 14.)

Fig. 4. *Conchothyra parasitica* (McCoy MS.) Hutt. *Ostrea* bed, Upper Waipara Gorge and Boby's Creek. Dorsal view. (Page 14.)

Fig. 5. *Conchothyra parasitica* (McCoy MS.) Hutt. Selwyn Rapids beds, Selwyn River, Malvern Hills. Young specimen. 5*a*, dorsal view ; 5*b*, ventral view. (Page 14.)

Fig. 6. *Conchothyra parasitica* (McCoy MS.) Hutt. Selwyn Rapids beds, Selwyn River, Malvern Hills. Young specimen. 6*a*, dorsal view ; 6*b*, ventral view. (Page 14.)

PL. III.



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Cretaceous Gastropoda.

PLATE IV.

(The figures are of natural size, unless the amount of enlargement is stated.)

Fossils from the Upper Senonian.

Fig. 1. *Conchothyra parasitica* (McCoy MS.) Hutt. Selwyn Rapids beds, Selwyn River, Malvern Hills. 1*a*, ventral view; 1*b*, dorsal view; 1*c*, apical view, of a young specimen. (Page 14.)

Fig. 2. *Conchothyra parasitica* (McCoy MS.) Hutt. Selwyn Rapids beds, Selwyn River, Malvern Hills. 2*a*, ventral view; 2*b*, dorsal view, of a young specimen; × 2. (Page 14.)

Fig. 3. *Protodolium speighti* Trechm. sp. Selwyn Rapids beds, Selwyn River, Malvern Hills. 3*a*, dorsal view; 3*b*, lateral view. (Page 18.)

Fig. 4. *Protodolium speighti* Trechm. sp. Selwyn Rapids beds, Selwyn River, Malvern Hills. 4*a*, dorsal view; 4*b*, ventral view, of a young specimen; × 2. (Page 18.)

Fig. 5. *Protodolium speighti* Trechm. sp. Selwyn Rapids beds, Selwyn River, Malvern Hills. Internal cast. (Page 18.)

Fig. 6. *Struthiolariopsis similis* sp. nov. Amuri Group, west wing, Amuri Bluff (loc. 13). (Page 17.)

Fig. 7. *Tudicula alta* sp. nov. Amuri Group, west wing, Amuri Bluff (loc. 13). Dorsal view of a young specimen. (Page 20.)

Fig. 8. *Tudicula alta* sp. nov. Amuri Group, west wing, Amuri Bluff (loc. 13). Dorsal view of a young specimen; × 2. (Page 20.)

Fig. 9. *Tudicula alta* sp. nov. Amuri Group, west wing, Amuri Bluff (loc. 13). Internal cast. 9*a*, apical view; 9*b*, ventral view. (Page 20.)

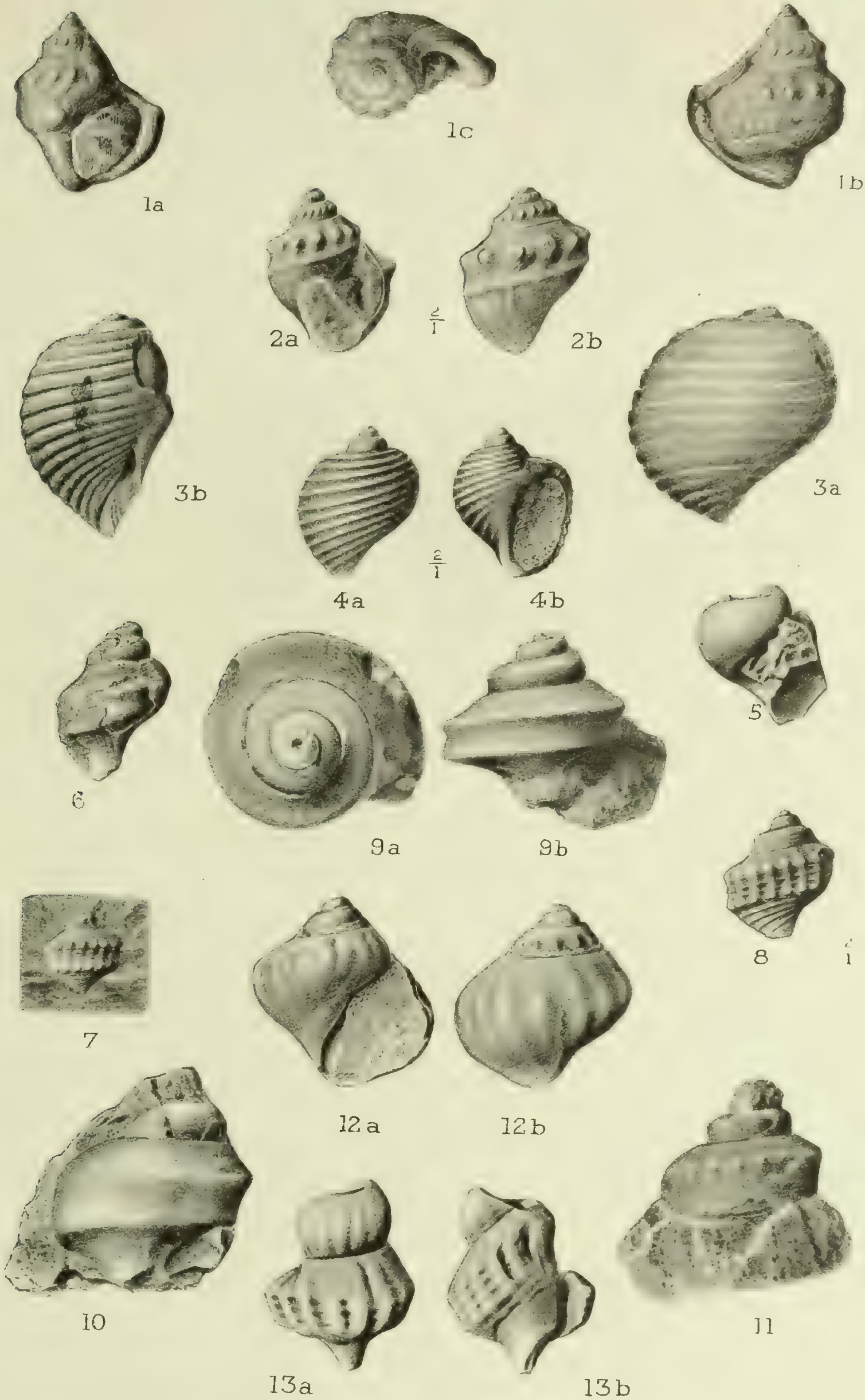
Fig. 10. *Tudicula alta* sp. nov. Amuri Group, west wing, Amuri Bluff (loc. 13). Internal cast: dorsal view. (Page 20.)

Fig. 11. *Tudicula alta* sp. nov. Amuri Group, west wing, Amuri Bluff (loc. 13). (Page 20.)

Fig. 12. *Tudicula* cf. *tumida* O. Wilck. Selwyn Rapids beds, Selwyn River, Malvern Hills. 12*a*, ventral view; 12*b*, dorsal view. (Page 20.)

Fig. 13. *Cryptorhytis vulnerata* sp. nov. Selwyn Rapids beds, Selwyn River, Malvern Hills. 13*a*, dorsal view; 13*b*, ventral view. (Page 21.)

PL. IV.



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Cretaceous Gastropoda

PLATE V.

(The figures are of natural size, unless the amount of enlargement is stated.)

Fossils from the Upper Senonian.

Fig. 1. *Procancellaria parkiana* sp. nov. Amuri Group, west wing, Amuri Bluff (loc. 13). Dorsal view; × 2. The small figure to the left indicates the natural size, and a damage omitted in the enlarged figure. (Page 21.)

Fig. 2. *Procancellaria parkiana* sp. nov. Amuri Group, west wing, Amuri Bluff (loc. 13). Ventral view. (Page 21.)

Fig. 3. *Conus* sp. Boulder-sands, Saurian beds, east wing, Amuri Bluff. (Page 23.)

Fig. 4. Gen. and sp. indetermin. Selwyn Rapids beds, Selwyn River.

Fig. 5. *Eriptycha punamutica* sp. nov. Amuri Group, west wing, Amuri Bluff (loc. 13). 5*a*, dorsal view; 5*b*, ventral view; 5*c*, apical view; × 3. (Page 23.)

Fig. 6. *Cylichna thomsoniana* sp. nov. Amuri Group, west wing, Amuri Bluff (loc. 13). (Page 24.)

Fig. 7. *Cylichna thomsoniana* sp. nov. Amuri Group, west wing, Amuri Bluff (loc. 13). (Page 24.)

Fig. 8. *Dentalium morganianum* sp. nov. Calcareous conglomerate, east wing, Amuri Bluff. (Page 24.)

Fig. 9. *Dentalium morganianum* sp. nov. Amuri Group, west wing, Amuri Bluff (loc. 13). (Page 24.)

Fig. 10. *Tubulostium ornatum* (Hect. MS. sp.) O. Wilck. Amuri Group, west wing, Amuri Bluff (loc. 13). 10*a*, basal view; 10*b*, apical view; 10*c*, lateral view, of the same specimen. (Page 25.)

Fig. 11. *Tubulostium ornatum* (Hect. MS. sp.) O. Wilck. Amuri Group, west wing, Amuri Bluff (loc. 13). Two young specimens. Chirotypes of Hector. (Page 25.)

Fig. 12. *Tubulostium ornatum* (Hect. MS. sp.) O. Wilck. Amuri Group, west wing, Amuri Bluff (loc. 13). Natural vertical section. (Page 25.)

Fossils from the Lower Utatúrian.

Fig. 13. *Trochus antipodum* sp. nov. Sawpit Gully mudstones, Sawpit Gully, Coverham. (Page 34.)

Fig. 14. *Trochus antipodum* sp. nov. Sawpit Gully mudstones, Sawpit Gully, Coverham. (Page 34.)

Fig. 15. *Natica* sp. Cover Creek mudstones, Cover Creek, Coverham. 15*a*, dorsal view; 15*b*, ventral view. (Page 34.)

Fig. 16. *Perissoptera* sp. Cover Creek mudstones, Cover Creek, Coverham. (Page 34.)

Fig. 17. *Serpula wharfensis* sp. nov. Wharf mudstones, Ouse River, Coverham, a quarter of a mile below junction with Wharf Stream. Several specimens. To the left, cross-section of shell; × 2. (Page 35.)

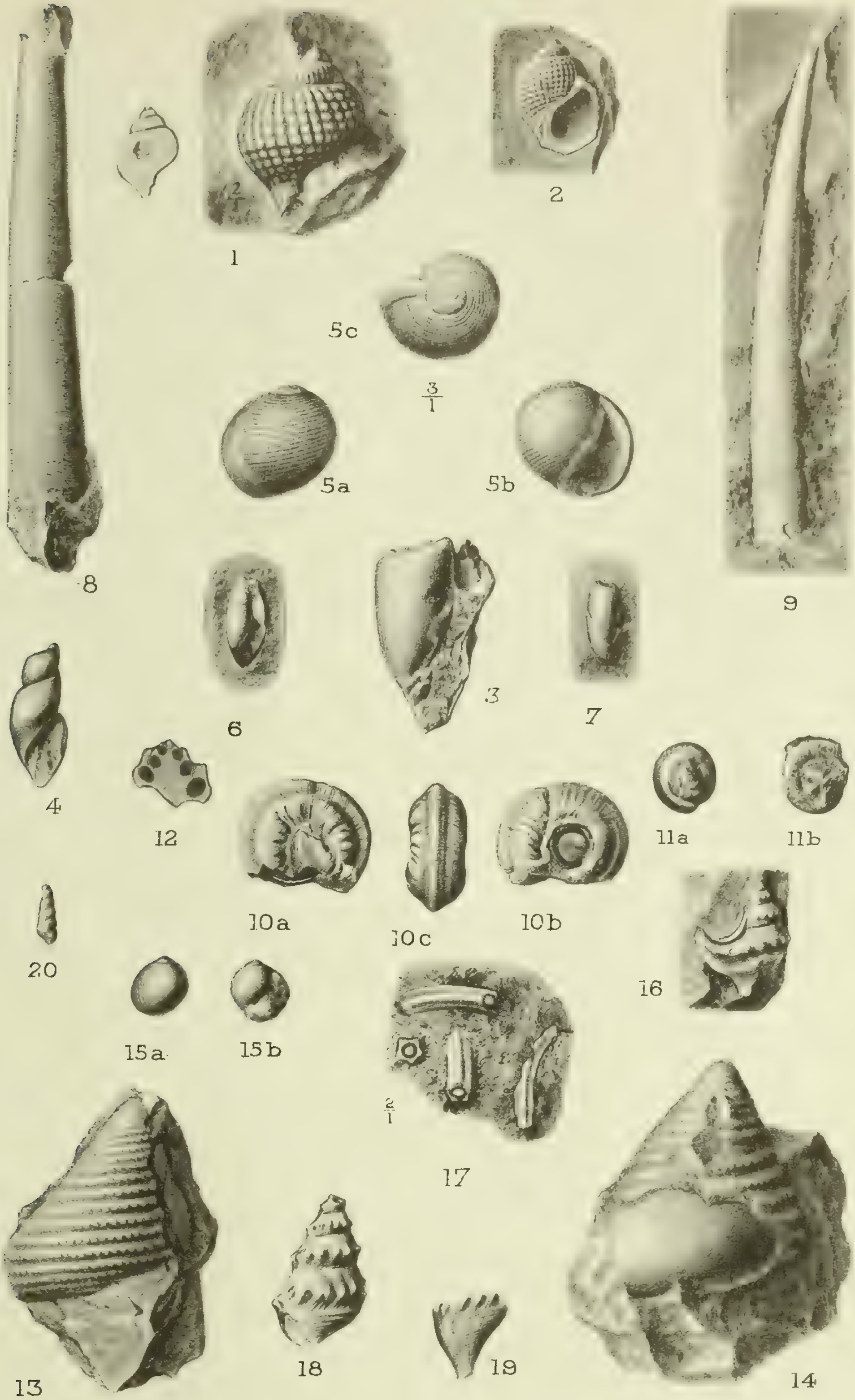
Fossils of Doubtful Age, but probably Upper Cretaceous.

Fig. 18. *Pleurotoma otagoënsis* sp. nov. Shag Point, Otago. Dorsal view of the upper portion of a shell. (Page 35.)

Fig. 19. *Pleurotoma otagoënsis* sp. nov. Shag Point, Otago. Lower portion of a shell. (Page 35.)

Fig. 20. *Turritella solitaria* sp. nov. Hapuka River, Eastern Marlborough. (Page 35.)

PL. V.



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NEW ZEALAND.

Department of Mines.

GEOLOGICAL SURVEY BRANCH.

(P. G. MORGAN, Director.)

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THE UPPER CRETACEOUS GASTROPODS OF NEW ZEALAND.

BY

OTTO WILCKENS, Ph.D.,

Formerly Professor of Geology and Palæontology and Director of the Geological and Palæontological Institute of the University of Strassburg, now of Bonn University.

Translated into English by the Author.

ISSUED UNDER THE AUTHORITY OF THE HON. G. J. ANDERSON, MINISTER OF MINES.

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