NEW ZEALAND.

Department of Mines.

GEOLOGICAL SURVEY BRANCH.

(P. G. MORGAN, Director.)

PALÆONTOLOGICAL BULLETIN No. 9.

THE UPPER CRETACEOUS GASTROPODS OF NEW ZEALAND.

BY

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TRANSLATED INTO ENGLISH BY THE AUTHOR.

ISSUED UNDER THE AUTHORITY OF THE HON. G. J. ANDERSON, MINISTER OF MINES.

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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.

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DIRECTOR.
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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 Ariyalûr 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 *Pleurotomariæ*(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 $2\frac{1}{2}$ 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 younger 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.

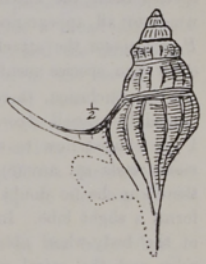

FIG. 1.—Hector's figure of *Perissoptera waiparaensis*.

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).

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-whorl, 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.

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(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 Magellänslandern, 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.

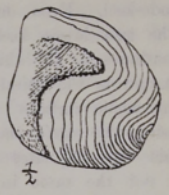

Fig. 2.—Hector's figure of *Conchothyra parasitica*.

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*.

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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 3¼ 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 3½ 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 ? cerlicalis* 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 $2\frac{1}{2}$–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 3½–4 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).

(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.*

(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.

(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 (I).
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.
Panopæa clausa O. Wilck. AC (G).
Panopæa 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 Utatúr 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 $3\frac{1}{2}$ whorls, the whole shell of $4\frac{1}{2}$. 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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(1) A. E. Ortmann, Tertiary Invertebrates. Rep. Princeton Univ. Exp. to Patagonia, iv, p. 238, pl. xxxvi, fig. 6.

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PL. I.

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(The figures are of natural size, unless the amount of enlargement is stated.)

FOSSILS FROM THE UPPER SENONIAN.

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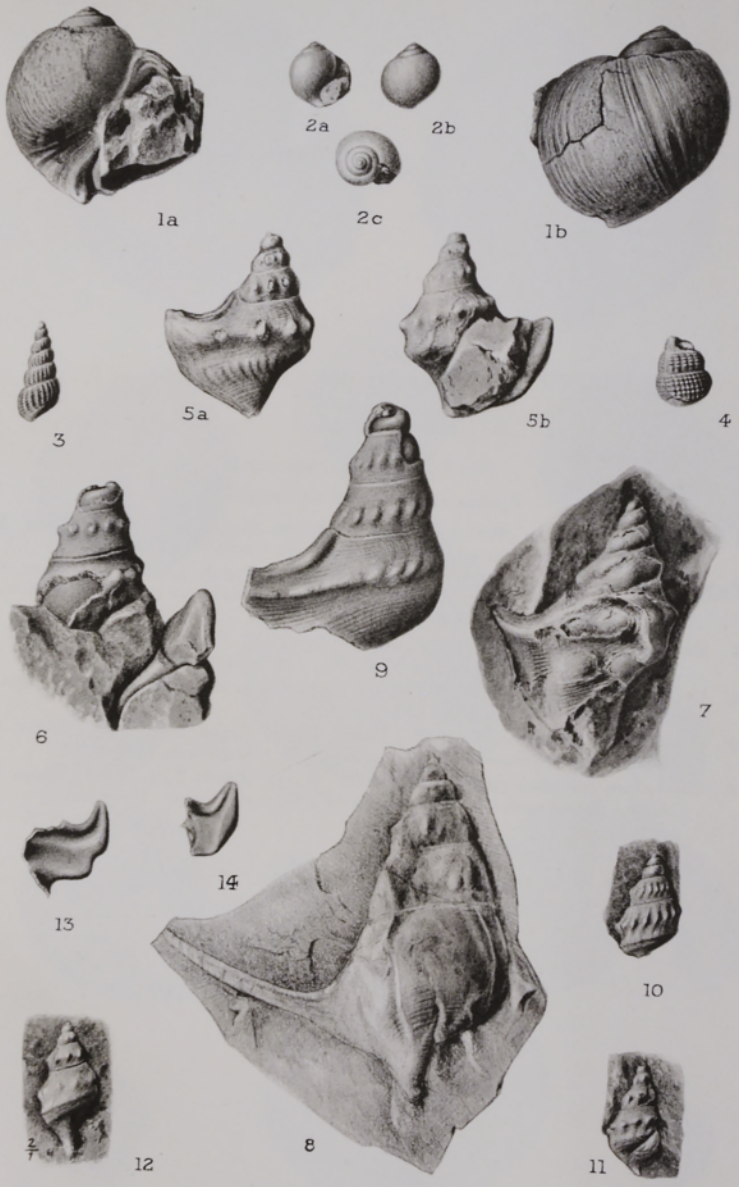

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(The figures are of natural size.)

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PL. III.

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(The figures are of natural size, unless the amount of enlargement is stated.)

FOSSILS FROM THE UPPER SENONIAN.

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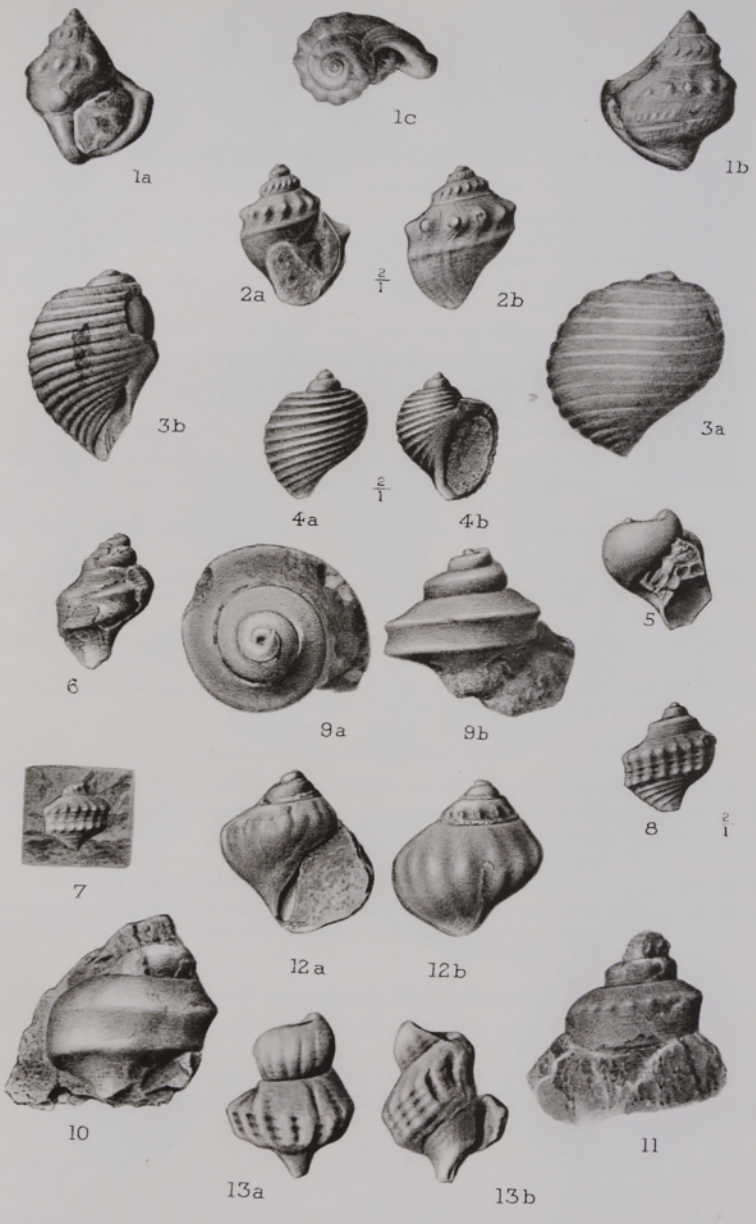

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(The figures are of natural size, unless the amount of enlargement is stated.)

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