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CONTENTS.

BOTANY.

ETHNOLOGY.

PALAEONTOLOGY.

ZOOLOGY.

New Species of Lepidoptera

in the

Collection of the Auckland Museum.

By ALFRED PHILPOTT, Hon. Entomologist.

The material on which the following article is based was derived almost entirely from the Chas. E. Clarke collection, recently presented to the Museum. It is fitting, therefore, that a very sincere note of appreciation of Mr. Clarke's generous action should be here inserted. The present contribution in no way exhausts the novelties in the collection, and more new species will undoubtedly be brought to light as the result of further study.

NOCTUIDAE.

Melanchra dives n. sp.

♂ ♀. 42-47 mm. Head, thorax and palpi dark reddish brown, darker in ♀ ; a small blunt anterior thoracic crest. Antennae reddish brown, rather strongly bipectinated in ♂. Abdomen greyish brown, lateral and apical tufts ferruginous. Legs reddish brown, tibiae obscurely annulated with ochreous. Forewings moderate, costa almost straight, apex obtuse, termen bowed, oblique; dark purplish brown, darker in ♀ ; a short black streak from middle of base, absent (?) in ♀ and not always present in ♂ ; traces of a double pale-centred basal line; first line obscure, thin, irregularly curved, blackish; orbicular moderately large, oblique, broadly oval, margined with ochreous and again obscurely with blackish; claviform normal shape, margined as orbicular; reniform moderately broad, partly filled with ochreous in ♂, margined as obicular; second line very obscure, waved, pale with dark margin, incurved beneath reniform; subterminal thin, waved, ochreous, suffusedly black-margined before and behind, two blunt teeth below middle; a few minute ochreous spots on apical third of costa: fringes concolorous with wing. Hindwings greyish brown: fringes whitish tipped.

Related to *M. insignis* Walk., but a larger and generally darker species. The female seems to be fairly stable in colour and markings, but the male varies a good deal. One example has the forewings bright ferruginous, while in another they are suffused with fawn.

Flagstaff Hill and Waitati, Dunedin, in October. A good series of both sexes taken by Mr. C. E. Clarke. Holotype (♂), allotype (♀) and paratypes in coll. Auckland Museum.

SELIDOSEMIDAE

Selidosema insignita n. sp.

♂. 32 mm. Head and palpi brown. Thorax greyish brown. Antennae brown, in ♂ moderately bipectinated, pectinations gradually decreasing in length apically, last twelve or thirteen segments simple. Abdomen greyish ochreous, sprinkled with fuscous. Legs ochreous, mixed with fuscous, anterior pair blackish, all tarsi annulated with ochreous. Forewings elongate triangular, costa moderately arched, apex blunt, termen bowed, oblique; whitish ochreous; basal 3/5 fuscous brown; first line indicated by ochreous outwards-curved fascia on costa at 1/4; outer edge of median band (margin of dark area) broadly and strongly projecting at middle, margined with white; a broad brownish terminal area including obscure white waved subterminal line: fringes (damaged) apparently brown mixed with ochreous. Hindwings pale ochreous sparsely sprinkled with brown; an interrupted brown line round termen: fringes ochreous.

The shape of the outer margin of the median band differs from all other New Zealand members of the genus.

Kaeo, in January. A single male taken by Mr. C. E. Clarke. Holotype in coll. Auckland Museum.

Selidosema pergrata n. sp.

♂. 32 mm. Head ochreous brown. Palpi brown. Antennae brown, in ♂ moderately bipectinated, pectinations abruptly shortened towards apex, last ten segments simple. Thorax and abdomen brownish ochreous. Legs ochreous, anterior pair fuscous; tibiae and tarsi annulated with ochreous. Forewings elongate triangular, costa hardly arched, apex obtuse, termen little bowed, oblique; brownish ochreous, densely strigulated with fuscous; first line straight, thin, whitish, from 1/4 costa to 1/3 dorsum; second line thin, whitish, from 2/3 costa to 3/5 dorsum, slightly indented on upper half and deeply incurved on lower 1/3; these two lines margin the median band, which is olive brown densely strigulated with ochreous; subterminal line whitish, waved, interrupted, anteriorly suffusedly margined with olive brown; a suffused olive brown patch beneath apex: fringes ochreous with medium dark line. Hindwings ochreous, strigulated with fuscous, especially towards termen: fringes ochreous mixed with fuscous.

This species belongs to the *productata* group. It is probably related to the preceding form, but the difference in antennal structure at once separates it.

Sandymount, Otago, in February. A single ♂ taken by Mr. C. E. Clarke. Holotype in coll. Auckland Museum.

CRAMBIDAE

Tauroscopa nebulosa n. sp.

♂ ♀. 24-25 mm. Head and palpi tawny black, in ♀ head ochreous and palpi ochreous internally. Antennae sooty black. Thorax tawny black; in ♀ sprinkled with whitish. Abdomen black, laterally and apically mixed with whitish ochreous. Legs black, more or less mixed with ochreous. Forewings oblong, costa slightly arched basally; apex subrectangular, termen rounded, hardly oblique; brownish black; densely but irregularly strewn with white: slightly ochreous-tinted towards apical half of costa; first line represented by clear black marks on costa and middle of wing: fringes greyish fuscous with dark basal line. Hindwings greyish fuscous, paler towards base: fringes whitish grey with prominent fuscous basal line.

Perhaps nearest *T. gorgopis* Meyr., but narrower-winged and differing in the presence of the white irroration and obsolescence of the usual lines.

Minaret Peak, lake Wanaka, in December. Two males and a female taken by Mr. C. E. Clarke. Holotype (♂), allotype (♀) and a male paratype in coll. Auckland Museum.

Orocrambus clarkei n. sp.

♂. 20 mm. Head, antennae and palpi brownish black, crown and upper surface of palpi more or less ochreous. Thorax tawny. Abdomen brownish black, anal tuft greyish. Legs brownish black, somewhat mixed with ochreous. Forewings suboblong; costa slightly arched, apex triangular, termen bowed, hardly oblique; brownish black, densely but irregularly strewn with white scales: fringes greyish fuscous, with darker basal line. Hindwings white; a broad suffused irregular band of fuscous round termen and dorsum: fringes greyish fuscous tipped with white and with a dark basal line.

Nearest to *O. melampetrus* Meyr., but a smaller and paler species.

Mt. Moltke, Franz Josef, 4,000 to 5,000 feet, in January. Two males taken by Mr. C. E. Clarke. Holotype (♂) and a male paratype in coll. Auckland Museum.

PYRAUSTIDAE

Scoparia famularis n. sp.

♀. 21 mm. Head yellow, mixed with fuscous and whitish. Palpi fuscous, whitish above and beneath. Maxillary palpi ochreous. Antennae fuscous black. Thorax fuscous mixed with ochreous and whitish. Legs fuscous mixed with whitish, tarsi annulated with whitish. Forewings moderate, costa subsinuate, apex rectangular, termen straight, slightly oblique; fuscous densely irrorated with yellow and with some white scales; a small roundish white patch on dorsum near base; first line slightly curved, outwardly oblique, broad, white; orbicular dark, obscure, followed by whitish patch; claviform large, dark, oval, preceded and followed by some whitish suffusion; reniform indicated by obscure dark patch, followed by whitish area; second line strong, white, subsinuate on upper third, thence incurved to dorsum; a white suffused subterminal line, indented at middle, not touching second line: fringes whitish ochreous with fuscous basal line. Hindwings greyish ochreous; broadly fuscous-tinged round termen; fringes ochreous with an obscure thin fuscous fuscous basal line.

Near *S. nomeutis* Meyr., but with prominent broad lines; the second line is also quite different in shape in *famularis*.

Kepler Mountains, Lake Te Anau. A single female taken in January at an elevation of 3,000 feet by Mr. Clarke. Holotype (♀) in collection Auckland Museum.

TORTRICIDAE

Pyrgotis modesta n. sp.

♂. 13 mm. Head and palpi brown. Antennae fuscous brown, ciliations in ♂ 2. Thorax and abdomen bronzy brown. Legs ochreous irrorated with fuscous, anterior pair wholly fuscous. Forewings elongate, costa strongly arched, apex rounded, termen nearly straight, oblique, rounded beneath; bronzy brown; slightly reddish tinged in disc; an indistinct dark fuscous shade round termen: fringes greyish fuscous with fuscous basal line. Hindwings fuscous: fringes greyish fuscous with dark basal line.

Nearest *P. consentiens* Philp., but a duller species with longer antennal pectinations.

Waiho Gorge, Westland, in January. A single male taken by Mr. C. E. Clarke. Holotype (♂) in coll. Auckland Museum.

P. humilis n. sp.

♂. 12 mm. Head and thorax brown mixed with ochreous. Palpi ochreous. Antennae ochreous annulated with black, ciliations in ♂ 1½. Abdomen bronzy fuscous. Legs fuscous mixed with ochreous. Forewings elongate, costa strongly arched, apex rounded, termen subsinuate, oblique; bright ochreous; suffusedly purplish fuscous towards termen: fringes ochreous mixed with fuscous. Hindwings fuscous: fringes fuscous tipped with ochreous and with a darker basal line.

Nearest to the preceding, but easily separated by the antennal characters.

Mount Maungatua, Otago, in December. A single male taken by Mr. C. E. Clarke. Holotype (♂) in coll. Auckland Museum.

Capua variegata n. sp.

♂. 14-15 mm. Head, palpi and thorax grey mixed with brown. Antennae ochreous, annulated with black, ciliations in ♂ 1/2. Abdomen ochreous grey. Legs ochreous, anterior pair fuscous annulated with ochreous. Forewings elongate triangular, costa moderately arched, termen subsinuate, oblique; white; markings ferruginous mixed with ochreous; basal fascia running from 1/6 costa to 1/2 dorsum; its outer margin very irregular; a moderately broad fascia from 1/3 costa to before dorsum, interrupted above and below middle; a very broad fascia on apical third, its outer margin separated from termen by narrow strip of white; near its anterior margin is a blackish spot followed by a dot of white; space between basal and terminal fasciae crossed by several interrupted strigulae, usually forming dark spots on costa and dorsum: fringes grey, tips paler. Hindwings greyish fuscous: fringes fuscous grey with obscure dark basal line.

Approaches *P. plagiatana* Walk., but has not the pronouncedly sinuate termen of the forewing of that species, and the antennal pectinations are shorter.

Wairakei in December and Whangarei in January. Two males taken by Mr. C. E. Clarke. Holotype (♂) and a male paratype in coll. Auckland Museum.

Epichorista mimica n. sp.

♂. 14-15 mm. Head, palpi and thorax grey mixed with brown. Antennae grey annulated with black, ciliations in ♂ 1½. Abdomen grey mixed with whitish ochreous. Legs ochreous, anterior pair infuscated, tarsi annulated with ochreous. Forewings elongate, suboblong, costa arched basally, thence almost straight, apex rounded, termen bowed, oblique; white, densely irrorated with pale fuscous and ochreous; markings blackish fuscous mixed with ferruginous; basal patch, including three interrupted fasciae, marked by spots on costa, outer margin indented on fold, where it is strongly marked in blackish; a broad irregular fascia from middle of costa, becoming obscure below middle and not reaching dorsum; four spots on costa between median fascia and apex, giving rise to obscure fasciae which coalesce in disc: fringes grey, basally brownish. Hindwings greyish fuscous, paler towards costa: fringes whitish grey with fuscous basal line.

Not superficially near any other *Epichorista*; the species might be taken at a first glance for a pale specimen of *Spilonota ejectana* Walk.

Mt. Ida, in February. Two males taken by Mr. C. E. Clarke. One of these is very indefinitely marked, the fasciae being reduced to a series of dots. Holotype (♂) in coll. Auckland Museum.

Tortrix clarkei n. sp.

♂ ♀. 20-25 mm. Head and thorax purplish grey, in ♀ ferruginous-tinged. Palpi rather long, purplish grey. Antennae ochreous annulated with blackish, ciliations in ♂ 3/4. Abdomen ochreous. Legs ochreous, anterior pair reddish brown. Forewings with costa moderately arched, subsinuate, apex pointed, termen markedly sinuate, hardly oblique; purplish grey;

markings dark reddish brown on margins, passing into dark purplish grey within and being narrowly margined with ochreous; a basal patch from 1/6 of costa, thence broadly and triangularly projecting to fold, after which it runs very obliquely to dorsum at 3/4 where it coalesces with inner margin of median fascia; a broad fascia from before middle of costa to tornus, its anterior margin sinuate beneath costa and its posterior margin straight; a fascia beyond middle represented by straight anterior margin only: fringes ochreous, ferruginous-tinged. Hindwings greyish white, obscurely mottled with brown: fringes greyish white faintly tinged with purplish.

Nearest to *T. orthocopa* Meyr., but at once distinguished by the form of basal patch.

Waimarino, in January. Three males and a female captured by Mr. C. E. Clarke. Holotype (♂), allotype (♀) and paratypes in coll. Auckland Museum.

T. indomita n. sp.

♂. 19 mm. Head, palpi and thorax dull ochreous, sprinkled with fuscous. Antennae ochreous annulated with fuscous, ciliations in ♂ 2. Abdomen ochreous mixed with brown. Legs ochreous mixed with brown, anterior pair infuscated, tarsi narrowly annulated with ochreous. Forewings with moderate costal fold, costa rather strongly arched, apex rectangular, termen subsinuate, slightly oblique; dull ochreous, springled and strigulated, especially towards termen, with brown; costal fold mixed with brown; a dark brown patch on costa, commencing before 1/3 and extending nearly to apex, its anterior margin running obliquely to middle of wing, thence almost straight to costa before apex; beneath this patch, at about half its length, and touching it, is an obscure and irregular brown blotch; an interrupted brown line round termen; fringes whitish ochreous. Hindwings ochreous, densely mottled with brown, especially towards termen: fringes whitish ochreous with dark basal line.

The type of marking approaches that of *T. orthropis* Meyr and *T. conditana* Walk., but the differences between the three are marked.

Waitati and Woodhaugh, Dunedin, in December. Two males taken by Mr. C. E. Clarke. Holotype (♂) and paratype in coll. Auckland Museum.

T. encausta n. sp.

♂. 11-12 mm. Head, palpi and thorax dark reddish brown. Antennae ochreous annulated with dark brown, ciliations in ♂ 3. Abdomen dark brown. Legs ochreous, mixed with brown. Forewings with costa strongly arched, moderate costal fold, apex subobtuse, termen subsinuate, rather oblique; purplish mixed with ochreous; basal patch extensive, outer margin almost straight, ochreous; a broad nearly straight slightly outwardly oblique median fascia; apical third of wing dark reddish brown, enclosing a roundish spot of purplish before apex and some ochreous towards tornus: fringes brownish mixed with ochreous. Hindwings dark fuscous tinged with purplish: fringes dark fuscous with darker basal line.

Not nearly related to any other *Tortrix*.

Kaeo, in January. Two males taken by Mr. C. E. Clarke. Holotype (♂) and paratype in coll. Auckland Museum.

Ctenopseustis fraterna n. sp.

♂. 19 mm. Head and palpi ochreous mixed with brown. Antennae ochreous dotted with brown, ciliations in ♂ 1½. Thorax brown. Abdomen ochreous mixed with brown. Legs ochreous, anterior pair dark fuscous, tarsi annulated with ochreous. Forewings with costa strongly arched, costal fold reaching to 1/2, apex rectangular, termen sinuate, hardly oblique; pinkish brown; markings blackish brown; irregularly margined with white; costal fold strigulated, and a series of spots on costa between end of fold and apex; a suboval spot beneath costal fold near base from which proceeds a striga to near base of dorsum; a larger suboval spot beneath costa at middle; some irregular marks below cubital fold and a number of similar marks on apical third of wing: fringes pinkish brown with a dark basal line. Hindwings and fringes pale purplish fuscous.

A very differently marked species from the other member of the genus, *C. obliquana* Walk.

Whangarei, Parua Bay, Kaeo and Wayby Gorge, in December and January. Four males captured by Mr. C. E. Clarke. Holotype (♂) and paratypes in coll. Auckland Museum.

Gelechiidae

Apatetris nivea n. sp.

♂. 11-14 mm. Head, palpi and thorax white sprinkled with blackish fuscous. Antennae white annulated with dark fuscous. Abdomen ochreous grey. Legs whitish sprinkled with dark fuscous. Forewings narrow, parallel-sided, costa moderately arched, apex broadly rounded; snow white, densely sprinkled with blackish fuscous scales; a prominent blackish fuscous spot beneath fold at 1/3: fringes concolorous with wing. Hindwings grey; fringes ochreous grey.

Differs from *A. melanombra* Meyr. in the very much whiter colouring and the absence of any markings except the one spot.

Auckland, in January. Four males taken by Mr. C. E. Clarke. Holotype (♂) and paratypes in coll. Auckland Museum.

Gelechia parvula n. sp.

♂ ♀. 10-12 mm. Head pearly white. Palpi whitish ochreous. Antennae purplish brown. Thorax ochreous white, tegulae dark purplish brown. Abdomen greyish brown. Legs ochreous mixed with fuscous, anterior pair wholly fuscous, tarsi obscurely annulated with ochreous. Forewings lanceolate, dark purplish brown; a broad stripe along dorsum and termen reaching nearly to middle of wing, ochreous white; fringes concolorous with wing. Hindwings leaden grey: fringes pale ochreous.

Resembles the much larger *G. parapleura* Meyr., but with the upper and lower halves of the forewing more strongly contrasted.

Bluecliff (Fiord), Lake Manapouri and Arthur's Pass in December and January. One female and a series of males taken by Mr. C. E. Clarke. Holotype (♂), allotype (♀) and male paratypes in coll. Auckland Museum. There are also several specimens in coll. Cawthron Institute.

G. contraria n. sp.

♂. 14-15 mm. Head pearly white. Palpi ochreous mixed with brown. Antennae dark brown. Thorax brown. Abdomen grey. Legs ochreous, anterior pair brown. Forewings with costa curved shortly at apex, apex short-pointed, termen very oblique; light brown sparsely sprinkled with darker; a stripe of white beneath fold from base to tornus, mixed with brown on apical half: fringes dull greyish ochreous with obscure dark subbasal line round apex. Hindwings leaden grey: fringes dull ochreous grey.

Near *G. parapleura* Meyr., but at once distinguished by the brown thorax.

Waiho Gorge (Westland) in January. Two males captured by Mr. C. E. Clarke. Holotype (♂) and paratype in coll. Auckland Museum.

OECOPHORIDAE

Borkhausenia levicula n. sp.

♂. 13 mm. Head, palpi and thorax whitish ochreous mixed with brown. Antennae ochreous closely annulated with fuscous, ciliations in ♂ 3/4. Abdomen grey, brassy tinged. Legs grey mixed with ochreous and brown. Forewings narrow, costa moderately arched, apex round-pointed, termen extremely oblique; greyish white mixed with dark fuscous; markings pale ochreous mixed with dark fuscous; a rather broad fascia from costa at base to dorsum at about 1/3; a similar fascia from costa at 1/4 to dorsum at 2/3; a third fascia from costa at 1/2 to above tornus where it coalesces with an inwardly oblique fascia from costa at 4/5; a moderately broad band round termen: fringes greyish white mixed with ochreous and fuscous. Hindwings grey: fringes grey with obscure darker basal line.

Belongs to the *xanthomicta-zanthodesma* group, but very much paler than any of the other species: the shape of the forewings is also a good distinguishing character.

Flat Mountain, Lake Manapouri, in December. Two males taken by Mr. Clarke at an elevation of about 4,000 feet. Holotype (♂) and a paratype in coll. Auckland Museum.

B. lassa n. sp.

♂. 11 mm. Head and thorax pale brown. Palpi, 2nd segment brown with apex whitish, terminal segment fuscous, with apex whitish ochreous. Antennae ochreous annulated with fuscous, ciliations in ♂ 1. Abdomen purplish grey. Legs ochreous mixed with fuscous, all tarsi banded with fuscous. Forewings with costa hardly arched, apex broadly rounded, termen rounded, oblique; white, densely irrorated with pale fuscous except beneath fold; markings consisting of obscure brown fascia and pale yellow spots; a rather large yellow patch on dorsum at base; a brown stripe along fold connecting with a slightly outwards-curved fascia from costa at 1/4; a rather prominent yellow spot at junction of these two fasciae and some yellow scales mixed with fascia from costa; a brown fascia from costa at 1/2 to tornus enclosing a yellow spot in disc and with some yellow scales at tornus; an obscure brown subterminal fascia containing some yellow scales: fringes brown with some white and yellow scales. Hindwings and fringes fuscous grey.

Probably with some affinity to the preceding species, but very distinct.

Leith, Dunedin, in December. A single male taken by Mr. Clarke. Holotype (♂) in coll. Auckland Museum.

B. laudata n. sp.

♂. 13-15 mm. Head and palpi purplish brown. Antennae dark brown, minutely spotted with ochreous, ciliations in ♂ 2½. Thorax purplish brown, apex and tips of tegulae yellow. Abdomen purplish brown. Legs fuscous, tarsi very obscurely annulated with ochreous. Forewings elongate, costa moderately arched, apex round-pointed, termen straight, oblique; bright ferruginous; beneath fold rather bright ochreous; a blackish spot below fold at 1/2 margined anteriorly with ferruginous and posteriorly with ochreous white: fringes ferruginous. Hindwings purplish fuscous: fringes fuscous with darker basal line.

Nearest to *B. amiculata* Philp., but rather smaller and with longer antennal ciliations. There are also several differences in colour and markings.

Bluecliff (Fiord) and Waitati, in January. Two males taken by Mr. C. E. Clarke. Holotype (♂) and paratype in coll. Auckland Museum.

Gymnobathra nigra n. sp.

♂. 12 mm. Head and thorax deep purplish black, collar with a few yellow scales. Palpi deep purplish black mixed with yellow. Antennae black, pubescent. Abdomen purplish black minutely sprinkled with brassy. Legs fuscous black. Forewings moderate, costa moderately arched, apex rectangular, termen rounded, hardly oblique; dark purplish fuscous; a few thin yellow scales irregularly scattered but chiefly below fold: fringes dark fuscous. Hindwings dark fuscous: fringes dark greyish fuscous.

The extremely dark coloration distinguishes this species from the other forms.

Kepler Mountains, in January. A single male captured at about 4,000 feet, by Mr. Clarke. Holotype (♂) in coll. Auckland Museum.

Trachypepla nimbosa n. sp.

♂. 12 mm. Head and thorax purplish fuscous; face mixed with ochreous. Palpi bright ochreous mixed with blackish, apex of terminal segment black. Antennae fuscous annulated with ochreous, ciliations in ♂ 2. Abdomen light purplish fuscous. Legs greyish fuscous mixed with ochreous, tarsi annulated with bright ochreous. Forewings elongate, costa moderately arched, apex rounded, termen rounded, oblique; dark fuscous with some whitish ochreous admixture; scale-tufts blackish tipped with ochreous (a basal one and plical and first discal spots); an obscure interrupted ochreous line at 1/2; a suffused ochreous spot on costa before apex: fringes concolorous with wing, but with faint darker basal line. Hindwings dark brownish fuscous: fringes dark fuscous with darker basal line.

Perhaps nearest *T. lichenodes* Meyr., but at once distinguished by the much shorter antennal ciliations.

Kauri Gully in January. A single male taken by Mr. C. E. Clarke. Holotype (♂) in coll. Auckland Museum.

T. festiva n. sp.

♂. 14 mm. Head and palpi greyish brown. Antennae greyish brown; ciliations in ♂ 3/4. Thorax greyish brown, apex and apical half of tegulae white. Abdomen brassy, segmental divisions and anal tuft pale greyish brown. Legs fuscous, posterior pair ochreous, all tarsi annulated with ochreous. Forewings elongate, costa subsinuate, apex broadly rounded, termen hardly rounded, oblique; white; a moderately broad dark fuscous mark along costa from base to 1/8; costa narrowly fuscous from 1/4 to middle, thence broadening into a semioval patch reaching to 2/3; a very irregular fascia from costa at about 1/4 to dorsum, broadening very much in disc and enclosing plical and first discal scale-tufts, mixed in disc and on dorsum with brownish ochreous; three or four very irregular interrupted fuscous fasciae proceeding from semioval costal patch; the whole area below middle of wing between the first and last fasciae dull brownish ochreous; two or three fuscous spots on apical 1/4 of costa and some fuscous suffusion in subterminal area: fringes ochreous grey sprinkled with fuscous. Hindwings pale fuscous grey: fringes greyish ochreous.

Near *T. hieropis* Meyr., but differing in the brown thorax and the lesser white area in the forewings.

Leigh, North Auckland, and Whangarei, in January. A single ♂ captured in the former locality in 1926 by the late Mr. D. D. Milligan and a second example taken at Whangarei in the following year by Mr. C. E. Clarke. Holotype (♂) in coll. Auckland Museum, and a paratype in coll. Cawthron Institute.

Locheutis fusca n. sp.

♂ ♀. 13-14 mm. Head dull ochreous, collar brighter. Palpi fuscous mixed with ochreous. Antennae fuscous, ciliations in ♂ 5. Thorax dark purplish brown. Abdomen greyish fuscous tinged with brassy. Legs fuscous, posterior pair ochreous, tarsi annulated with ochreous. Forewings rather long, costa slightly arched, apex rounded, termen rounded, oblique; fuscous grey mixed with darker fuscous; markings obscure, frequently almost obsolete; stigmata ferruginous brown; plical spot beneath first discal; second discal usually prominent, emitting a rather thick striga to tornus; usually a small whitish ochreous patch on costa at 2/3: fringes fuscous grey, often ochreous tinged. Hindwings purplish fuscous: fringes fuscous with obscure darker basal line.

At once distinguished from *L. pulla* Philp. by the very much longer antennal ciliations and from *L. vagata* Meyr., where the ciliations are nearly as long, by the absence of the pronounced coppery sheen of that species.

Tongariro National Park, in January. Very common in *Nothofagus* forest on the banks of the Whakapapa River. Holotype (♂), allotype (♀) and several paratypes in coll. Auckland Museum.

Carposinidae

Carposina literata n. sp.

♂ ♀. 22-24 mm. Head and thorax ochreous whitish. Palpi ochreous whitish, mixed with brown except towards base, ciliations in ♂ 5. Abdomen white. Legs whitish ochreous, anterior pair fuscous. Forewings with costa strongly arched, apex rather sharp, termen almost straight, oblique; creamy white; markings blackish fuscous margined with rather bright ochreous and sometimes mixed with white; an inwardly oblique series of spots (3) close to base; a dot below costa before 1/4 and one beneath it well below fold; a third in disc beyond forms a conspicuous triangle. A rather large spot below costa almost at 1/2, from which proceeds a suffused streak halfway to apex including other dots and a large white-ringed spot near to its apex; a few brownissh dots on costa above this streak; a subterminal series of spots most prominent in disc; a series of dots round termen: fringes ochreous whitish mixed with brownish. Hindwings shining white: fringes white.

Near *C. maculosa* Philp., but the discal dark streak is a good distinguishing character.

Defiance Hut, Franz Josef Glacier, in January. One male and two females taken by Mr. C. E. Clarke. Holotype (♂), allotype (♀) and a female paratype in coll. Auckland Museum.

GLYPHIPTERYGIDAE

Heliostibes barbarica n. sp.

♂ ♀. 12-15 mm. Head purplish fuscous mixed with bright yellow. Palpi ochreous, terminal segment fuscous. Antennae dark fuscous, ciliations in ♂ 2. Thorax purplish fuscous with some bright yellow scales. Abdomen purplish fuscous, brassy tinged. Legs dark fuscous, tarsi obscurely annulated with ochreous. Forewings with costa slightly arched, apex subrectangular, termen rounded, not very oblique; dark purplish fuscous, densely strewn with orange yellow scales except beneath fold and in disc at 3/4; stigmata indicated by areas free of yellow scales: fringes purplish fuscous. Hindwings and fringes deep purplish fuscous.

Apparently near *H. callispora* Meyr., but distinguished at once by the much longer antennal ciliations.

Whangarei, in January. One of each sex taken by Mr. C. E. Clarke. Holotype (♂) and allotype (♀) in coll. Auckland Museum.

Simaethis inspoliata n. sp.

♂. 10 mm. Head and thorax dark brown. Face grey. Palpi, second segment with dense rounded descending tuft, grey. Antennae black spotted with white, ciliations in ♂ 3½. Abdomen greyish fuscous. Legs dark fuscous, mixed and banded with white. Forewings with costa slightly arched, apex rounded, termen almost straight, oblique; brown; markings formed chiefly by dense white irroration; a small irregular basal patch; a broad band from 1/5 to 1/2 costa and 1/4 to 1/2 dorsum, its inner edge slightly incurved and its outer margin irregular; a broad fascia from costa at 3/4 to tornus, constricted beneath costa and somewhat excurved; a thin subterminal line white on costa and metallic blue round termen: between second and third fasciae on lower half of wing a large black blotch enclosing two small patches of metallic blue scales: fringes brown, touched with white at tornus and with a darker basal line. Hindwings pale purplish brown, lighter towards apex; a rather obscure white fascia from tornus reaching about half way round termen and keeping close to the margin: fringes brown, more or less white-tipped and with a darker basal line.

Only comparable with *S. urbana* Clarke, but at once distinguished, apart from the very different markings, by the antennal structure.

Flat Mountain, Hunter Mountains, in December. A single male taken by Mr. C. E. Clarke at an elevation of about 4,000 feet. Holotype (♂) in coll. Auckland Museum.

S. tristis n. sp.

♂. 10-11 mm. Head and thorax dark brown sprinkled with white. Palpi white annulated with black. Antennae black annulated with white, ciliations in ♂ 3½. Abdomen dark brown, segmental divisions whitish. Legs dark brown mixed with white. Forewings with costa moderately arched, apex rounded, termen hardly rounded, oblique; deep blackish fuscous densely sprinkled with bluish white scales which tend to form fasciae at base, 1/3 and 3/4; a short streak of whitish scales along termen above tornus; usually a rather conspicuous white spot on costa at 3/4: fringes dark drown, tipped with white at tornus and beneath apex. Hindwings dark purplish fuscous; a very obscure whitish fascia from tornus to about middle of wing, sometimes absent: fringes brown, more or less mixed with white and with a broad purplish fuscous basal band.

Approaching *S. albifasciata* Philp., but without the characteristic whitish subterminal shade of that species.

Tongariro National Park, in January. Four males taken on the slopes of Ruapehu. Holotype (♂) and male paratypes in coll. Auckland Museum.

S. fasciata n. sp.

♂ ♀. 10-11 mm. Head and thorax bronzy brown sprinkled with white scales. Palpi brown closely annulated with white, second segment roundly tufted beneath. Antennae black annulated with white, ciliations in ♂ 2. Abdomen bronzy brown sprinkled with white. Legs bronzy brown mixed with whitish. Forewings with costa slightly arched, apex subrectangular, termen almost straight, oblique; bronzy brown; densely irrorated with white except on broad median angled band: fringes bronzy brown, subbasal line and tips white. Hindwings pale bronzy brown, greyish towards base; an interrupted white fascia from tornus along termen to about 1/4, thence diverging into disc and reaching about middle of wing: fringes as in forewings.

Paler than most of the smaller species of the genus and well distinguished by the dark median band of forewings.

Arthur's Pass, in January. Six males and a female captured by Mr. C. E. Clarke. Holotype (♂), allotype (♀) and several paratypes in coll. Auckland Museum.

Hyponomeutidae

Zelleria maculata n. sp.

♂. 15-17 mm. Head and thorax whitish grey. Palpi ochreous grey mixed with fuscous. Antennae greyish brown. Abdomen whitish ochreous. Legs ochreous white, anterior pair infuscated. Forewings long, narrow, parallel-sided, apex bluntpointed, termen extremely oblique; white, densely mixed with pale dull brown; a clearer white streak along dorsum and partly round termen, much interrupted by dark fuscous marks, a fairly large spot on dorsum at 1/2, connecting with an indistinct oblique fascia from costa at 1/3, and a similar one at tornus; many indistinct dark fuscous dots on apical 1/2, especially on the lower portion; a distinct white spot on costa before apex, followed by a triangular dark fuscous spot; extreme apex whitish: fringes ochreous grey round termen, dark fuscous round apex, with a dividing whitish patch. Hindwings grey: fringes ochreous grey.

The white preapical spot seems to be a good distinguishing character. I have not seen a specimen of *Z. sphenota* Meyr., but the present species appear to be a considerably larger insect and to have more affinity with *Z. rorida* Philp.

Mount Maungatua, Otago, in December and January. Several males taken by Mr. C. E. Clarke. Holotype (♂) and a series of paratypes in coll. Auckland Museum.

COSMOPTERYGIDAE

Batrachedra astricta n. sp.

♂ ♀. 13-15 mm. Head and thorax whitish grey. Palpi whitish grey mixed with fuscous, second segment with small apical scale-projection. Antennae ochreous annulated with fuscous. Abdomen greyish brown. Legs whitish ochreous mixed with fuscous. Forewings long, narrow, parallel-sided, apex round-pointed; white, densely sprinkled with blackish fuscous scales, agregations of which form the stigmata; first discal at about 1/2, obliquely beyond plical; second discal at 3/4, rather below middle: fringes pale fuscous grey with a blackish fuscous line round apex. Hindwings and fringes pale greyish fuscous.

Related to *B. tristicta* Meyr, but the stigmata are not elongate and there is no round black apical spot.

Opoho, Dunedin, in December. One male and two females taken by Mr. C. E. Clarke. Holotype (♂), allotype (♀) and a paratype in coll. Auckland Museum.

PLUTELLIDAE

Orthenches septentrionalis n. sp.

♂. 15 mm. Head pale fuscous, face grey. Palpi greyish fuscous. Antennae grey dotted with blackish. Thorax (abraded) apparently fuscous. Abdomen grey. Legs whitish mixed with fuscous. Forewings with costa moderately arched, subsinuate, apex pointed, termen rounded, oblique; white; suffused with purplish, especially below fold; numerous interrupted transverse brown strigulae; a purplish brown blotch on costa at 1/3 and a brown suffusion along costa between this and apex: fringes greyish fuscous with dark brown basal line. Hindwings grey, purplish tinged towards apex: fringes grey with darker basal line.

Belongs to the *chartularia-semifasciata* group, but is abundantly distinct.

Kauri Gully, Auckland, in January. A single male taken by Mr. C. E. Clarke. Holotype (♂) in coll. Auckland Museum.

TINEIDAE

Archyala tigrina n. sp.

♂. 13-14 mm. Head greyish white. Palpi white, second segment outwardly dark fuscous. Antennae greyish white annulated with pale brown. Thorax greyish white mixed with fuscous. Abdomen greyish brown. Legs grey mixed with fuscous, anterior pair dark fuscous, tarsi annulated with whitish. Forewings with costa slightly arched, apex round-pointed, termen very oblique; white: somewhat mixed with pale fuscous; numerous outwardly-oblique interrupted transverse dark fuscous strigae; in some cases these are double and then have the internal space filled with ochreous; the most prominent strigae are at 1/6, 1/3, 3/4 and 5/6: fringes greyish white mixed with fuscous. Hindwings shining grey; round tornus and termen broadly purplish: fringes greyish fuscous, purplish tinged.

Nearest *A. paraglypta* Meyr., but a smaller and paler insect.

Whangarei and Pakotai (North Auckland) in January. Two males taken by Mr. C. E. Clarke. Holotype (♂) and paratype in coll. Auckland Museum.

Tinea aerata n. sp.

♀. 11 mm. Head and palpi greyish fuscous. Antennae ochreous closely annulated with black. Thorax fuscous mixed with ochreous. Abdomen purplish fuscous, segmental divisions whitish. Legs dark fuscous, tarsi annulated with ochreous. Forewings with costa moderately arched, apex round-pointed, termen rounded, strongly oblique; blackish fuscous; apical third of wing except on costa, brassy ochreous; a white blotch on dorsum near base; an obscure double white angled striga at 1/4; a similar striga at 1/2 becoming obsolete on brassy area; a thin paired white striga from costa at 3/4, strongly outwards-curved and traceable to tornus; four short white strigae from costa between this and apex; apex black: fringes pale greyish fuscous, round costa barred with white and with a prominent black basal line. Hindwings violet purplish: fringes greyish fuscous.

Perhaps nearest to *T. atmogramma* Meyr., a species which I have not seen. The brassy ochreous terminal area and several other details of markings seem, however, to distinguish the species sufficiently.

Tongariro National Park in January and Cape Saunders (C. E. Clarke) in November. Two females. The southern specimen has very little of the brassy suffusion. Holotype (♀) and a paratype in coll. Auckland Museum.

Tinea furcillata n. sp.

♂. 9 mm. Head white, palpi whitish mixed with fuscous. Antennae grey with a dark fuscous band just beyond base. Thorax white mixed with dark fuscous. Abdomen grey. Legs ochreous white, tarsi banded with ochreous. Forewings with costa moderately arched, apex pointed, termen very obliquely rounded; ochreous white; markings brassy fuscous, darker on costa and dorsum; a broad basal patch, becoming almost obsolete on dorsum; a broad fascia at 1/3, becoming suffused in disc and breaking up into two or three fasciae on dorsum; a similar fascia at 2/3 forming a semioval spot on costa; some undefined short fasciae on apical 1/4 of costa; an obscure series of dark marks round termen: fringes white mixed with brassy brown. Hindwings shining grey: fringes whitish grey.

Much lighter in colour than any other of the "mimetic" Tineids. It may be noted that in the forewings 7 and 8 are stalked as are 5 and 6 in the hindwings.

Andersons Bay, Dunedin, in November. Two males captured by Mr. C. E. Clarke. Holotype (♂) in coll. Auckland Museum.

Astrogenes insignita n. sp.

♂. 9-10 mm. Head dark greyish fuscous. Palpi whitish. Antennae fuscous grey. Thorax and abdomen bronzy fuscous. Legs greyish fuscous. Forewings moderate, costa hardly arched, apex round-pointed, termen rounded, oblique; bronzy fuscous; a prominent purplish metallic almost straight transverse fascia at before 1/2; a similar but interrupted one at 3/4; a purplish metallic dot at apex: fringes bronzy fuscous. Hindwings purplish fuscous: fringes dark fuscous.

A much smaller species than *A. chrysograpta* Meyr., and with quite a different arrangement of the metallic markings.

Woodhaugh, Dunedin, from November to January. A series of males taken by Mr. C. E. Clarke. Holotype (♂) and paratypes in coll. Auckland Museum.

Talaeporia triangularis n. sp.

♂. 12-14 mm. Head and palpi greyish brown. Antennae ochreous annulated with brown. Thorax and abdomen purplish brown. Legs greyish brown. Forewings with costa almost straight, apex rounded, termen rounded, very oblique; pale purplish brown, with some ochreous whitish admixture; a triangular ochreous whitish spot on dorsum before tornus; some obscure whitish marks on dorsum between this and base; a series of roundish ochreous whitish spots round apex and termen: fringes greyish fuscous, darker basally. Hindwings and fringes fuscous grey.

The Hump, Fiord, in January, and Waitati, Dunedin, in November. A series of males taken by Mr. C. E. Clarke. Holotype (♂) and paratypes in coll. Auckland Museum.

The Paryphantidae of New Zealand:

their Hypothetical Ancestry, with descriptions of New Species and a New Genus.

By A. W. B. POWELL, Conchologist and Palaeontologist.

Study of the distribution of land snails has long been recognised to be of great value in suggesting former land connections, for it is well known that immersion for a length of time in either fresh or salt water is sufficient to kill individuals or the life within their eggs. In the case of *Paryphanta* these eggs are of such large size that any suggestion of accidental transportation by means of migratory birds or other chance means need not be considered.

The inferences are that continuous land is necessary for dispersal and that the species must have developed approximately within or close to the areas they now occupy, and that geographic features such as mountain ranges, river systems and islands, have played and are still playing an important part in the segregation and evolution of species.

In this paper an attempt has been made, not only to record and describe species of the larger New Zealand land snails but to illustrate that many of the so termed colour variations are constant within definite geographic areas and for this reason alone are well worthy of subspecific distinction.

HOW PRESENT GEOGRAPHIC FEATURES GOVERN THE DISTRIBUTION OF SPECIES.

Typical *hochstetteri* and its subspecific forms live on the mountains at between 2,500 feet and the snow-line. They are very rarely found living below this level and never lower than 2,000 feet. This habit no doubt originated through climatic conditions, as it is essential to the life of *Paryphanta* to be kept continually moist, not being adapted to withstand long periods of dryness.

Possibly the present mountain habitat most closely corresponds to general weather conditions previously prevalent in this country. Whatever the cause, the mountain habit, whether recently acquired or not, is assisting even at the present time in the gradual evolution of new forms by isolation.

These mountain tops are as islands in a sea, the surrounding low country below the 2,000 ft. level acting as a barrier between the mountain areas.

This fact is well illustrated in comparing (a) the Western, and (b) the Eastern distribution of the *hochstetteri* forms.

(a) Taking the western area, that of the typical species, we have a continuous distribution over the high country of west Nelson; along the Pikikiruna Range, across the Tasman Range and then north again along the Haupiri Range.

All the specimens collected and examined from these connected mountain systems are characterized by a light base with the umbilical area free from bands or colour zone.

(b) The eastern or Marlborough Sounds area is a complex system of mountains, further complicated by comparatively recent subsidence, allowing great inroads by the sea. This whole area is now completely isolated so far as high country connections are concerned, being bounded by the sea to the north, the valley of the Wairau to the east, the Waimea Plain to the west and to the south by a low saddle near Tophouse, separating the St. Arnaud Range from the apparently nameless range continuing north to D'Urville and Stephen Islands.

The shells from this area belong to subspecific forms of *hochstetteri,* differing in having a basal colour patch invariably present, filling and surrounding the umbilical area. These can be further subdivided into two regional colour forms, a western type with the base almost entirely dark and an eastern type in which the dark colour is confined to a small patch in and around the umbilicus. The dividing line between these two forms however is imperfect, the areas of distribution overlapping, causing a few intermediate forms.

In west coast districts where there is a greater rainfall species of *Paryphanta* range down almost to sea level. In North-west Nelson the Whakamarama Range and western coastal strip supports the distinctive *gilliesi* and its subspecies *subfusca,* which latter is isolated from the typical species by the waters of West Haven Inlet.

Similarly further down the coast the axially striped *lignaria* is found from Karamea to the north side of the Mokihinui River, while a related species without colour bands is restricted to the area from the south side of the river to Westport. A further species of this series is described in this paper from the vicinity of Ross but its boundaries still need to be determined for only a single specimen has so far been found.

HYPOTHETICAL GEOLOGICAL ANCESTRY AND DEVELOPMENT.

A. (PARYPHANTA)

The fact that *Rhytida* and closely allied genera range from South Africa to New Caledonia while *Paryphanta* is probably restricted to New Zealand, Tasmania and Victoria points to greater antiquity and a more ancient dispersal for the former.

No doubt *Paryphanta* originated from *Rhytida* like stock within the New Zealand faunal area and achieved its greatest distribution during the great land extensions of the Lower Cretaceous whereby Tasmania and Victoria gained the ancestors of their present species. The route was probably via New Caledonia and Eastern Australia.

It has been pointed out that cool temperatures and moist conditions are essential to *Paryphanta* which does not possess the ability to conserve moisture by sealing the shell with an epiphragm. The genus has survived therefore only in locations where moist conditions have prevailed.

Species ascribed to *Paryphanta* are on record from both New Guinea and the Louisiades, but it is very doubtful if any of these belong to the family.

Unfortunately the writer has been unable to secure specimens or refer to the original description of the Louisiades species (*P. louisiadarum* Moellendorff, Nachrbl. Deutsch. Malak. Ges. pp. 20-22, 1899.)

The New Guinea species were described by Fulton (Ann. Mag. Nat. Hist. vol. 9, seventh ser. p. 182, 1902). One of these, *elegans* has a carinated periphery with hair-like projections so can be excluded from the family. Fulton's other species, *striata,* which is closely allied to *louisiadarum* according to its author, is also quite small having a maximum diameter of only 9 mm.

The small size of these species alone indicates that they probably do not belong to the genus *Paryphanta.* *

During the Lower Tertiary great land subsidence probably caused the drowning of the greater part of the *Paryphanta* distribution, isolating in the northern part of the North Island the ancestors of the living *busbyi,* to which the Victorian and Tasmanian species are probably nearest allied. Similarly a southern remnant of the older land developed the *hochstetteri* ancestors on what is now the northern part of the South Island.

In describing the later geological history of New Zealand, Dr. Cotton (1916, p. 248) wrote:—"The most profound deformation of this vast sedimentary group took place in the Jurassic or early Cretaceous times . . . . when probably a great mountain range came into existence." . . . "From the above considerations and from a general survey of what is known of the Tertiary Rocks it is apparent that during the period of their deposition a great part of the site of the present islands of New Zealand was continuously submerged, and that very little of the remainder was left above water."

In a paper dealing with West Nelson Dr. J. Henderson (1911, p. 312) wrote:—"The land seems to have been above sea-level till Tertiary times, when depression permitted the inroads

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* Since this was written J. Thiele in a paper entitled, "Mollusken vom Bismark-Archipel, von Neu-Guinea und Nachbar-Insel" (Zoologische Jahrbucher, Jena, 55, pp. 126-127, 1928), has proposed *Paryphantopsis,* a new subgenus of *Flammulina* for these shells, referring it to the *Endodontidae.* (= *Flammulinidae* of Iredale and *Endodontidae-Phenacohelicidae* of Suter.) Thiele's excellent figures of these shells show features quite foreign to the *Paryphantidae* and his description of both the nuclear and dental characters prove the relationship with the *Endodontidae.*

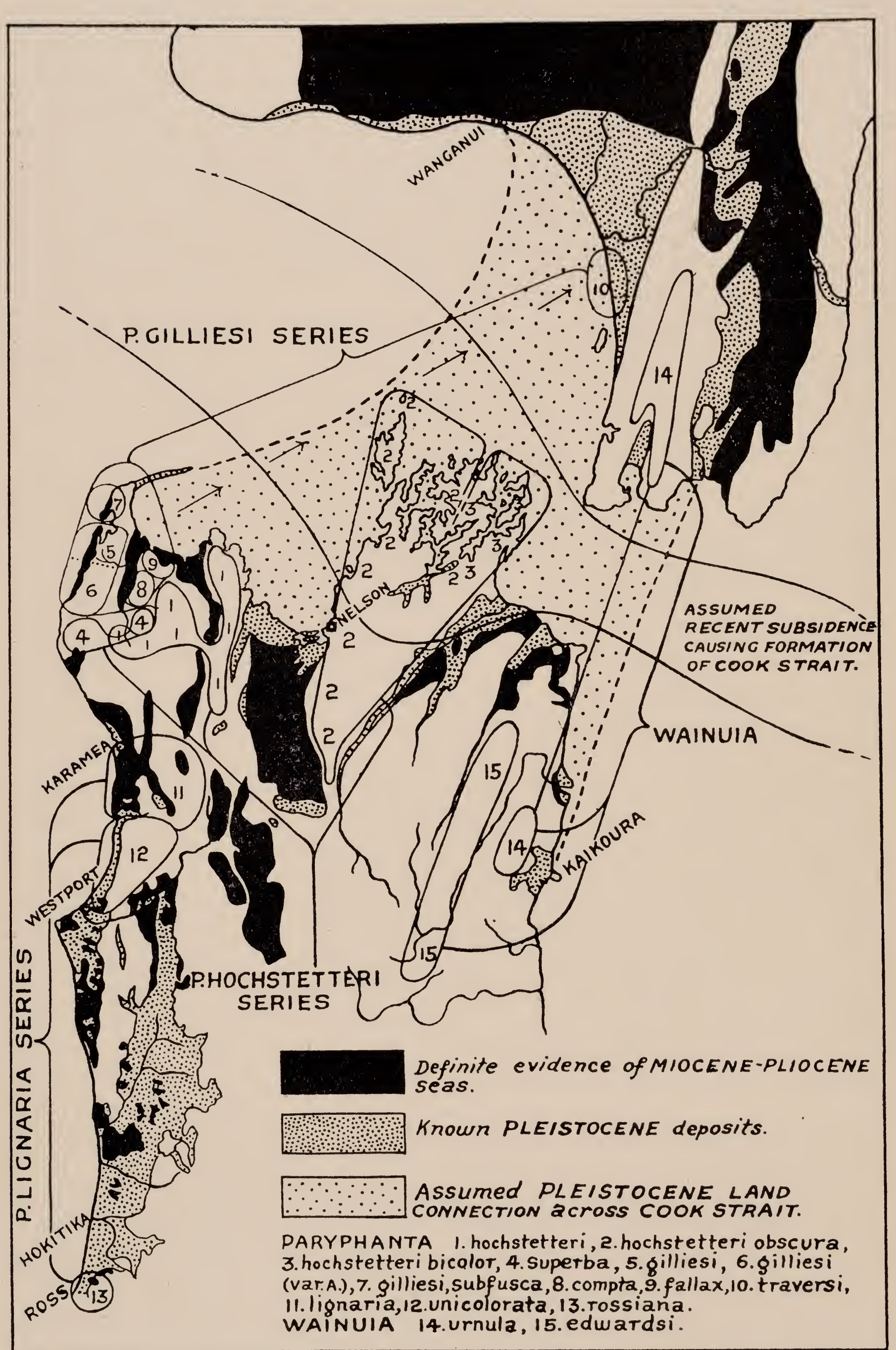

Fig. 1. HYPOTHETICAL GEOLOGICAL MAP OF THE COOK STRAIT REGION, ILLUSTRATING THE DISTRIBUTION OF PARYPHANTA AND WAINUIA.
(Based partly on Morgan's 1922 Geological Sketch Maps of N.Z.)

of the sea into rift-valleys which had already been formed." . . . "Further depression permitted the formation of sandstones. . . ." etc. "When these last were formed the land surface of what is now West Nelson was represented by a series of base-levelled islands."

Probably the small *Paryphantas* of the *gilliesi* series owe their origin to isolation on West Nelson island blocks that escaped submergence. Similar detached areas to the south were no doubt responsible for the development of such distinctive types as *lignaria* and *superba.*

It is well known that evolution by deviation from type is often accelerated as the result of small colonies becoming isolated.

Later came a period of great uplift which reached its maximum during Pliocene and Pleistocene times providing new land for colonization.

The Pleistocene was an age of great mountain building, glaciation, rapid weathering and the resultant formation of extensive plains. The great erosion that took place points to a very heavy rainfall, a condition favourable to the dispersal of *Paryphanta.*

So complete was the erosive work of the *Pleistocene* that in West Nelson practically the whole of the Gouland Downs area and most of the country on the eastern side of the Aorere was stripped of the Miocene covering strata.

A new species, *compta,* described in this paper from The Castles, a ridge of about 2,000 feet elevation situated on the eroded sloping plateau of the eastern side of the Aorere Valley, probably owes its origin to an eastern drift of the *gilliesi* type after the uplift of the present Aorere Valley floor. Old crushed specimens referrable to this species occur in the Pleistocene and Recent silts of the valley, suggesting that *compta* once covered a much wider area but has been diminished together with the erosion of the land surface.

Another species of the *gilliesi* series occurs on the ridge running from behind Onekaka to Parapara Peak, on Palaeozoic rocks of the Aorere Series. Possibly this species owes its origin to insular isolation at the same time that the Whakamarama *gilliesi* ancestors were isolated.

The species from The Castles shows closer relationship to *gilliesi* than to the Onekaka species, they being the only two species of *Paryphanta* with a granulated parietal wall.

Geologists are of the opinion that during the Pliocene and until comparatively recent times Cook Strait was closed. Support to this idea is given by the occurrence of a *Paryphanta* related to the West Nelson *gilliesi* series, on the Pleistocene plains around Levin.

These plains have been practically stripped of their forest covering for agricultural purposes so it is now impossible to estimate the former extent of the colony.

This low country habit has no doubt been inherited from West Nelson ancestors of the *gilliesi* series, for the relationship as shown by shell proportions cannot be denied.

The final separation of the Levin species from its South Island relatives was due to the formation of Cook Strait, which feature is considered to be of very recent origin. Dr. Cotton (1916, p. 319) wrote:—"Faults of late date appear also to have determined the outlines of at least some parts of the New Zealand coast, especially in and about Cook Strait." And in a later paper (1918, p. 325): "This justifies the adoption of a tentative hypothesis that at the close of the orogenic movements which gave birth to the New Zealand land mass, the dividing strait was not in existence, and that the separation of the two islands has taken place subsequently, as a result of subsidence of blocks, possibly contemporaneous with the partial subsidence of an adjacent portion of the South Island."

B. (WAINUIA)

Probably contemporaneous with the evolution of the *Paryphanta* series a second genus here named *Wainuia* and showing affinity to both *Paryphanta* and *Rhytida* was developing on the Kaikoura-Tararua block.

Dr. Cotton (1916, p. 248) wrote:—"The orogenic movements which followed the Tertiary deposition, and to which the present relief is entirely or almost entirely due must have occurred in or about the Pliocene period. The period of movement may be termed the 'Kaikoura orogenic period' since the Kaikoura ranges were the first to be explained . . . . as owing the whole of their elevation to these late earth-movements." And later (1922, p. 184): "The valleys of the Awatere and Wairau Rivers clearly mark the position of depressed blocks—great triangular areas of subsidence."

The Wairau and Awatere River Valleys now extend far inland and have probably existed since pre-Tertiary times, effectively separating the Kaikoura block and its land fauna from the Marlborough Sounds—Nelson area.

The distribution of the two species of *Wainuia* is satisfactorily explained by the assumed recent origin of Cook Strait. One of the species is apparently confined to the Inland Kaikoura system and Hossack Downs a mountain area to the south, but the other is found on both sides of Cook Strait, the Rimutaka-Tararua systems in the North and on the Seaward Kaikouras in the South Island.

C. (RHYTIDA)

As previously suggested *Rhytida* is considered the most ancient genus of the *Paryphantidae* in New Zealand. Species are distributed over the North, South and Stewart Islands. One species, *greenwoodi,* is found on both sides of Cook Strait and affords still further evidence of the comparatively recent origin of this geographic feature, which has evidently not been in existence sufficiently long to have caused a faunal division.

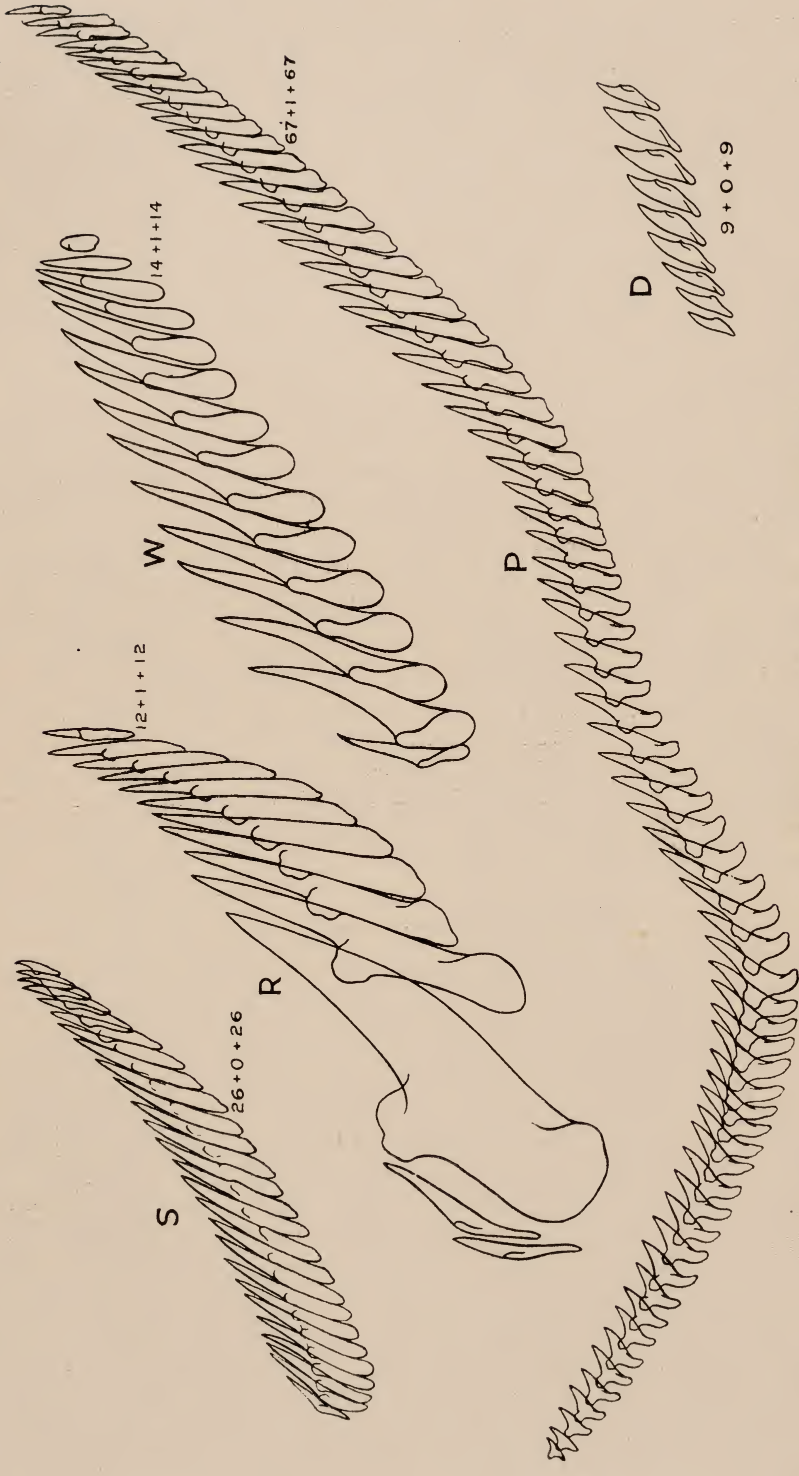

Fig. 2. GENERIC TYPES OF DENTITION IN PARYPHANTIDAE.
S. *Schizoglossa* (Type), R. *Rhytida* (Type), W. *Wainuia* (Type),
P. *Paryphanta* (*hochstetteri*), D. *Delos* (Type).

DENTITION.

The dentition presents a distinctive type for each of the five New Zealand genera. (Text Fig. 2.) Specific distinctions are also well shown in the genera *Rhytida* and *Wainuia*, but in some members of the *hochstetteri* and *gilliesi* series of the genus *Paryphanta* the radulae are all very similar, showing close relationship, and making the selection of a precise formula for each of the species impossible. Shell characters alone have been used in these species as they have proved quite constant and distinctive among each of the geographic or regional types.

Paryphanta has a radula consisting of a large number of aculeate laterals gradually increasing in size from the margin and then decreasing again towards the centre. Typical formula, 50 + 0 + 50.

Rhytida has a radula consisting of a comparatively small number of aculeate laterals. Mostly with a few very small teeth at the margin followed by the largest tooth, then decreasing to the centre. Central tooth mostly present. Typical formula, 12 + 1 + 12.

Wainuia has a radula consisting of a comparatively small number of aculeate laterals. First tooth at margin half the height of the next which is the largest, then decreasing to the centres. Central tooth small. Typical formula, 14 + 1 + 14.

Schizoglossa has a radula consisting of a moderately large number of aculeate laterals. First tooth at margin small, following four rapidly increasing, then gradually decreasing to the centre. No central tooth. Typical formula, 26 + 0 + 26.

Delos has a radula consisting of a very small number of aculeate laterals, increasing in size from the margin, last one smaller. No central tooth. Typical formula, 9 + 0 + 9.

FOOD OF PARYPHANTA.

These snails feed on the common bush earth-worms. The writer has removed from a living specimen of *gilliesi* an entire worm eight and a half inches in length.

This worm had not been swallowed but simply enveloped in the folds of the foot and withdrawn into the shell until lifeless. Later, no doubt the worm would have been eaten at leisure as evidenced by some disgorged fragments in the case of *P. hochstetteri*, which had been shredded by the radula at one end.

The large spreading foot shown in plate 7 illustrates the suitability of this portion of the animal for capturing the worms by the simple process of crawling over them.

NATURAL ENEMIES OF PARYPHANTA.

The Weka consumes large numbers of the young and half-grown snails, and many of the adult specimens often show marks where they have been pecked by these birds; size and weight apparently preventing the removal of the adult snails from under the tussock and fern where they live. The Weka always attacks the top of the shells, pecking out the spire and early whorls in order to facilitate the removal of the animal.

INTRODUCED ENEMIES AND PRESENT DAY CONDITIONS CONTRIBUTING TOWARDS THE GRADUAL EXTERMINATION OF PARYPHANTA.

The introduced rat is a serious menace, particularly in the lower country, consequently the species *busbyi, gilliesi, subfusca* and *traversi* are more often affected. The rat eats back the body-whorl from the periphery thus giving access to the major portion of the animal.

Introduced birds such as the thrush have also been observed pecking through the shell and eating the animal, in a similar fashion to their method with the common imported garden snail (Waiopehu Reserve, Levin. A.W.B.P. 8/2/1930).

Indirectly the ravages of the deer on our mountain forests are responsible for killing off large numbers of *Paryphanta,* by thinning out the vegetation and rendering the ridges too dry. Similarly the hand of man in clearing the vegetation from the lower slopes of the mountains has the same detrimental effect of making the bush abnormally dry.

MATERIAL.

For over four years the writer has been collecting material and data for this paper, having personally collected at a number of localities representative of Marlborough, Nelson, Westland, Wellington, Taranaki and Auckland Provinces.

Many interesting and important records however are the result of the generous help of a number of people whose names are mentioned below.

ACKNOWLEDGMENTS.

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Genus RHYTIDA Albers 1860.

Type: *Helix greenwoodi* Gray.

The genus is widely distributed in New Zealand being found wherever forest conditions are suitable. The species can be divided into three groups, one of which is confined to the northern part of the North Island, the second to the South and Stewart Islands, while the third is found in both the North and South Islands.

Rhytida is characterized by its shell which is wrinkled or malleated and composed of more lime and less conchin than in the shell of *Paryphanta;* and also by its radula which is composed of comparatively few teeth. The outermost laterals are very small and are followed by the largest tooth, the succeeding laterals decreasing in size to the centre. Central tooth small or absent.

KEY TO SPECIES DEALT WITH IN THIS PAPER.

A. Periphery of body-whorl keeled.

(1) Spire low, ratio of height into diameter averaging 1.79. Dental formula 18 + 1 + 18, five consecutive teeth from margin small, the sixth extra large, then decreasing to centre. Average dimensions 26mm. × 14.5mm. *dunniae.*

(2) Higher spire, ratio of height into diameter averaging 1.55. Dental formula 15 + 1 + 15, four consecutive teeth from margin small, and fifth extra large, then decreasing to centre. Average dimensions 30.25mm. × 19.50mm. *tarangaensis*

B. Periphery of body-whorl rounded. Body-whorl with 5 or 6 spiral ribs.

(3) Ratio of height into diameter averaging 1.62. Dental formula 12 + 1 + 12, two small teeth at margin, third tooth extra large, then decreasing to centre. Average dimensions 25.57mm. × 15.78mm. Umbilicus typically coloured dark-brown. *greenwoodi*

(4) Ratio of height into diameter averaging 1.74. Dental formula 13 + 1 + 13, one small tooth at margin, second tooth extra large, then decreasing to centre. Average dimensions 33.66mm. × 19.33mm. *stephenensis*

C. Periphery rounded. Spiral ribs absent.

(5) Shell microscopically malleated and sculptured with dense microscopic spiral striae. Umbilicus narrow and deep, one thirteenth major diameter. Dental formula 18 + 0 + 18 (Hutton). One small tooth at margin, second tooth extra large, then decreasing to centre. Dimensions 20.5mm. × 12mm. *patula*

(6) Shell microscopically malleated, spiral striae absent. Umbilicus wider, one seventh major diameter and aperture smaller than in *patula.* Dental formula 14 + 0 + 14, largest tooth at margin, then decreasing to centre. Dimensions 17.5mm. × 10mm. *otagoensis*

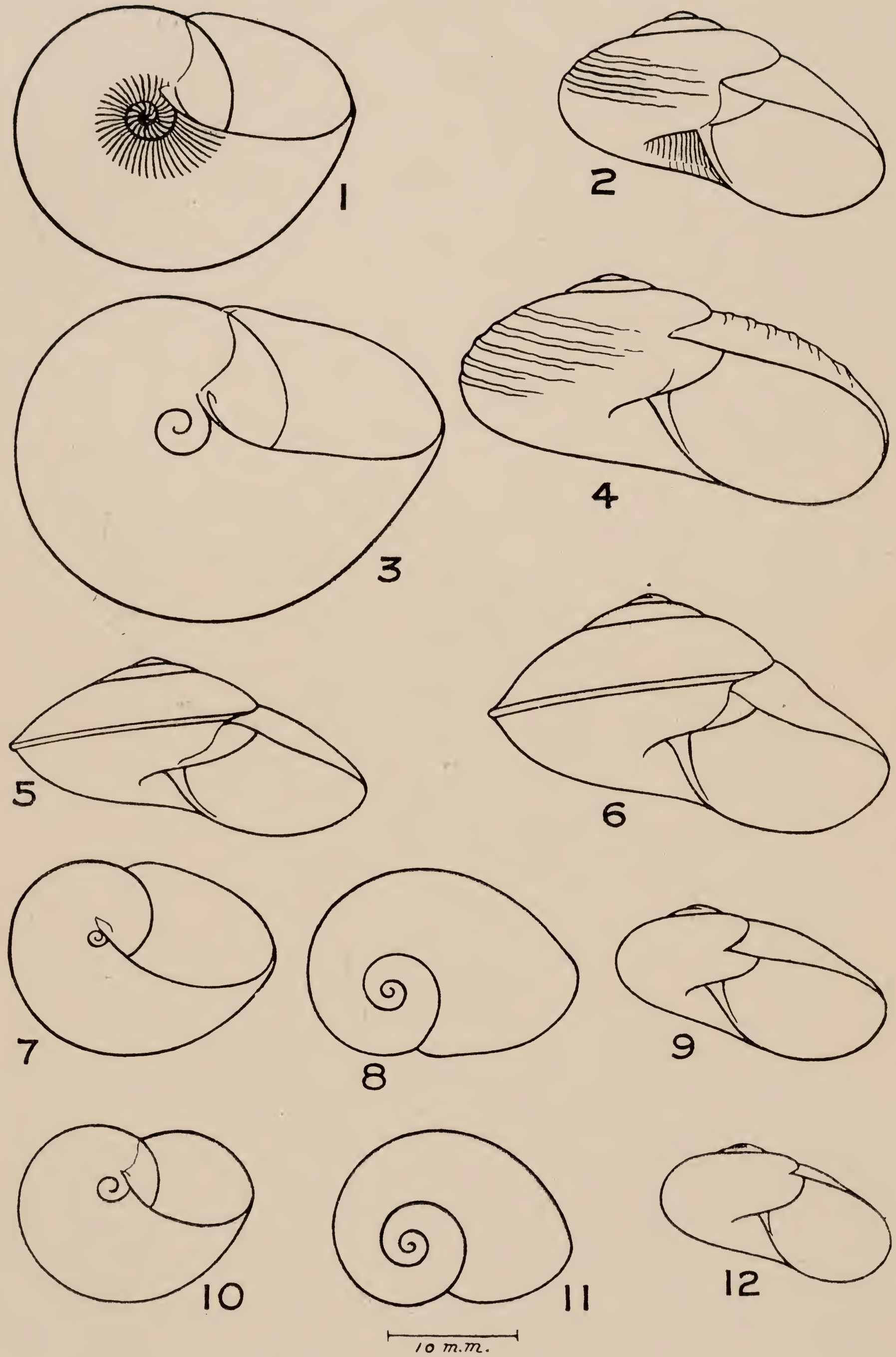

Fig. 3. RHYTIDA.
1 and 2 *Rhytida greenwoodi* (Gray), Muriwai, West Coast.
3 and 4 *Rhytida stephenensis* n. sp., Holotype.
5 *Rhytida dunniae* (Gray), Whangarei.
6 *Rhytida tarangaensis* n. sp. Holotype.
7, 8, 9 *Rhytida patula* Hutton, Mokihinui.
10, 11, 12 *Rhytida otagoensis* n. sp. Holotype.

Fig. 4. DENTITION OF SCHIZOGLOSSA AND RHYTIDA.
1 *Schizoglossa novoseelandica* Pfeiffer.
2 *Rhytida dunniae* (Gray).
3 *Rhytida tarangaensis* n. sp.
4 *Rhytida stephenensis* n. sp.
5 *Rhytida greenwoodi* (Gray).
6 *Rhytida otagoensis* n. sp.

Rhytida greenwoodi (Gray) (Plate 4, Fig 7 and Text Fig 3, 1 and 2).

1850 *Helix greenwoodi* Gray P.Z.S. p. 165.

1913 *Rhytida greenwoodi* (Gray). Manual N.Z. Mollusca, H. Suter (for full synonymy).

Type from Auckland in the British Museum.

Specimens have been examined from the following localities Muriwai, West Coast, Auckland (a few dead shells, A.W.B.P., 1915); in a small patch of native bush about 3 miles south of Waiuku (sheltering from heat in summer and excessive moisture in winter, in the fallen leaf-sheaths of the "Nikau" palms, A.W.B.P., June 1927 and December 1928); Waikato Heads (Mr. W. La Roche); Opotiki (Mr. D. H. Graham); near Gisborne (Mr. Goffe); Awakino Gorge and Mount Messenger (on the ground under decaying "Ponga" fronds, A.W.B.P., January 1927); Levin (on the ground under decaying "Ponga" fronds, A.W.B.P., Jan. 1927); 10 miles up Takaka Valley, Nelson (a half grown specimen, Dr. J. Henderson, 1922); in a cave on left bank of Lee, Wairoa Valley, Nelson (bleached shell, Mr. F. V. Knapp).

This species has also been recorded from Whangaroa; Kamo; Cuvier Island; East Island; Pukekohe; Mount Pirongia; Cape Kidnappers; Tuhoe-land; Wanganui; Midhurst, Taranaki; and Lake Guyon Run, near source of the Waiau River, Nelson. (Suter, 1. c. p. 775). The Stephen Island record refers to the next species.

The typical Auckland shells have the umbilicus coloured dark chestnut-brown, while those from the south have this feature entirely lacking. Specimens from Muriwai and Waiuku are 100 per cent. with the brown umbilical patch, from Waikato Heads 75 per cent., and from Awakino Gorge, Mount Messenger and Levin respectively 100 per cent. plain.

Dimensions of three specimens from Muriwai—

Major diameter 27mm.; height 17mm.
Major diameter 27mm.; height 17mm.
Major diameter 26mm.; height 16mm.

Dimensions of four specimens from Levin—

Major diameter 25mm.; height 15.5mm.
Major diameter 25mm.; height 15.0mm.
Major diameter 25mm.; height 15.5mm.
Major diameter 24mm.; height 14.5mm.

Average dimensions—

25.57mm. $\times$ 15.78mm.

Dimensions of Muriwai (typical) *specimen*—

Major diameter 26mm.; minimum diameter 20.5mm.; height 16mm. (Plate 4, Fig. 7.)

Dentition (Text Fig. 4, 5). Formula 12 + 1 + 12. There are two small rudimentary teeth at the margin followed by the third tooth which is large and massive, far exceeding the size of all the others. The remaining teeth gradually diminish in size towards the centre. The central tooth is small, narrow and straight-sided about two thirds the size of the adjacent laterals. (Waiuku specimens.)

Rhytida stephenensis n. sp. (Plate 4, Fig 8 and Text Fig 3, 3 and 4)

This shell differs from *greenwoodi* in its larger adult size, distinctive dentition, and proportionately lower spire; ratio of height into diameter averaging 1.74 in *stephenensis* as compared with 1.62 in *greenwoodi.*

The five or six obliquely transverse parallel ribs so typical of *greenwoodi* are more pronounced in *stephenensis,* while the radials in this latter species are almost obsolete from the base but strongly developed and irregularly anastomosing over the entire upper surface. Another permanent feature seems to be the absence of the characteristic brown umbilical-patch found in typical *greenwoodi.* Ground colour normally olive-brown, spirit specimens bleached to a yellowish-brown.

Major diameter 34mm.; height 19.0mm.
Major diameter 34mm.; height 19.5mm.
Major diameter 33mm.; height 19.5mm.

Average dimensions, 33.66mm. × 19.33mm.

Dimensions, of *Holotype*—Major diameter 34mm.; minimum diameter 26mm.; height 19.5mm.

Holotype in Dominion Museum, Wellington. Paratypes in author's collection and Auckland Museum collection.

Habitat—Stephen Island, Cook Strait. (Collected by Mr. H. Hamilton.)

Dentition (Text Fig. 4, 4). Formula 13 + 1 + 13, one small rudimentary tooth at margin, second tooth extremely large and massive exceeding the size of all the others, the remaining teeth gradually diminishing in size towards the centre. The central tooth is small, about two thirds the size of the adjacent laterals.

The formation and arrangement of the teeth are similar to those of *greenwoodi,* except that there is only one small tooth preceding the largest at the margin. In *greenwoodi* there are two of these small teeth at the margin and the dental formula is 12 + 1 + 12.

Rhytida dunniae (Gray) (Text Fig. 3, 5).

1840 *Helix dunniae* Gray, A.M. Nat. Hist. (1), 6, p. 317
1913 *Rhytida dunniae* (Gray). Manual N.Z. Mollusca, H. Suter, p. 773 (for full synonymy).

Type in the British Museum.

Specimens have been examined from the following localities: Takahui, Victoria Valley, Kaitaia (coll. Mr. W. La Roche);

Rawene, Hokianga (coll. Mr. W. La Roche); Whangaroa (coll. Mrs. F. W. Sanderson); Kamo and Parua Bay, Whangarei (coll. Mr. C. Cooper); Whangarei (coll. Mr. A. E. Brookes); Waitakerei,, Auckland (coll. Mr. A. Suter); near Cornwallis, Manukau Harb., inside the fallen leaf-sheaths of "Nikau" palms (A.W.B.P. 8/5/1927); "Dreamlands," Henderson Valley, Auckland (with eggs) at the roots of ferns in the open (coll. A.W.B.P., 10/9/1926).

This species has also been recorded from Bay of Islands; Otonga East; Auckland; Howick; and Thames. (Suter 1. c, p. 773.) The Hen Island record refers to the next species.

Dimensions of shell—

Major diameter 25.5mm.; height 14.5mm.
Major diameter 26.5mm.; height 14.5mm. (Victoria Valley, Kaitaia.)

Dimensions of egg—

3mm. × 3.5mm. (Henderson Valley specimens.)

The typical shells have a low spire, ratio of height into diameter averaging 1.79, and the dimensions 26mm. 14.5mm.

Dentition (Text Fig. 4, 2). Formula 18 + 1 + 18, the first five lateral teeth increasing in size from the margin, the sixth is the largest and the remainder diminish towards the centre. The central tooth is narrow as in *greenwoodi* and about half the size of the adjacent laterals. (Henderson Valley specimens.)

Rhytida tarangaensis n. sp. (Text Fig. 3, 6).

This shell differs from *dunniae* in its larger adult size, sculpture, dentition, and proportionately higher spire; ratio of height into diameter averaging 1.55 in *tarangaensis* as compared with 1.79 in *dunniae.*

The sculpture in *dunniae* is in the form of radiating obliquely-retractive granular-wrinkles, less prominent over the base. In *tarangaensis* the radials are more regular and in the form of close, sinuous, anastomosing raised riblets, evenly developed over the entire shell. Whorls 4¾. Colour uniformly yellowish-brown. Periphery angled as in *dunniae.*

Major diameter 31mm.; height 19.5mm.
Major diameter 29.5mm.; height 19.5mm.

Dimensions of Holotype—Major diameter 31mm.; minimum diameter 24.5mm.; height 19.5mm.

Holotype presented to Auckland Museum. Paratypes in collection of A. W. B. Powell.

Dentition (Text Fig. 4, 3). Formula 15 + 1 + 15. The first four lateral teeth are small and slender, the fifth large and massive exceeding the size of all the others, and the remaining teeth gradually diminish in size towards the centre. Central tooth almost as large as the adjacent laterals but narrower and rather blunt.

Habitat—Taranga (or Hen Island), Hen and Chicken Islands (coll. Mr. H. Hamilton).

Rhytida patula Hutton (Text Fig. 3, 7, 8, 9).

1883 *Rhytida patula* Hutton. Trans. N.Z. Inst. vol. 15, p. 139.
1913 *Rhytida patula* Hutton (in part) Manual N.Z. Mollusca, H. Suter, p. 776.

Type from Greymouth in Canterbury Museum, Christchurch.

Habitat—Greymouth (type) (Helms); Capleston near Reefton (Cavell); near Mokihinui, towards Corbyvale. (A.W.B.P., 27th December, 1927.)

Dimensions of topotype—Major diameter 20.5mm.; minimum diameter 15mm.; height 12mm.

Dentition—Formula 18 + 0 + 18 (Hutton). One small tooth at margin, second tooth extra large, then decreasing to centre.

Rhytida otagoensis n. sp. (Text Fig. 3, 10, 11, 12).

Shell of similar shape to that of *patula*, differing in the wider umbilicus, smaller aperture, absence of spiral striae and in the distinctive dentition. Shell thin, covered with a pale greenish-olive epidermis. Whorls $3\frac{3}{4}$, more tightly coiled than in *patula*, resulting in the smaller aperture. Periphery rounded as in the *patula* series. Umbilicus one seventh major diameter. Protoconch flat of $1\frac{1}{2}$ finely radially striated whorls. All post-nucular whorls sculptured with close slightly irregular radial growth lines. The whole surface microscopically malleated, less prominently on the base. The dense spiral striae so typical of *patula* is entirely wanting in this species.

Dimensions of holotype—Major diameter 17.5mm.; minimum diameter 13.5mm.; height 10mm.

Holotype in author's collection.

Habitat—Bluecliff, western side of Te Waewae Bay, Southland (coll. C. E. Clark, 1920); Hutton's Balclutha, Southland record, quoted by Suter, Man. N.Z. Mollusca, p. 777, also refers to this species, not *patula*, as shown by the dental formula 14 + 0 + 14.

Dentition (Text Fig. 4, 6). Formula 14 + 0 + 14. Largest tooth at margin, then decreasing in size to centre. All teeth long and slender. The largest lateral is slightly bent at the middle and has an angular ridge dividing it right from the point to the base.

Genus PARYPHANTA Albers, 1850.

Type: *Nanina busbyi* Gray

The species of *Paryphanta* in New Zealand are covered by two groups, occupying two distinct areas of distribution separated by a gap of about 300 miles. The northern area is represented by *P. busbyi*, a shell having a uniformly dark greenish-black coating of conchin, while the southern area is represented by seven distinct species and three sub-species, all differing from the northern *busbyi* in being variously coloured and banded.

Fig. 6. DENTITION OF PARYPHANTA.
A. *P. atramentaria* Shuttleworth, Victoria.
M. *P. milligani* Pfeiffer (= *fumosă*), Tasmania.
B. *P. busbyi* Gray, North Auckland, N.Z.
H. *P. hochstetteri* Pfeiffer, Nelson-Marlborough, N.Z.
L. *P. lignaria* Hutton, West Nelson, N.Z.
S. *P. superba* n. sp., West Nelson, N.Z.
G. *P. gilliesi* Smith, West Nelson, N.Z.

Radula characters (see under species *busbyi*), and a dark coating of conchin without colour bands are features common to *busbyi* and the Victorian and Tasmanian species, but discordant with the *hochstetteri-lignaria-gilliesi* series which are confined to the Wellington, Marlborough, Nelson and Westland provinces of New Zealand.

However, apart from the close similarity in dentition and coloration, *busbyi* and the Victorian and Tasmanian species show rather diverse anatomical features. Likewise the New Zealand *busbyi* and *hochstetteri* are just as diverse in their anatomy. It seems as though in *Paryphanta* we cannot place any reliance in the genital organs, as pointed out by Murdoch in dealing with the anatomy of the Tasmanian *milligani* (= *fumosa*).

"The most striking peculiarity in the anatomy of the several known species of *Paryphanta* is the marked difference in their genital organs. The difference is chiefly centred in the receptaculum seminis; the contour of this organ is so distinct in each species that, when added to the minor difference in other organs, it presents a type of genitalia unusually distinct among species of the same genus. *P. busbyi* can scarcely be compared with the other members, its genital organs are almost totally different; but this condition is probably due to degeneration." (Murdoch, 1904, p. 160.)

The genus no doubt originated from ancestral *Rhytida* like stock somewhere within the New Zealand area, and achieved its greatest distribution during the great land extensions of the Lower Cretaceous. (See earlier part of this paper.)

Paryphanta is characterized by its shell which is formed very largely of conchin and by its radula which is composed of a large number of aculeate laterals gradually increasing in size from the margin and then decreasing again towards the centre.

KEY TO SPECIES OF PARYPHANTA.

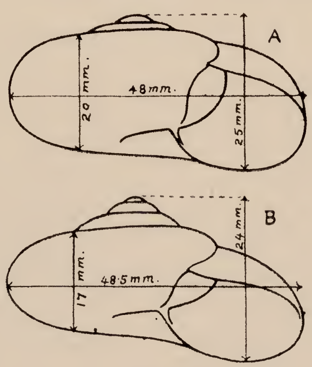

Fig. 5.

Group A. Shell composed of an inner layer of lime with a thick outer coating of uniformly dark brownish-green conchin. One species in New Zealand. North Auckland Peninsula.

(1) Large shell. Dental formula 50 + 0 + 50. *busbyi*

Group B. Shell composed of very little lime but a thick outer covering of conchin, variously coloured and banded. A number of species distributed over the south-western part of the North Island and the northern and western parts of the South Island.

(a) The *hochstetteri* series.

Spirally banded or plain shells up to 87mm. in width. Restricted to the mountains of Marlborough and Nelson; typical species at 2,000 feet and over. Shell proportions as in diagram A, Text Fig. 5.

(2) Shell large, up to 75mm. in width. Ground colour light yellowish-brown above and below, variously spirally banded with dark-brown. Umbilical area always free from colour bands. Dorsal surface to periphery spirally striated. Dental formula 67 + 1 + 67. Pikikiruna, Tasman and Haupiri Ranges at 2,000 to 4,000 feet. *hochstetteri hochstetteri*

(3) Slightly smaller than typical species, up to 58mm. in width. Ground colour light olive or greenish-brown above, with spiral bands and lines of dark-brown as in typical species. Base uniformly dark-brown or almost black, sometimes broken up into one or two spirals towards periphery. Umbilicus never light coloured as in typical species. East Nelson mountains and Western Marlborough Sounds area at 2,000 to 4,000 feet. *hochstetteri obscura*

(4) About same size as *obscura,* up to 61mm. in width. Dark colour of the base confined to umbilicus and a small surrounding area, remainder of base free from bands. Dorsal surface banded as in typical species and with same dental formula. Eastern Marlborough Sounds area at 2,500 to 4,000 feet. *hochstetteri bicolor*

(5) Largest species of genus, up to 87mm. in width. Colour uniformly yellowish-olive without colour bands. Smooth above and below. Dental formula 66 + 1 + 66. Eastern side of Aorere Valley and Rocks Point, Karamea at 1,100 to 2,500 feet. *superba*

(b) The *lignaria* series.
Axially banded or plain shells restricted to the West Coast of the South Island. From a few hundred feet above sea-level to 2,900 feet and probably over. Shell proportions as in the *hochstetteri* series, diagram A, Text Fig. 5.

(6) Shell large, up to 68mm., alternately banded with yellowish and dark-reddish-brown axial streaks. Dorsal surface striated. Dental formula 70 + 1 + 70. Karamea to north side of Mokihinui River, from 120 feet to 1,000 feet and probably over. *lignaria*

(7) Smaller than *lignaria,* up to 45mm., and uniformly olive-brown without axial streaks. Dorsal surface striated. Dental formula 54 + 1 + 54. Seddonville, on south side of Mokihinui River to near Westport, from about 300 feet. *unicolorata*

(8) Smaller than above species, 35mm. Entire surface smooth. Dark greenish-brown, irregularly axially streaked with darker brown. Mt. Greenland 2,900 feet, Ross, Westland. *rossiana*

(c) The *gilliesi* series.
Spirally banded shells up to 50mm. in width. From near sea level to about 2,000 feet and restricted to Northern Nelson and Western Wellington Provinces. All species with striated dorsal surface. Parietal callus smooth or granulated. Shell proportions as in diagram. B. Text Fig. 5.

(9) Parietal callus strongly granulated. Under side bright red-brown. Large umbilical dark patch with clearly defined edge. Periphery with from one to four broad black bands. Dental formula 59 + 1 + 59. Northern Whakamarama Range, West Nelson. *gilliesi gilliesi*

(10) Parietal callus strongly granulated. Same as above species but without basal dark patch. Periphery with four or five strong dark-brown bands. Southern Whakamarama Range, West Nelson. *gilliesi* (variety A)

(11) Parietal callus strongly granulated. Under side olive-brown, gradually deepening to dark-brown in and around umbilicus. Two or three narrow dark bands at periphery. No other dark bands showing on base. Dental formula 64 + 1 + 64. Low country north side of West Haven Inlet, West Nelson. *gilliesi subfusca*

(12) Parietal callus obscurely granulated. Ground colour golden to sienna-brown, base slightly darkened in and around umbilicus by a zone of crowded faint brownish or greenish spiral lines. Upper surface variably banded with dark-brown spiral lines and a light greenish secondary series. Dark bands strongest at periphery and absent from base. Eastern side Aorere Valley, West Nelson. *compta*

(13) Parietal callus smooth. Colour greenish to chocolate-brown, variably marked with numerous narrow spiral bands of dark greenish and reddish-brown with a secondary series of lighter colour in the form of wavy spiral lines and zones. The strongest bands are at the periphery and are from three to five in number. Base dark chocolate-brown, lighter towards outer part, allowing lower peripheral spirals to show. Ngarino and Onekaka Ridges, West Nelson. *fallax*

(14) Parietal callus smooth. Colour light greenish-brown, variably marked with narrow dark-brown spiral bands, one or two strong ones at periphery, a few on the upper surface, more numerous on the base. Dental formula 65 + 1 + 65. Plains around Levin, North Island. *traversi*

Paryphanta busbyi (Gray).

1840 *Helix busbyi* Gray. Ann. Mag. Nat. Hist. (1), vol. 6, p. 317.

1913 *Paryphanta busbyi* (Gray). Manual N.Z. Mollusca, H. Suter, p. 778 (for full synonymy).

Type in British Museum.

Habitat—Northern parts of the North Island; Kaitaia; Hokianga; Mangonui; Bay of Islands; Otonga East; Mania Hill, Whangarei. (Suter, l. c., p. 779.)

The following additional localities are worthy of note: Poor Knight's Islands (Mr. Baker, Bay of Islands, 1923); Taranga, Hen and Chicken Islands (Mr. H. Hamilton, 1925); Awanui (Mr. W. La Roche, 1923); and near Araparera, Makarau, Kaipara (Mr. G. Graham, 1921).

Dentition (Text Fix. 6, B.). Formula 50 + 0 + 50. The individual teeth of *busbyi* differ from those of the remaining New Zealand species in the form of the base, which is produced above forming a deep sinus between this basal projection and the cusp. In all the species of the *hochstetteri-lignaria-gilliesi* series so far examined the upper extremity of the base terminates in a large irregular knob but is not produced upwards as in *busbyi*.

The Victorian *atramentaria* and *compacta* and the Tasmanian *milligani* (= *fumosa*) each have the bases of the teeth shaped as in *busbyi*.

Major diameter 66mm.; minimum diameter 53mm.; height 29mm. (type).

Major diameter 79mm.; minimum diameter 61mm.; height 42mm. (large specimen from near Dargaville).

Eggs—Length 12.5mm.; width 10mm.
Length 12mm.; width 9.5 mm. (Broadwood, Hokianga.)

This species is the well known "Kauri-snail" or "Pupurangi".

Paryphanta hochstetteri (Pfeiffer).

1862 *Helix hochstetteri* Pfeiffer, *Mal. Bl.,* 8, p. 146.

1868 *Helix hochstetteri* Pfeiffer, *Monog. Heliceorum Viventium,* vol. 5, p. 48.

1867 *Helix hochstetteri* Pfeiffer, *Hochstetter's "Neu Seeland",* p. 434, Fig. in text; English edition, p. 169.

1895 *Paryphanta hochstetteri* (Pfeiffer), in Travers *Trans. N.Z. Inst.,* vol. 27, 27, pp. 224-225.

1913 *Paryphanta hochstetteri* (Pfeiffer), in part, Suter, *Man. N.Z. Mollusca,* pp. 781-785.

Pfeiffer (1868) gave the locality of his *Helix hochstetteri* as "Habitat in Alpibus calcareis Novae Seelandiae (v. Hochstetter)".

The illustration in Hochstetter's "Neu Seeland," p. 434, Fig. in text, and p. 169 (English edition) clearly shows that the upper and lower surfaces of the shell were similarly marked with spiral bands on a light ground. Shells from the Pikikiruna Range between Motueka and Takaka fit this description, and the fact that these mountains are covered with great outcrops of marble, strongly suggests that the type locality "in Alpibus calcareis Novae Seelandiae" was somewhere on the Motueka or Takaka side of the Pikikiruna Range.

W. T. L. Travers (1. c, p. 224) mentioned that Hochstetter's first specimen was found near some ponds on the Dun Mountain Pass, between Nelson and the Pelorus Valley. This spot is marked on the Geological Survey map as the saddle on the old Mokatapu Track (2,952ft.). All specimens the writer has seen and personally collected from this spot have the whole of the base dark without any definite banding, quite unlike Hochstetter's figure.

Beutler in describing this dark-based form as a new subspecies *obscura* mentioned that it differed from the typical *hochstetteri* by the colour of the under-side; the typical form having a pale ground colour below as well as above.

We may conclude therefore that Hochstetter's first specimen was not made the type of Pfeiffer's species and that the actual type specimen as described and subsequently figured by Hochstetter came from the Pikikiruna Range.

A specimen in the writer's collection from Mt. Campbell on the Motueka side of the Pikikiruna Range has been selected as a Plesiotype of Pfeiffer's species and is here figured. (Plate 1, Fig 1).

Description of Typical Species

Paryphanta hochstetteri hochstetteri (Pfeiffer) (Plate 1, Figs 1 and 2)

Shell very large, depressed, umbilicated. Dorsal surface sculptured with minute wavy spiral striae, abruptly terminated at periphery. Ventral surface smooth. Ground colour light yellowish-brown irregularly banded with dark-brown or reddish spiral bands and lines, varying in tone from every shade of brown to almost black. In some specimens the bands have a tendency to become fewer and wider on the base, but in most specimens the upper and lower surfaces are approximately similarly banded. However variable the banding, all specimens conform in having the pale ground colour of the umbilical area entirely free from bands or dark colour zone.

Dimensions of shells (Page's Saddle near Canaan)

Major diameter 74.5mm.; minimum diameter 60mm.; height 35mm.

Major diameter 70mm.; minimum diameter 59mm. height 31mm.

Major diameter 67mm.; minimum diameter 57.5mm.; height 35mm.

Major diameter 64mm.; minimum diameter 53mm.; height 31mm.

Dimensions of egg—Length 12.5mm.; width 10.5mm. (Takaka Saddle, one old specimen with worn surface, original colour probably dull-white).

Habitat—Pikikiruna, Tasman and Haupiri Ranges, Nelson. Above saddle, main road between Motueka and Takaka at about 2,900 feet, on the ground under several inches of decaying leaves in Beech forest (narrow banded specimens, A.W.B.P. Dec. 1927); Mt. Campbell, west of Motueka at about 2,500 feet (Miss V. Chapman, 1927, narrow banded specimens); near Canaan, 2,500-3,000 feet, situated between the main road saddle and the coast (narrow to broad banded specimens, Mr. Chapman, 1927); Page's Saddle, 2,200 feet, between Takaka and Canaan on the main range (living under decaying leaves around the roots of old moss-covered tree trunks and among blocks of limestone, B. E. Feary and A.W.B.P., 27/1/1930; narrow to broad banded specimens). Records covering practically the whole extent of the Pikikiruna Range from near Separation Point to Mt. Arthur inclusive have been given by residents of Takaka and Motueka. The following records from the Tasman and Haupiri Ranges suggest that in all probability the species has a continuous distribution over the connected mountain systems, embracing these localities and those of the Pikikiruna Range. Walker's Ridge at about 3,000 feet, between the Waikoromumu and Anatoki Rivers (Mr. J. F. Galey); Flower's Track, 2,000-3,000 feet, Parapara Peak (A.W.B.P., Jan. 1930); and Gouland Downs (Mr. R. E. Clouston).

Dentition (Text Fig. 6H). Formula 67 + 1 + 67. Central tooth smaller than adjacent laterals which are long and slender, very gradually decreasing in size towards margin where they become short and triangular shaped.

Paryphanta hochstetteri obscura Beutler (Plate 2, Figs 1 and 2).

1901 *Paryphanta hochstetteri obscura* Beutler, *Zool. Jahrbucher, Anat.,* vol. 14, p. 369.

1913 *Paryphanta hochstetteri obscura* Beutler, *Man. N.Z. Mollusca,* H. Suter, p. 783.

The writer is indebted to Dr. H. A. Pilsbry for the following translation and notes from the original description, which is not available in New Zealand.

"The species was collected by Professor Schauinsland from the vicinity of Elmsley Bay, N.Z."

"The shell is of greenish-brown colour and traversed by about 13 dark-brown, weakly wavy stripes of unequal breadth. On the under side the shell is dark-brown, nearly black" (translation).

"It is said to differ from the typical *hochstetteri* by the colour of the under side; the typical form having a pale ground colour below as well as above."

Topotypes presented by Professor F. P. Worley have been examined by the writer and one is here figured. In these typical shells the ground colour varies from greenish-brown to yellowish olive. The upper surface is banded with dark-brown spiral lines varying in number and width, but the base is constant in being almost completely covered with a uniformly dark-brown or almost black zone. Towards the periphery this zone is often broken up into from two to six spiral bands.

This subspecies is distributed over the Western Marlborough Sounds area and along the East Nelson mountains from French Pass to Gordon's Knob near Tophouse.

Dimensions of shells—

Major diameter 56mm.; minimum diameter 46mm.; height 26mm. (Topotype)

Major diameter 47mm.; minimum diameter 38mm.; height 24.5mm. (Topotype)

Major diameter 56mm.; minimum diametter 48mm.; height 31mm. (Mt. Stokes)

Major diameter 49mm.; minimum diameter 41mm.; height 25mm. (Koromiko)

Major diameter 58mm.; minimum diameter 50mm.; height 32mm. (Saddle Hill)

Habitat—Elmslie Bay, French Pass (Type); near Admiralty Bay (Captain Bollons); Stephen Island (Captain J. Bollons); on range near Koromiko, western side of Tuamarina Valley (Miss M. K. Mestayer); saddle on "Old Mokatapu Track," 2,952 feet, East Nelson mountains (living around roots of tussock, *Gahnia procera* Forst., A.W.B.P., 2/2/1930); Saddle Hill, east of Nelson at about 3,000 feet (A.W.B.P., 13/1/1930); on the ridge running from Wangamoa Saddle to Mt. Duppa at 2,500 to 3,000 feet (Mr. Wastney and Dr. Kidson); on the slopes of Mt. Kiwi and Mt. Stokes, 2,000-3,000 feet, Marlborough Sounds (H. Harvey, 1928). Local residents report this subspecies from Mt. Starveall and Gordon's Knob.

In the four Mt. Duppa specimens the basal dark patch is rather smaller than in typical shells, but a series of specimens is required before this character is known to be constant.

Dentition—Suter (1913) gave the dental formula as 59 + 1 + 59, presumably quoting from Beutler's paper. Unfortunately no adult live specimens have been at the writer's disposal.

Paryphanta hochstetteri bicolor n. subsp. (Plate 2, Figs 3 and 4).

Shell about the same size as *hochstetteri obscura* but never attaining the size of the typical species. The subspecies *bicolor* is distinguished from *obscura* by the colour of the under-side of the shell, which is a light yellowish-olive, free from banding with the exception of a small dark-brown patch in and around the umbilical area.

This colour form is quite constant over the Eastern Queen Charlotte Sounds district but owing probably, to former imperfect isolation at the head-waters of the present Sounds, colonies of both *bicolor* and *obscura,* together with occasional hybrids are now found over the country intermediate between the two Sounds. To the west of the Pelorus on Stephen Island and on the range extending from French Pass to the saddle near Tophouse the subspecies *obscura* is found to the exclusion of *bicolor,* suggesting that for a considerable time topographic conditions were responsible for the segregation and evolution of these two colour forms into an eastern and a western type, but comparatively recent changes have again facilitated intercourse between these two types resulting in an intermingling and a certain number exhibiting hybrid characteristics.

The Eastern Queen Charlotte Sounds colonies, however, are now completely isolated from the Western Sounds area by the Tuamarina Valley and the Sound, the connecting land not exceeding 250 feet in height. Every specimen of a large series collected from this area had the typical *bicolor* base.

With regard to the suggested hybrids it is well known that the sexes are united in each individual but on the other hand it is also known in the case of the true *Helicidae* that the union of two individuals is required for mutual impregnation.

As the two colour forms are constant in their extreme districts and are found to intermingle only where separation has not been perfect they can be considered distinct geographic races and are entitled to subspecific distinction on this account.

Description of holotype —

Ground colour of whole shell light yellowish-olive. Dorsal surface marked with a few irregular spiral bands of dark-brown becoming stronger towards periphery. Base entirely free from bands with the exception of a circular patch of dark chocolate-brown in and surrounding the umbilical area. Interior of aperture and parietal callus light to dark purplish-brown.

Of the few live specimens collected and the hundreds of dead specimens seen at the type locality not one showed any marked variation.

Major diameter 61mm.; minimum diameter 51mm.; height 31mm. (Holotype)

Major diameter 56mm.; minimum diameter 47mm.; height 27mm.

Major diameter 56mm.; minimum diameter 47mm.; height 30mm.

Major diameter 57mm.; minimum diameter 47mm.; height 30mm.

Holotype presented to Auckland Museum.

Habitat—Mt. Piripiri, east of Picton, 2,700-3,000 feet (type), living on the ground under dead leaves around the roots of the fern *Blechnum discolor* Forst. (A.W.B.P., Dec. 1928); Arapawa Island, Queen Charlotte Sound (Miss M. K. Mestayer); Ocean Bay, Port Underwood (Captain J. Bollons); on the Range near Koromiko, western side of Tuamarina Valley, together with *obscura* (Miss M. K. Mestayer); on the slopes of Mt. Kiwi and Mt. Stokes, 2,000-3,000 feet. Of the 27 specimens received, 12 were typical *bicolor*, 6 typical *obscura* and 9 exhibited hybrid characteristics as evidenced by the colour pattern (H. Harvey, 1928). These assumed hybrids have the umbilical colour patch, but the remainder of the base is crowded with numerous colour lines and ill defined bands.

Dentition—Formula 67 + 1 + 67, the same as in the typical species.

Much field work is required in order to accurately map the respective areas of distribution of this and the previous subspecies.

Paryphanta superba n. sp. (Plate 4, Fig. 3 and Plate 3).

Shell very large, sub-discoidal, umbilicated, thin, smooth and glossy. Colour of protoconch yellowish, early spire whorls dark-brown, remainder of shell uniformly yellowish-olive. Interior of aperture and parietal wall deep chocolate-brown. Whorls 5½ including protoconch of one small smooth flat whorl, nucleus slightly sunken. First four whorls closely coiled then rapidly increasing and inclined downwards towards aperture. Upper spire whorls only slightly raised above body-whorl. Base and body-whorl evenly convex. Umbilicus shallow, about one fifth major diameter of base. Sutures impressed. Both dorsal and ventral surfaces of shell smooth and glossy, crossed by numerous slightly retractive, regularly spaced axial growth folds, more prominent towards sutures. Aperture lunate-oval. Peristome discontinuous, thin, advancing above. Parietal callus thin, dark-brown, terminating abruptly.

Major diameter 77mm.; minimum diameter 65mm.; height 38mm. (holotype).

Major diameter 80mm.; minimum diameter 67mm.; height 40mm. (paratype).

Major diameter 87mm.; minimum diameter 75mm.; height 50mm. (Rocks Point specimen).

Holotype in author's collection, paratypes in Auckland Museum collection; Rocks Point specimens in Cawthron Institute collection, Nelson.

Habitat—"Cedar Creek Ridge," at about 2,500 feet (type), between the Boulder and Clark Rivers: this ridge runs from the Quartz Ranges to the slopes of Lead Hills, eastern side of the Aorere Valley. Living around the roots of tussock, *Gahnia procera* Forst. in stunted sub-alpine forest consisting mainly of mountain beech, cedar and *Dracophyllum* (collected by the writer, accompanied by Mr. R. E. Clouston, of Bainham); five miles south of Rocks Point, north of Karamea Bight and one mile from the sea at 1,100 feet (coll. Mr. Wastney, Nelson).

Probably this species occurs right through the Gouland Downs region, connecting the two localities given above.

Dentition (Text Fig. 6, S). Formula 66 + 1 + 66. Central tooth narrow and about half the height of adjacent laterals. Lateral teeth very similar to those of *hochstetteri*.

This handsome snail is the largest species of the genus. It is allied to *hochstetteri* but lacks the characteristic colour bands and dorsal striae.

The writer is much obliged to Mr. Wm. C. Davies of the Cawthron Institute, Nelson, for the fine photographs illustrating this species.

Paryphanta lignaria Hutton (Plate 4, Fig. 1).

1888 *Paryphanta lignaria* Hutton, Trans. N.Z. Inst., vol. 20, p. 43.

1913 *Paryphanta lignaria* Hutton (in part), Manual N.Z. Mollusca, p. 783.

Type from saddle between Mokihinui and Lyell Rivers, Nelson Province.

This species is undoubtedly our most handsome land snail. Typical shells are exquisitely radially banded with alternating yellowish and dark reddish-brown stripes. In occasional specimens the brown bands are quite wide but the yellowish ones are invariably narrow. The dorsal surface to the periphery is microscopically sculptured with close uneven spiral striae. There are in addition several slightly stronger shallow spiral furrows towards the upper suture. Whorls 5 to 5½ including protoconch.

Hundreds of dead shells were observed by the writer during December 1927; on the ground in native forest at from 100 to 200 feet above sea-level, near St. Helens, Mokihinui. They all showed the characteristic alternate banding and although an exhaustive search was made only one living specimen was found, the majority being dead shells, badly cracked and broken due to an unusually prolonged dry spell.

Mr. R. Curtis, of St. Helens, stated that living specimens were frequently seen crawling in the open across bush-tracks after rain. He later sent eight living specimens collected after rain from under logs and uprooted trees.

Both Hutton's (1900, pl. 2) and Suter's (1915, pl. 32) figures represent a new species, described below, which is always uniformly coloured and devoid of bands. This latter species is confined to the coastal area from the south side of the Mokihinui

River to near Westport while the typical banded *lignaria* is found from the north side of the Mokihinui to Karamea.

Dimensions of three specimens of typical *lignaria* from St. Helens.

Major diameter 48mm.; minimum diameter 39.5mm.; height 27mm. (figured specimen).

Major diameter 59mm.; minimum diameter 49.5mm.; height 34mm.

Major diameter 68mm.; minimum diameter 57mm.; height 39mm.

Holotype in Canterbury Museum, Christchurch.

Habitat—Saddle between Mokihinui and Lyell Rivers (type). About 1½ miles up Marris' Tramway, near junction of Mumm and Stillwater Creeks at 120 feet, north side of Mokihinui River, West Coast, Nelson (coll.A.W.B.P., Dec. 1927); near Corbyvale at 1,000 feet (coll. Dr. P. Marshall, Geological Survey collection, Wellington); Karamea (Dominion Museum coll.).

Dentition (Text Fig. 6, L). Formula 70 + 1 + 70. Central tooth same size as adjacent laterals. Individual teeth similar to those of *hochstetteri.*

Paryphanta unicolorata n. sp. (Plate 4, Fig 2, and Plate 6, Fig 6).

1900 *Paryphanta lignaria* Hutton (not of Hutton 1888). Trans. N.Z. Inst. vol. 32, p. 22, pl. 2.

1915 *Paryphanta lignaria* Hutton (not of Hutton 1888). Manual N.Z. Mollusca, Atlas of plates Pl. 32, Figs. 12, a, b.

Shell moderately large and solid, subdiscoidal, narrowly umbilicated, smooth below, striated above. Colour uniform olive-brown with exception of first post-nuclear whorl which is dark reddish-brown. Whorls more rapidly increasing than in *lignaria,* 4½ including smooth protoconch of 1½ whorls; body-whorl proportionately larger, more expansive towards aperture and slightly more narrowly rounded at periphery. Spire bluntly rounded and slightly elevated. The dorsal surface to the periphery is sculptured with close delicate uneven spiral striae but finer and less conspicuous than in *lignaria.* Umbilicus as in *lignaria,* small, about one ninth major diameter of base. Aperture lunate-oval. Peristome discontinuous, thin, overhanging above. Parietal wall covered by a thick bluish-white callus.

Dimensions of holotype—

Major diameter 45mm.; minimum diameter 36.5mm.; height 26mm.

Dimensions of eggs—

Length 8.5mm.; width 8.25mm.

Length 9mm.; width 7.5mm.

Colour of eggs—Dull olive-brown.

Holotype in author's collection.

Habitat—Seddonville, West Coast, Nelson (type) (a number of specimens collected from around flax (*Phormium*) bushes by the late Clement L. Wragge, 1908). Also a series of live specimens from Seddonville in collection of Dr. E. N. Drier, collected by Mr. R. Curtis; Mt. Rochfort, near Westport (Hutton's 1900 figured specimen and Suter's 1915 copy of the same plate).

Dentition—Formula 54 + 1 + 54. Central tooth two thirds size of adjacent laterals. Individual teeth similar to those of *lignaria* and the *hochstetteri* series.

Paryphanta rossiana n. sp. (Plate 4, Figs. 4, 5 and 6).

Shell sub-globose, moderately large, narrowly umbilicate, smooth and glossy. Shell substance thin, composed almost entirely of conchin with exception of a thin internal calcareous film. Colour dark greenish-brown, irregularly axially streaked with slightly darker brown co-incident with the growth periods. Apical whorls light in colour, first half whorl white, next whorl light grey merging first into chestnut-brown and then into the dark greenish-brown of later whorls. Whorls rapidly increasing, 4½, including protoconch of 1½ smooth almost flat whorls. Adult whorls broadly rounded at periphery. Spire low, bluntly rounded, very little raised above body-whorl. Umbilicus small, deep, about one tenth major diameter of base. Aperture lunate-oval. Peristome discontinuous, thin, advancing and overhanging above towards centre of whorl, strongly retracted on either side and over base. Parietal callus dark greyish, caused by a thin, dull, semitransparent veneer of callus over the dark greenish-brown body-whorl.

Major diameter 35mm.; minimum diameter 27.5mm.; height 19mm.

Holotype the only known specimen in author's collection.

Habitat—At the top of Mt. Greenland, 2,900 feet, Ross, Westland (collected alive by Mr. H. Hamilton, March, 1910).

Dentition unknown, animal not preserved.

The obscure axial banding of *rossiana* suggests relationship with *lignaria* but this latter species differs in having a striated upper surface and a moderately heavy calcareous layer.

The southern range of the genus is extended considerably by the finding of this beautiful species.

Paryphanta gilliesi E. A. Smith.

1880 *Paryphanta gilliesi* Smith, Ann. Mag. Nat. Hist., ser. 5, vol. 6, p. 159.

1913 *Paryphanta gilliesi* Smith, Manual N.Z. Mollusca, H. Suter, p. 781.

The type locality for *gilliesi* was given as Whakamarama Mountain, Collingwood, but the name Whakamarama does not refer to any particular mountain but to a coastal range extending for about thirty miles, from the coast near Collingwood to the Gouland Downs. This range terminates within three miles of Collingwood township in a mountain of bold outline known as Mt. Burnett. The accessibility of Mt. Burnett to Collingwood, combined with the original description of the species are the reasons for assuming that Smith's type came from this particular part of the range .

Fortunately there is only one species of *Paryphanta* so far known to occur on or in the vicinity of the Whakamarama Range. There are three distinct colour forms however, one being restricted to the low country around the shores of West Haven Inlet which could hardly be termed Whakamarama Mountain, while the second is found on both slopes along the southern section of the range and the third here considered the typical form is found on the northern extremity of the range near Collingwood.

With regard to the dimensions of Smith's type the height given is less than that of any specimen of similar diameter so far observed but this can be accounted for by the shrunken condition of the type specimen, which fact is mentioned in the original description. Smith's description is lacking in detail making the task of identification impossible without recourse to topotypes. Suter (1915, Pl. 48, Fig. 13) provided a figure which he ascribed to *gilliesi* but did not state its origin. This figure appears to have been taken from the Dominion Museum specimen mentioned by Suter (1913, p. 781) as shown by the peculiar contour of the peristome towards the umbilicus. The Dominion Museum specimen shows this same feature which is adventitious, having been brought about by warping of the shell, which is now a shapeless mass, broken and collapsed in drying or through exposure to sunlight. Enough remains however to show that without doubt the Dominion Museum specimen is a half grown example of the common Whakamarama shell.

In order to definitely fix the characters of *gilliesi* a plesiotype from Mt. Burnett in the Auckland Museum collection is here described and figured.

Paryphanta gilliesi gilliesi Smith (Plate 5, Figs 3 and 4, and Plate 6, Fig. 1).

Shell moderately large, umbilicated. Dorsal surface sculptured with minute wavy spiral striae abruptly terminated at periphery. Ventral surface smooth and glossy. Colour of protoconch pale yellow, spire whorls umber toning to burnt-sienna-brown, variably marked with numerous narrow dark-brown and reddish-brown spiral lines. Periphery with either one broad black band or two, three, and sometimes four smaller bands occupying the same position. On the base there is a broad band of ground colour between the peripheral bands and a uniformly dark-brown almost black clearly defined patch filling and surrounding the umbilical area. The ground colour of the base where not obscured by peripheral bands and umbilical patch is a bright red-brown like rosewood. Interior of aperture and parietal callus dark-brown almost black in fresh specimens. Whorls slowly increasing, five, including protoconch of one and a half almost flat, slightly sunken, roughly striated whorls. Spire low, rounded, only slightly raised above body-whorl. Base and body-whorl evenly convex. Umbilicus narrow one eighth major diameter of base. Parietal callus distinctive, always covered with fine granulations even in juvenile shells.

Major diameter 41mm.; minimum diameter 33.5mm.; height 28.5mm. (plesiotype)

Major diameter 46mm.; minimum diameter 36mm.; height 23mm.

Major diameter 48.5mm.; minimum diameter 41mm.; height 24mm.

Major diameter 35mm.; minimum diameter ——; height 14mm. (Smith's type).

Major diameter 35mm.; minimum diameter 29mm.; height 20mm.

Holotype in British Museum. *Plesiotype* in Auckland Museum.

Habitat—Mt. Burnett, Collingwood, Nelson. Near the top at 1,900-2,000 feet, living on the ground under decaying leaves among blocks of marble in stunted sub-alpine forest (A.W.B.P., Jan., 1930).

Eggs pale-buff, surface smooth but dull. Length 9mm., width 8.25mm.

Food—These snails feed upon the common bush earthworms. The writer has removed from a living specimen an entire worm 8½ inches in length. (See note elsewhere in this paper.)

Dentition (Text Fig. 6, G). Formula 59 + 1 + 59. Central tooth about two-thirds size of adjacent laterals.

The permanent features of typical *gilliesi* are the granulated parietal callus, deep red-brown colour of the under side and the large sharply defined dark patch filling and surrounding the umbilical area. The variable features are in the number and strength of the dorsal and peripheral bands. Taking 76 specimens, 12 were found to have the one broad peripheral band, 42 had this divided into two, 21 into three, and 1 into four smaller bands.

Paryphanta gilliesi (variety A) (Plate 5, Fig. 5).

Dorsal surface similar in every respect to that of the typical species. Ventral surface the same red-brown colour but without the characteristic central dark patch. There are from four to five strong dark-brown almost black peripheral bands, three of which are situated below the periphery and are visible from the base. Other characters as in typical species.

This colour form occurs on the south side of the Paturau River and may prove to be a good geographic subspecies. There are similar specimens together with a few of the typical species in a lot reputed to have been collected on the Whakamarama Range west of Bainham. This collection however may not have been restricted to the actual locality recorded. It is not considered desirable therefore to give this form a name until more definite information is obtainable.

Habitat—Paturau River, West Coast, Nelson (Mr. Donald McKenzie, 1928); Kahurangi Point (Captain J. Bollons); Whakamarama Range, west of Bainham (per Mr. F. V. Knapp).

Two river systems, the Paturau on the west, and the Kaituna on the east, almost meet at their head-waters forming the only break in the continuity of the Whakamarama Range. This break probably acts as the segregating factor giving rise to the variation from the type observed in the form described above.

Paryphanta gilliesi subfusca n. subsp. (Plate 5, Figs. 6 and 7).

Shell moderately large, umbilicated. Dorsal surface sculptured with minute wavy spiral striae abruptly terminated at periphery. Ventral surface smooth and glossy. Colour of protoconch pale yellow, spire whorls greenish-umber toning to sienna-brown on body-whorl, variably marked with numerous narrow dark-brown and reddish-brown spiral lines, a few stronger bands at periphery and bordering the upper suture. The peripheral bands are narrow compared with the typical species and vary from two to four, the upper one being the strongest. The base is practically devoid of strong spiral colour bands and the ground colour is an olive-brown, gradually deepening to a dark greenish to reddish brown in and around the umbilicus. Axial streaks and obscure closely spaced light greenish concentric lines radiate from the umbilical patch which does not end with a sharply defined edge as in the typical species. The lowest of the peripheral bands encircles the base near to the periphery but apart from this there are no strong bands on the ventral surface. Interior of aperture and parietal wall dark-brown. Whorls slowly increasing, five, including protoconch of one and a half almost flat, slightly sunken, roughly striated whorls. Spire low, rounded, slightly raised above body-whorl. Umbilicus narrow one seventh major diameter of base. Peristome discontinuous, thin, advancing above and curved slightly downwards. Parietal callus distinctive, always covered with fine granulations, even in juvenile shells.

Major diameter 47mm.; minimum diameter 40mm.; height 25.5mm.

Major diameter 45mm.; minimum diameter 39mm.; height 24mm. (holotype).

Holotype presented to Auckland Museum.

Habitat—Kaihoka, near the coast to the north of the entrance to West Haven Inlet, Nelson, at about 120 feet above sea level. On the ground under fallen "Ponga" and "Nikau" leaves in a small patch of bush between the two lakes. Collected by Mr. A. H. Fletcher, of Collingwood.

This subspecies is separated from the typical Whakamarama *gilliesi* by the waters of West Haven Inlet and the forest area to the north of the Pakawau Gorge, from which no specimens have been seen by any of the local residents.

Dentition—Formula 64 + 1 + 64. Central tooth about same size as adjacent laterals. Individual teeth similar to those of *hochstetteri*

The permanent features of *gilliesi subfusca* apart from the granulated parietal callus, are the colour of the ventral surface which is an olive-brown gradually deepening to a dark greenish to reddish-brown in and around the umbilicus, and the almost complete absence of spiral bands from the ventral surface. The variable features as in the typical species are in the number and strength of the dorsal and peripheral bands.

Paryphanta compta n. sp. (Plate 6, Figs. 4 and 5).

Shell moderately large, of similar size and shape to *gilliesi*. Whorls 5 including protoconch of 1½ almost flat, roughly striated and wrinkled whorls. Dorsal surface sculptured with minute wavy spiral striae, abruptly terminated as periphery. Ventral surface smooth and glossy. Colour of protoconch pale yellow, remainder of shell golden to sienna-brown. Banding extremely variable, two to four dark-brown moderately strong spiral lines at periphery, the lowest one visible from the base; the remainder of the dorsal surface with narrow dark-brown spiral lines, varying considerably in number and arrangement. Associated with these dark lines is an obscure secondary series of light-green bands, which are practically confined to the immediate vicinity of the dark lines and vary in width according to the width of the lines they are adjoining. Mostly these green bands occur on the lower side of the dark lines. Excepting the lowest peripheral band, the base is devoid of the dark lines. There is however a gradual darkening of the colour of the base towards the umbilicus, but the darkest part is comparatively light in tone. The only other basal markings are a zone of crowded faint greenish or brownish concentric spiral lines, mostly confined to the umbilicus and surrounding area. Interior of aperture bluish-black. Parietal callus dark pinkish-grey with a few scattered granulations within, becoming obsolete towards mouth of the aperture. Umbilicus one ninth major diameter of base.

Major diameter 48mm.; minimum diameter 41mm.; height 28mm. (Holotype).

Major diameter 47mm.; minimum diameter 40mm.; height 24mm.

Holotype in Auckland Museum collection.

Habitat—Between the Castles and Beetham's Clearing at about 2,000 feet, Brown Cow Ridge, eastern side of Aorere Valley, West Nelson (A.W.B.P. and Mr. Langford, of Bainham, 23/1/1930). Living on the ground under decaying leaves around the roots of *Blechnum discolor* Forst, in mixed forest; also received from Mrs. G. Graham, Bainham.

Dentition—The correct dental formula of this species is uncertain for one of the two mounted radulae has a formula of 53 + 1 + 53 and the other which shows abnormal features 65 + 1 + 65. In the latter example six laterals on the extreme right and four on the extreme left differ in having several cusps and a bifid base. In most of these abnormal teeth the usual strong aculeate cusp is bifid and even traces of a third cusp are clearly shown in several of the teeth on the extreme right.

This species stands nearest to *gilliesi* and probably originated from an eastern drift of the ancestors of that species after the uplift of the present Aorere Valley floor. The eroded sloping plateau now occupied by this species bears evidence of having been under the sea during Miocene times and having been later subjected to extensive erosion. Only a few isolated masses of the covering strata escaped destruction and so far as the writer was able to observe this species is now restricted to the forests on and in the vicinity of these areas of Miocene limestone.

The occurrence of old crushed specimens ascribed to this species in the Pleistocene and Recent silts of the valley is mentioned in the early part of this paper.

Paryphanta fallax n. sp. (Plate 6, Figs. 2 and 3).

Shell moderately large of similar size and shape to *gilliesi.* Whorls 5 including typical protoconch of 1½ almost flat roughly striated and wrinkled whorls. Dorsal surface to periphery sculptured with minute wavy spiral striae as in other species. Colour of protoconch yellow, dorsal surface dark olive to sienna-brown, variably marked with numerous narrow spiral bands of dark greenish and reddish-brown, diffused by a secondary pattern of obscure wavy spiral lines, and frequently by spiral zones of lighter greenish and brownish tone, the whole giving a sombre dark greenish-brown to chocolate-brown appearance. The strongest of the dark-brown bands vary from three to five in number, and are situated from just above the periphery to the outer part of the base, the upper one being usually the strongest. The ground colour of the base is a dark chocolate-brown, lighter towards the outer part, just sufficient to allow the lower peripheral spirals to show. Interior of aperture dark-brown, almost black. Parietal callus dark purplish-brown, quite smooth without any traces of granulations. Umbilicus narrow, one eighth major diameter of base.

Major diameter 48mm.; minimum diameter 38mm.; height 25.5mm.

Major diameter 45mm.; minimum diameter 37mm.; height 25mm. (Holotype).

Major diameter 41mm.; minimum diameter 33mm.; height 24mm.

Holotype presented to Auckland Museum.

Habitat—Hidden Treasure Track at about 2,300 feet, Ironstone Creek watershed, between Parapara Inlet and Takaka, West Nelson (Mr. H. Ives and Mr. Flowers); on Flower's Track to Parapara Peak at about 3,000 feet, one dead shell (A.W.B.P., 25/1/1930); Onekaka Hill, on the track to the Iron Works Quarry at about 900 feet (Dr. J. Henderson, 1922).

This species is probably distributed over the Ngarino and Onekaka Ridges and extends from the Parapara River to Parapara Peak.

The shell is very similar to *gilliesi* in general appearance but can at once be distinguished by the smooth parietal callus and the chocolate, not reddish-brown colour.

The writer is very much obliged to both Messrs. Ives and Flowers, of Puramohoi, who collected the specimens upon which this species is founded.

Dentition unknown.

Paryphanta traversi n. sp. (Plate 5, Figs. 1 and 2).

1913 *Paryphanta hochstetteri* var. *obscura* Suter (in part, not of Beutler, 1901). Manual N.Z. Mollusca, p. 783.

Shell moderately large, umbilicated. Dorsal surface sculptured with minute wavy spiral striae abruptly terminated at periphery. Ventral surface smooth and glossy. Colour light greenish-brown, early spire whorls and base darker. Dorsal surface with a few obscure traces of spiral bands. Ventral surface crowded with dark brown spiral bands, one or two strong ones at periphery, the remainder of varying strength becoming crowded below forming a darkened area surrounding the umbilicus. There are about twelve to fourteen spiral bands visible on the base exclusive of those merged around the umbilical area. Interior of aperture bluish-black. Parietal callus smooth, dark purplish-grey irregularly marked by axial growth periods. Whorls 5 including protoconch of 1½ low roughly striated whorls. Umbilicus narrow, one sixth major diameter of base. Aperture lunate-oval. Peristome discontinuous, thin, advancing above and curved slightly downwards.

Major diameter 49.5mm.; minimum diameter 41.5mm.; height 28.5mm. (Holotype).

Major diameter 51.5mm.; minimum diameter 43mm.; height 32mm.

Eggs, pale olive-brown.

Length 10.5mm.; breadth 8mm.
Length 10.5mm.; breadth 8mm.
Length 10mm.; breadth 8mm.

Holotype presented to Auckland Museum.

Habitat—On the plains around Levin and Shannon, North Island; in small patches of native bush on the Government Experimental Farm, Levin, about 120 feet altitude. Living on the ground under decaying leaves (A.W.B.P., Jan., 1927); Waiopehu Reserve, on the plains near Levin (Type); living on the ground under leaves and masses of decaying "ponga" fronds in native bush (A.W.B.P., Jan., 1928).

Dentition—Formula 65 + 1 + 65. Individual teeth similar to those of the *hochstetteri* series, except that the central tooth is considerably shorter than the adjacent laterals.

This species is confined to the plains of Pleistocene age around Levin and Shannon, in the North Island and is nearest related to *P. gilliesi*, a subspecies of which occupies the low country of early Tertiary age around Collingwood and West Haven, Nelson.

Marshall and Murdoch (1920, p. 118) suggested the former existence of a continuous beach between Kahurangi Point and the Wanganui area during the formation of the Wanganui Upper Tertiary sediments, which are composed of material assumed to have been derived from Karamea granite. This continuous land surface would account for the emigration of a member of the *hochstetteri* series to what is now the North Island.

Probably at about the same time the areas now occupied by the Seaward Kaikoura and Rimutaka-Tararua systems were connected across Cook Strait on the eastern side, accounting for the distribution of *Wainuia urnula,* mentioned later in this paper.

Wainuia n. gen.

Type: *Helix urnula* Pfeiffer.

The genus is a curious one showing relationships with both *Paryphanta* and *Rhytida.* It seems to stand nearer to the latter genus as shown by the malleated shell and the dentition. The radula has a relatively small number of teeth per row and the outermost lateral is only half the size of the second lateral from the margin, which is the largest; the remaining teeth diminish in size to the centre. These features are also common to *Rhytida* but not to *Paryphanta* in which a much greater number of teeth are present per row and these differ in gradually increasing in size from the margin and decreasing again towards the centre. The radula of *Wainuia* differs from that of *Rhytida* in all the teeth being long, slender and similarly shaped.

A feature showing relationship with *Paryphanta* is in the composition of the shell which is almost entirely of conchin. It has been stated by Murdoch (1906, p. 313) that the predominance of conchin in the shells of *Paryphanta* is the one prominent feature by which the shells may be distinguished from the nearly akin *Rhytida.*

The anatomy of both *W. urnula* and *W. edwardi* have been described by Murdoch (1902) and Collinge (1901) respectively. It is difficult to form accurate comparisons from these independently published descriptions but it is made quite evident that *urnula* and *edwardi* have certain characteristics of both *Rhytida* and *Paryphanta* but do not agree entirely with either genus.

The shell of *Wainuia* is characterized by being thin, black, malleated and composed almost entirely of conchin.

Probably the most interesting feature about *Wainuia* is its significant distribution, being confined to the higher levels of two big Trias-Jura mountain systems. If any further evidence is necessary in tracing the continuity of the Seaward Kaikouras of Marlborough across Cook Strait and resolving into the Rimutaka-Tararua system of Wellington, the distribution of one of the species of *Wainuia* should be taken into account.

There are only two species referrable to this genus so far discovered and one, *edwardi,* is apparently confined to the Inland Kaikoura Range of the South Island and Hossack Downs, an area to the South of the Kaikoura systems, while the other, *urnula,* has been found on both the Seaward Kaikoura Range of the South and the Rimutaka-Tararua Range of the North

Island. The finding of the same species in both islands provides further evidence in support of the comparatively recent origin of Cook Strait. *

The genus *Wainuia* is never found at less than 1,000 to 1,500 feet altitude and has not been found outside the area mentioned above. The fact that the eggs are quite large eliminates any suggestion of accidental transportation.

Cockayne (Trans. N.Z. Inst., vol. 39, p. 313, 1907) and Myers (1. c., vol. 56, p. 445, 1926) have also noted in the case of plants and heteroptera respectively that "Cook Strait forms no line of demarcation."

Cotton (1916, Geol. Mag., vol. 3, pp. 248 and 319) has stated that the formation of Cook Strait probably took place subsequent to the Pliocene orogenic movements, as the result of subsidence of blocks. (See earlier part of this paper.)

KEY TO SPECIES

(1) Shell comparatively small, major diameter 24mm. Protoconch sculptured with close, retractive axial riblets. Dental formula 14 + 1 + 14. *urnula*

(2) Shell larger and more globose, major diameter 34mm. Apical whorls more depressed, sculpture of protoconch almost obsolete. Body-whorl more tightly coiled. Dental formula 26 + 1 + 26. *edwardi*

Wainuia urnula (Pfeiffer)

1855 *Helix urnula* Pfeiffer, Proc. Zool. Soc (Lond.), 49.

1913 *Paryphanta urnula* (Pfeiffer). Manual N.Z. Mollusca, p. 784, H. Suter (for full synonymy).

The following localities were given by Suter (1913, p. 785):

Lowry Bay, Port Nicholson (Sir J. Hector); Crow's Nest, 4 miles north of Wellington at about 1,000 feet (R. M. Laing); Wainuiomata (G. V. Hudson); Pohui (Hutton); Tararua Mountains (H. Hamilton).

The following additional localities are known to the writer:

Paraparaumu, 2,200 feet (H. Hamilton, Oct., 1924); Wainuiomata, 1,200 feet (A.W.B.P., Jan., 1928); Mt. Holdsworth, Tararua Range (collected H. W. Simmonds, Dominion Museum coll.); Monkeyface, a mountain over 2,000 feet altitude, 15 miles due west of Kaikoura Peninsula (collected by the late Dr. J. Allan Thomson, Dominion Museum collection).

The species has previously been considered precinctive to the Tararuas and the environs of Wellington.

At Wainuiomata, *urnula* occurs quite commonly on the ground under masses of decaying "ponga" leaves. Eggs, juve-

* Since this was written Mr. Davies of the Cawthron Institute, Nelson, has sent the writer a live specimen of *edwardi*, collected on the Seaward Kaikoura Range at a point six miles north of Kaikoura and about two miles from the sea at an altitude of 500 feet. He was informed that empty shells were plentiful up to 2,000 feet. This specimen has the same dental formula as the typical species and agrees with it in every respect. The Dominion Museum specimens from Monkeyface however, although from the same range, undoubtdly have the shell features of *urnula*. It is evident that the distribution of these two species overlaps as in the case of the Marlborough subspecies of *Paryphanta*. Further field work is necessary in order to accurately define the areas of distribution of these two species.

niles and adults were collected by the writer towards the end of January, 1928.

Dimensions of Wainuiomata 1,200 feet specimens—

Major diameter 24mm.; minimum diameter 18mm.; height 17mm.

Major diameter 22mm.; minimum diameter 16mm.; height 15mm.

Major diameter 13mm.; minimum diameter 10mm.; height 9mm.

Eggs calcareous, white. Length 5mm.; breadth 4mm.

Dimensions of Paraparaumu, 2,200 feet specimens—

Major diameter 24.25mm.; minimum diameter 17.75mm. height 17mm.

Eggs, Length 5.75mm.; breadth 4.4mm.

Dimensions of Monkeyface specimen (three specimens, two damaged)—

Major diameter 21mm.; minimum diameter 15.5mm.; height 14.5mm.

Dentition—Formula 14 + 1 + 14. Wainuiomata specimen (Text Fig. 2, W).

Wainuia edwardi (Suter).

1899 *Paryphanta edwardi* Suter, Pro. Malac. Soc., vol. 3, p. 290, pl. 2, Figs. 22-25.

1913 *Paryphanta edwardi* Suter, Manual N.Z. Mollusca, H. Suter, p. 780.

Type in Suter collection, now in Wanganui Museum.

Habitat—Hossack Downs, North Canterbury (E. Suter) south of the Kaikoura Ranges. Found on the hills at the source of the Hamner River, under bushes and especially under leaf mould. (Private communication from Mr. E. Suter per Mr. A. Suter, 20/12/1927); on the slopes of Tapuaenuka, Clarence River side (collected by Mr. R. Wilson, Dec., 1915; Dominion Museum collection).

Dimensions of Hossack Downs specimens—

Major diameter 30mm.; minimum diameter 25mm.; height 20mm. (Suter, 1913).

Major diameter 34mm.; minimum diameter 26mm.; height 21mm. (Topotype).

Major diameter 17.75mm.; minimum diameter 14mm.; height 13mm (Topotype).

Major diameter 12mm.; minimum diameter 9mm.; height 8.5mm. (Topotype).

Egg calcareous, white. Length 6mm.; breadth 5mm.

Dimensions of Tapuaenuka specimens—

Major diameter 21.75mm.; minimum diameter 17mm.; height 15.5mm.

Major diameter 22.5mm.; minimum diameter 17.5mm.; height 15.5mm.

Dentition—Formula 26 + 1 + 26.

Genus SCHIZOGLOSSA Hedley, 1892.

Type: *Daudebardia novoseelandica* Pfeiffer.

The genus is nearest allied to *Paryphanta*, as pointed out by Hedley (1892) and later by Murdoch (1900).

Shell auriform, flattened, incapable of containing the animal, being reduced to the function of a shield to the lungs and heart.

The radula (Text Fig. 2, S, and Fig 4, 1) consists of from 25 to 28 laterals on each side, with the outermost very small, the following four increasing in size and then decreasing to centre.

The species described below makes the second known member for the genus, which is at present known only from the North Island of New Zealand.

Schizoglossa gigantea n. sp. (Plate 1, Figs. 5 and 6).

Shell large, solid, rectangular-ovate. Protoconch with major diameter of 5mm., 1½ very rapidly increasing whorls, first smooth, then spirally grooved as in *novoseelandica*. Post-nuclear whorl sculptured with irregular spiral striae and anastomosing axial wrinkles. The whole shell is much more massive and attains a far greater size than *novoseelandica*, and differs mainly in being flatter, more rectangular and in having the early part of the periphery distinctly keeled.

Major diameter 32mm.; minimum diameter 19mm.; height 6mm. (Holotype).

Holotype in author's collection.

Habitat—Subfossil with moa bones, cave near Tahora, Gisborne District (H. Hamilton).

PARYPHANTIDAE *

(Synopsis of New Zealand members of the family.)

Genus 1 *Rhytida* Albers, 1860. (Type: *Helix greenwoodi* Gray.)

(1) *R. greenwoodi* (Gray). Whangaroa to Lake Guyon, Nelson.
(2) *R. stephenensis* Powell. Stephen Island, Cook Strait.
(3) *R. dunniae* (Gray). Kaitaia to Thames.
(4) *R. tarangaensis* Powell. Taranga Id., Hen and Chicken Islands.
(5) *R. duplicata* Suter. Cape Maria van Diemen and Te Reinga.
(6) *R. meesoni* Suter. Nelson and Marlborough.
(7) *R. patula* Hutton. Greymouth to Reefton, West Nelson.
(8) *R. citrina* Hutton. Greymouth to Buller River, West Nelson.
(9) *R. otagoensis* Powell. Southland.
(10) *R. australis* Hutton. Stewart Island.

Genus 2 *Paryphanta* Albers 1850. (Type: *Nanina busbyi* Gray.)

(1) *P. busbyi* (Gray). North Auckland Peninsula.
(2) *P. hochstetteri* (Pfeiffer). Pikikiruna-Tasman and Haupiri Ranges, West Nelson.
(3) *P. hochstetteri obscura* Beutler. Western Marlborough Sounds.
(4) *P. hochstetteri bicolor* Powell. Eastern Marlborough Sounds.
(5) *P. superba* Powell. Eastern side Aorere Valley and Rocks Point, West Nelson.
(6) *P. lignaria* Hutton. Karamea to Mokihinui River, West Nelson.
(7) *P. unicolorata* Powell. Mokihinui River to Westport, West Nelson.

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* The family name is here changed from *Rhytididae* to *Paryphantidae* in conformity with the now generally accepted method of basing the family name on the oldest genus name admitted to the family.

(8) *P. rossiana* Powell. Mount Greenland, Ross, Westland.
(9) *P. gilliesi* Smith. Northern Whakamarama Range, West Nelson.
(10) *P. gilliesi* (var. A.) Southern Whakamarama Range, West Nelson
(11) *P. gilliesi subfusca* Powell. North side West Haven, West Nelson.
(12) *P. compta* Powell. Eastern side Aorere Valley, West Nelson.
(13) *P. fallax* Powell. Ngarino and Onekaka Ridges, West Nelson.
(14) *P. traversi* Powell. Levin, North Island.

Genus 3 *Wainuia* Powell, 1930. (Type: *Helix urnula* Pfeiffer.)
(1) *W. urnula* (Pfeiffer). Rimutaka-Tararua Ranges, North Island and Seaward Kaikoura Range, South Island.
(2) *W. edwardi* (Suter.) Inland Kaikoura Range and Hossack Downs, South Island.

Genus 4 *Schizoglossa* Hedley, 1902. (Type: *Daudebardia novoseelandica* Pfeiffer.)
(1) *S. novoseelandica* (Pfeiffer). North Island.
(2) *S. gigantea* Powell. Cave near Tahora, Gisborne (sub-fossil).

Genus 5 *Delos* Hutton, 1904. (Type *Zonites coresia* Gray.)
(1) *D. coresia* (Gray). North Island.
(2) *D. jeffreysiana* (Pfeiffer). North Island.

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Description of Plates.

PLATE 1.
Fig. 1. *Paryphanta hochstetteri* (Pfeiffer) (Plesiotype).
Fig. 2. *Paryphanta hochstetteri* (Pfeiffer), Canaan, Nelson.

Figs. 3 and 4. *Schizoglossa novoseelandica* Pfeiffer, Manaia, Whangarei Heads.
Figs. 5 and 6. *Schizoglossa gigantea* n. sp. (Holotype).

PLATE 2.
Figs. 1 and 2. *Paryphanta hochstetteri obscura* Beutler (Topotype).
Figs. 3 and 4. *Paryphanta hochstetteri bicolor* n. subsp. (Holotype).

PLATE 3.
Paryphanta superba n. sp. Rocks Point specimens.
Wm. C. Davies, Cawthron Institute, Photo.

PLATE 4.
Fig. 1. *Paryphanta lignaria* Hutton, Mokihinui.
Fig. 2. *Paryphanta unicolorata* n. sp. (Holotype).
Fig. 3. *Paryphanta superba* n sp. (Holotype).
Figs. 4, 5 and 6. *Paryphanta rossiana* n. sp. (Holotype).
Fig. 7. *Rhytida greenwoodi* (Gray), Muriwai, West Coast.
Fig. 8. *Rhytida stephenensis* n sp. (Holotype).

PLATE 5.
Figs. 1 and 2. *Paryphanta traversi* n. sp. (Holotype).
Figs. 3 and 4. *Paryphanta gilliesi* Smith (Plesiotype).
Fig. 5. *Paryphanta gilliesi* (var. A.) Paturau River, West Nelson.
Figs. 6 and 7. *Paryphanta gilliesi subfusca* n. subsp. (Holotype).

PLATE 6.
Fig. 1. *Paryphanta gilliesi* Smith (Plesiotype).
Figs. 2 and 3. *Paryphanta fallax* n. sp. (Holotype).
Figs. 4 and 5. *Paryphanta compta* n. sp. (Holotype).
Fig. 6. *Paryphanta unicolorata* n. sp. (Holotype).

PLATE 7.
Paryphanta hochstetteri obscura Beutler. Specimens from the "Old Mokatapu Track," 2,952 feet, East Nelson Mountains.
Wm. C. Davies, Cawthron Institute, Photo.

Fig. 1. HYPOTHETICAL GEOLOGICAL MAP OF THE COOK STRAIT REGION, ILLUSTRATING THE DISTRIBUTION OF PARYPHANTA AND WAINUIA.
(Based partly on Morgan's 1922 Geological Sketch Maps of N.Z.)

Fig. 2. GENERIC TYPES OF DENTITION IN PARYPHANTIDAE.
S. *Schizoglossa* (Type), R. *Rhytida* (Type), W. *Wainuia* (Type), P. *Paryphanta* (*hochstetteri*), D. *Delos* (Type).

Fig. 3. RHYTIDA.
1 and 2 *Rhytida greenwoodi* (Gray), Muriwai, West Coast.
3 and 4 *Rhytida stephenensis* n. sp., Holotype.
5 *Rhytida dunniae* (Gray), Whangarei.
6 *Rhytida tarangaensis* n. sp. Holotype.
7, 8, 9 *Rhytida patula* Hutton, Mokihinui.
10, 11, 12 *Rhytida otagoensis* n. sp. Holotype.

Fig. 4. DENTITION OF SCHIZOGLOSSA AND RHYTIDA.
1 *Schizoglossa novoseelandica* Pfeiffer.
2 *Rhytida dunniae* (Gray).
3 *Rhytida tarangaensis* n. sp.
4 *Rhytida stephenensis* n. sp.
5 *Rhytida greenwoodi* (Gray).
6 *Rhytida otagoensis* n. sp.

Fig. 6. DENTITION OF PARYPHANTA.
A. *P. atramentaria* Shuttleworth, Victoria.
M. *P. milligani* Pfeiffer (= *fumosa*), Tasmania.
B. *P. busbyi* Gray, North Auckland, N.Z.
H. *P. hochstetteri* Pfeiffer, Nelson-Marlborough, N.Z.
L. *P. lignaria* Hutton, West Nelson, N.Z.
S. *P. superba* n. sp., West Nelson, N.Z.
G. *P. gilliesi* Smith, West Nelson, N.Z.

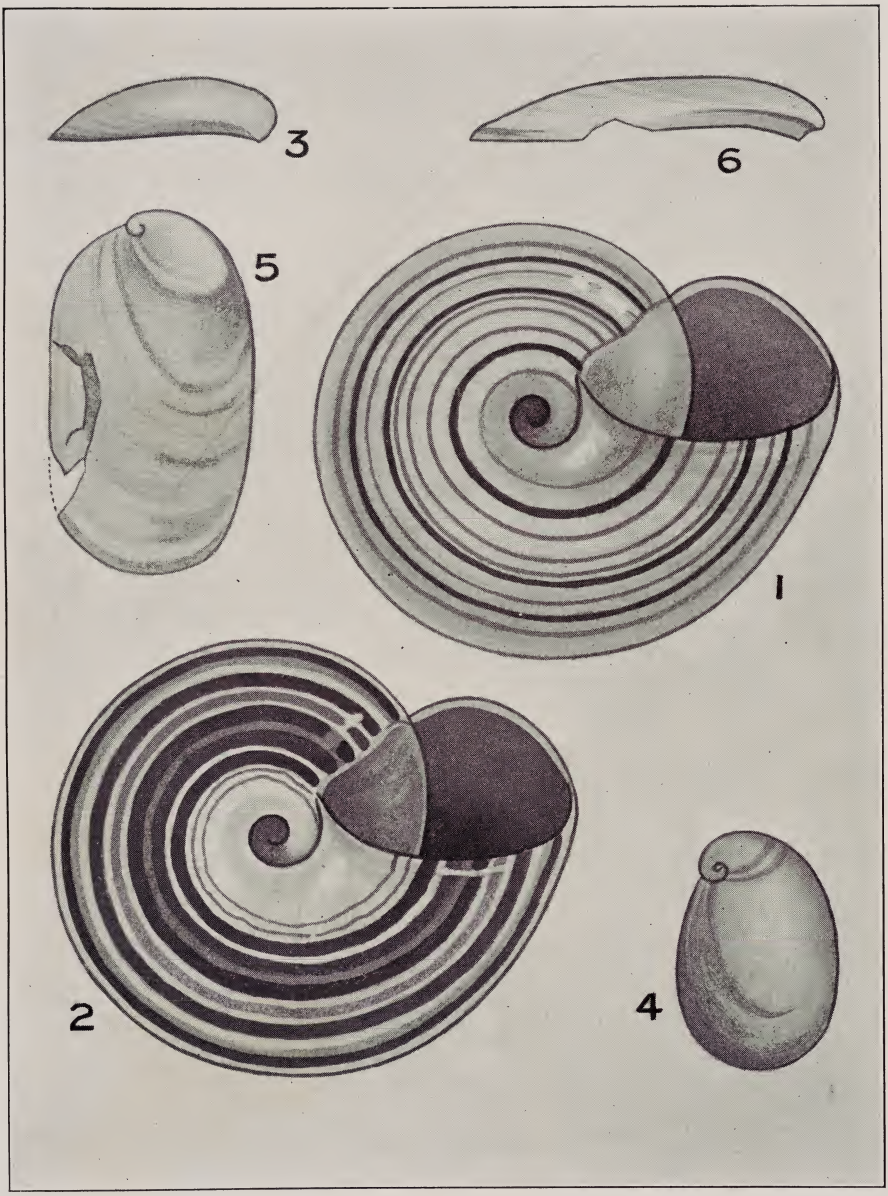
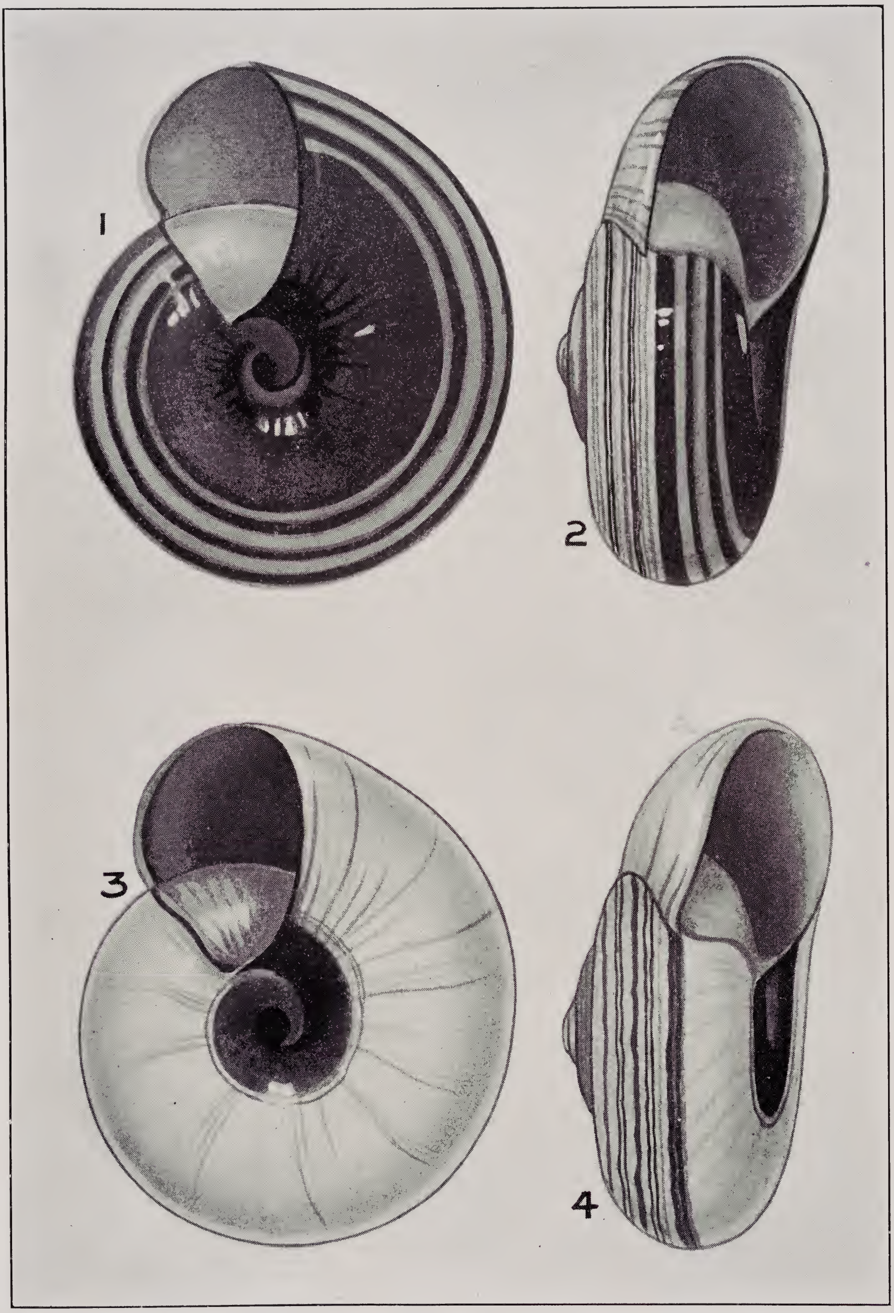


Fig. 1. *Paryphanta hochstetteri* (Pfeiffer) (Plesiotype).
Fig. 2. *Paryphanta hochstetteri* (Pfeiffer), Canaan, Nelson.
Figs. 3 and 4. *Schizoglossa novoseelandica* Pfeiffer, Manaia, Whangarei Heads.
Figs. 5 and 6. *Schizoglossa gigantea* n. sp. (Holotype).



Figs. 1 and 2. *Paryphanta hochstetteri obscura* Beutler (Topotype).
Figs. 3 and 4. *Paryphanta hochstetteri bicolor* n. subsp. (Holotype).

Paryphanta superba n. sp. Rocks Point specimens.
Wm. C. Davies, Cawthron Institute, Photo.

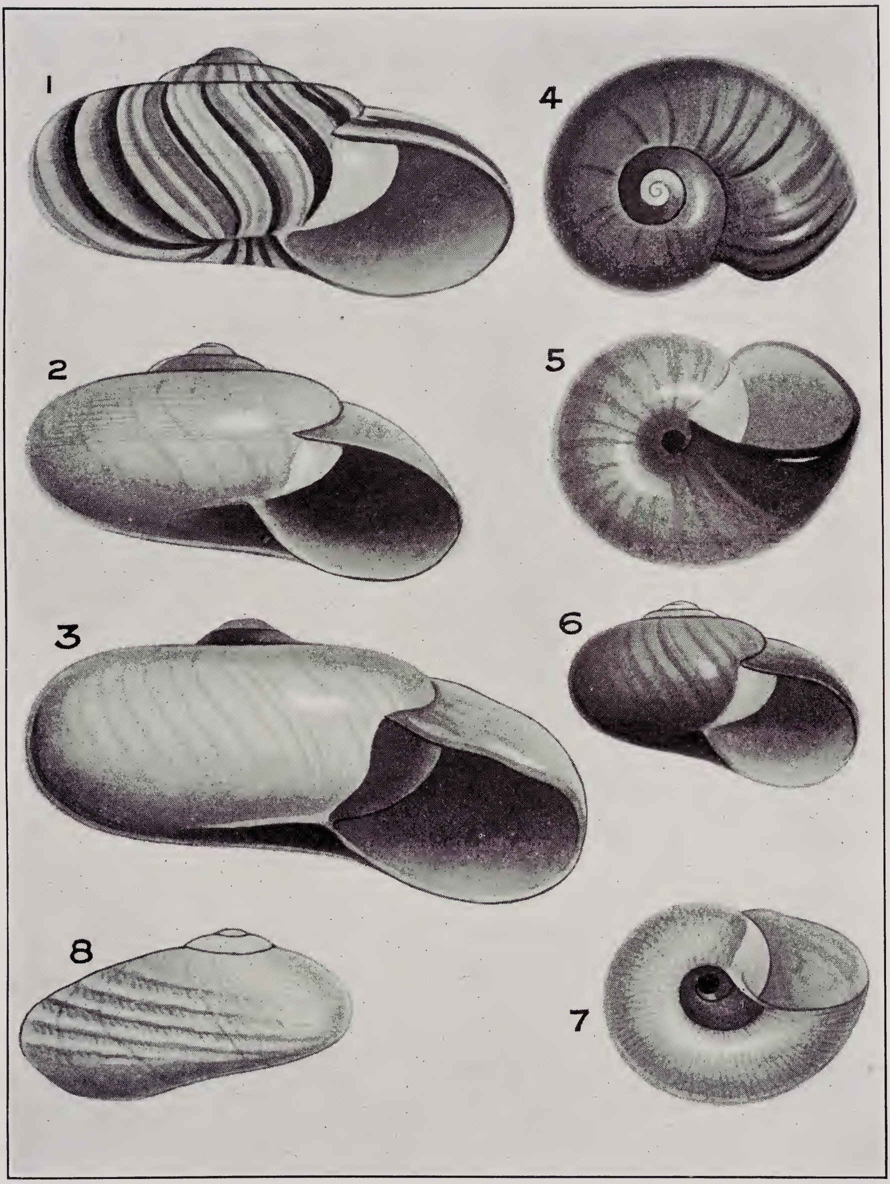
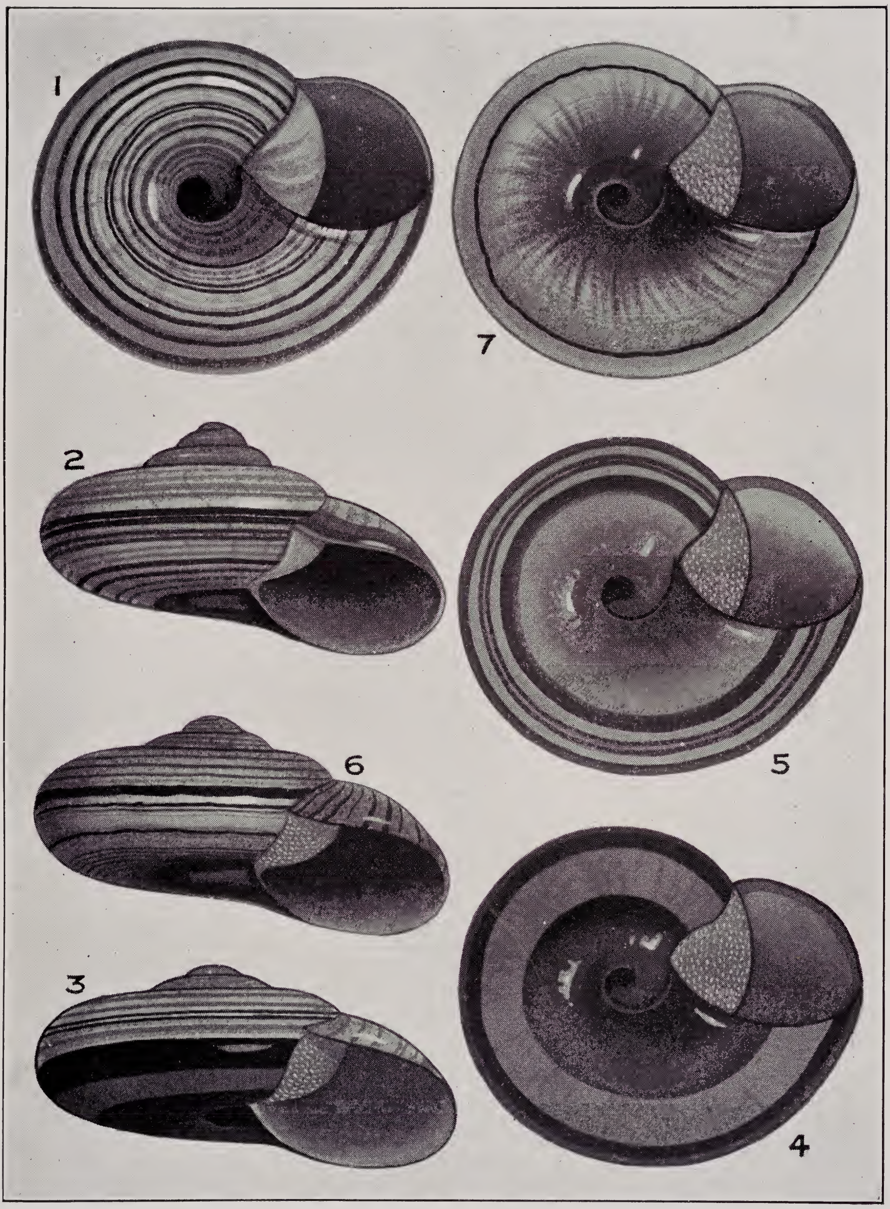


Fig. 1. *Paryphanta lignaria* Hutton, Mokihinui.
Fig. 2. *Paryphanta unicolorata* n. sp. (Holotype).
Fig. 3. *Paryphanta superba* n sp. (Holotype).
Figs. 4, 5 and 6. *Paryphanta rossiana* n. sp. (Holotype).
Fig. 7. *Rhytida greenwoodi* (Gray), Muriwai, West Coast.
Fig. 8. *Rhytida stephenensis* n sp. (Holotype).



Figs. 1 and 2. *Paryphanta traversi* n. sp. (Holotype).
Figs. 3 and 4. *Paryphanta gilliesi* Smith (Plesiotype).
Fig. 5. *Paryphanta gilliesi* (var. A.) Paturau River, West Nelson.
Figs. 6 and 7. *Paryphanta gilliesi subfusca* n. subsp. (Holotype).

Plate 6

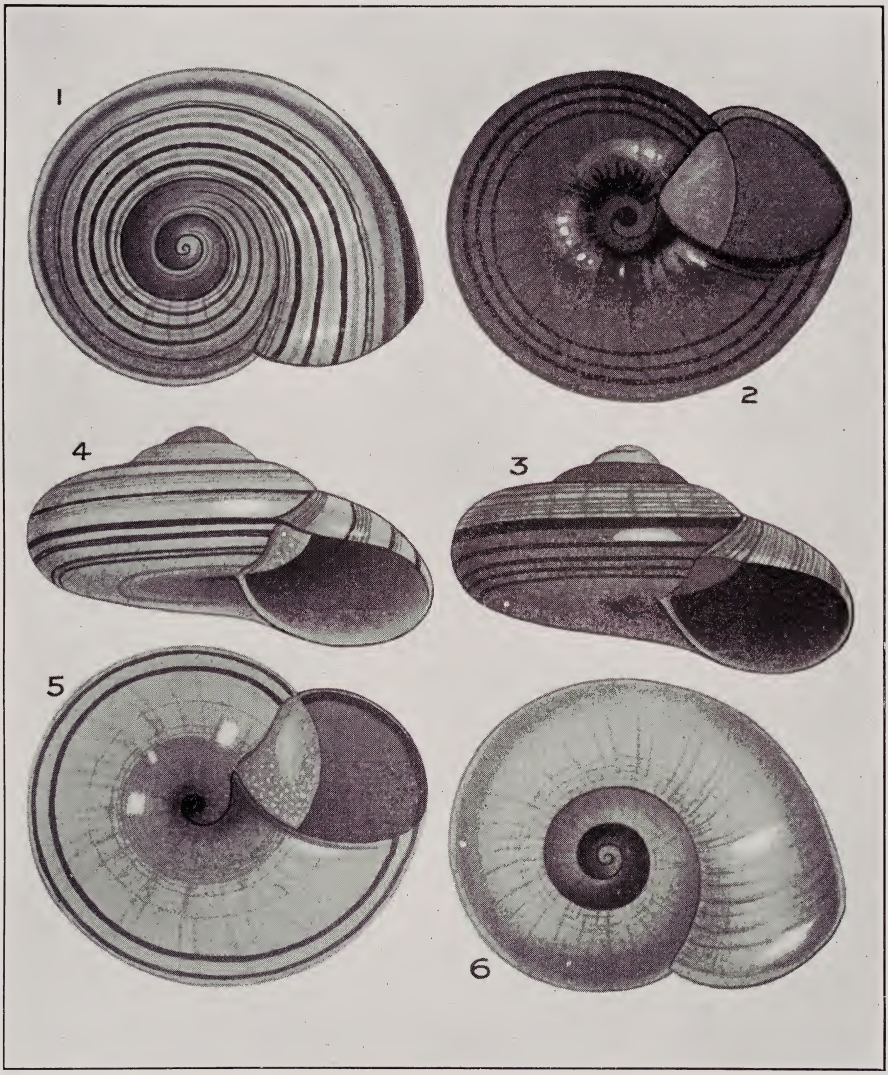


Fig. 1. *Paryphanta gilliesi* Smith (Plesiotype).
Figs. 2 and 3. *Paryphanta fallax* n. sp. (Holotype).
Figs. 4 and 5. *Paryphanta compta* n. sp. (Holotype).
Fig. 6. *Paryphanta unicolorata* n. sp. (Holotype).

Paryphanta hochstetteri obscura Beutler. Specimens from the "Old Mokatapu Track," 2,952 feet, East Nelson Mountains.
Wm. C. Davies, Cawthron Institute, Photo.

The Piraunui Pa at Matawhana, Waikato.

By L. W. DELPH, King's College, and GILBERT ARCHEY, Director.

The dissection of the high rhyolite plateau of Central Waikato has resulted in a series of characteristic rock-capped headlands, extending for several miles south of Arapuni on both sides of the river, and on certain of these natural strongholds are the elaborate terraces of Maori fortifications.

In the vicinity of Matawhana there are three such *pa*: Pirau-nui, Pirau-iti and a small one unnamed. Pirau-nui is the furthest south and is directly opposite the quarry from which the rock for the Arapuni hydro-electric construction was taken.

Through the kindness of Mr. A. Commons, owner of the property, we were able to examine these *pa* shortly after the scrub, fern and tall grass had been burnt off Pirau-nui, thereby clearly revealing the general lay-out and the terraces; and the following description is based on a plane-table survey made at the time.

The general arrangement (Plate 8, plan) comprises:—

I. A flat portion the *marae* high up on a broad spur, below which is

II. A series of terraces on either side of the steeper ridge formed by the narrowing spur: these lead down to

III. A still narrower and much steeper sided (walled might be a better term) ridge cut across by a deep fosse and so forming a strongly protected approach to

IV. The stronghold or "citadel," a high rhyolite-capped vertical-walled spur, which would, we imagine, have been well-nigh impregnable against attack, rising as it does, with sheer precipitous cliffs above the deep Waikato valley, which was, as we watched it, being steadily converted into the new Arapuni Lake.

To the east, above the marae, the hills rise quite a hundred feet, and on this open, undefended area are numerous food-pits, and several not very well defined depressions, which may have been house-pits.

AREA I. THE MARAE.

This area, 165ft. by 120ft., is almost level, and contains 10 large *whare* sites the largest of which is 20ft. x 15ft., and may have been that of the *Whare-runanga,* the others being, perhaps, guest houses or the *whare* of the leading members of the community.

The *marae* is protected on three sides by a trench, entrance being made by a gateway, 15ft. wide, situated almost mid-way along the eastern side. We found no trace of a *ngatu* or entrance-screen.

The trench was cut in loose soil and is now half filled, but appears originally to have been 5ft. deep, i.e., including the bank of earth thrown up on each side.

In places the large holes occupied by the main palisade posts are still open, and one or two actual butts are in place, being *totara* posts about 1ft. in diameter. Fires would have destroyed the actual stockade many years ago.

The trench on the north side comes off at an angle of about 80 degrees from the front trench, and although well defined, is quite flattened out. It goes down the hill from the edge of the plateau to a point at which the slope into the gulley to the north is sufficiently steep to need no more than a single palisade to afford protection.

The trench to the south consists of a number of short lengths that follow roughly the edge of the flat ground, and so shield the terraces below. It comes to a rather indefinite end outside the third series of terraces mentioned below.

AREA II.

The second main portion of the *pa* consists of four series of terraces, each, perhaps, occupied by a family. One series, that on the ridge between the two gullies, is almost obliterated, but the other three are particularly well defined, and, but for the trampling of stock, would have their house walls and food pits undamaged.

On the north this area is protected by the trench previously mentioned; while to the north-west is a single trench following the contour line to the point where the slope itself becomes too steep to need organised works, and near to where the sterner fortifications of the gap begin. It is probable that a strong palisade closed any gap that might have existed. To the south-east protection is afforded by a continuation of the main outer work. This is continued in a curving wall, which may either mark the site of a palisade, or have been a device to shed water from the hill above from the terraces below. On the south side there is no clearly defined trench. At this point too, palisading would have been sufficient.

To the west the area leads into the main fortified part of the *pa*, by means of a narrow ridge, across which there was, doubtless, a strong palisade.

The living terraces are more or less uniform in size. We have not been able to describe the second series owing to the difficulty in tracing the various features. The others we have labelled from north to south as X, Y and Z.

Terrace Series X.

In this series there are five terraces, their northern edges being the inside of the trench on that side of the *pa*. Their other ends reach to the ridge running down middle of the *pa*.

The *whare* sites are interesting in that while on most of the terraces in the other series they are facing the north, they are facing the north, south and west but not east.

The upper three seem to have a subdivision on the trench side, the uppermost has a distinct wall cutting off a portion 22ft. by 21ft. Their proximity to the trench seems to indicate that they might have been inhabited by men concerned with the defence of the *pa* on that side.

On each terrace there are four or five *rua* placed in line down the middle of the terrace.

The general arrangement of the terraces and the whares thereon can be seen on the plan.

The sizes of the terraces, which are about 6ft. below one another are:—

X 1. 75ft. x 21ft. It has a short wall and a path at the middle.

X 2. 75ft. x 21ft. It also has a path, behind the two central *whare* sites.

X 3. 80ft. x 30ft. Half way along is a well-defined circular terrace about 3ft. high.

X 4. 81ft. x 30ft., and X 5. 96ft. x 30ft. They are not so well preserved as the upper ones, and are without traces of whares at the outer ends.

Below the last terrace the ground falls suddenly by a scarp and about 15ft. below is a moderately well marked trench curving along the contour from the straight trench on the north side to the steep slope on the edge of the narrowest portion of the ridge.

The second series of terraces lies just to the other side of the ridge, and has suffered more damage from stock. The actual position of the terraces could be seen, if not the *whare* sites and *rua*, many of these latter having been filled up on account of accidents to stock. The highest terrace of all was of considerable size being 75ft. by 39ft., and had immediately between it and the edge of the plateau above, a terrace, backed by a ten foot scarp, at the bottom of which had been excavated five *rua* with their roofs at ground level. These were cut into the soft subsoil and would probably have had *totara* slab doorways, which have since disappeared.

At the south end of this terrace were three well marked house sites facing north.

Terrace Series Y.

The third series consists of five large terraces following the contours of the hill. Whereas the other two groups lie immediately below the main plateau on either side of the ridge, this third series is protected above by a continuation of the main outer trench with a number of short trenches at right angles to each other. The division of the second from the third group is not very well defined, but the general arrangement is in echelon.

The slope on this side is fairly steep and the average difference in the level of the terraces is about twelve feet, this being represented in each case by a sheer scarp, in places somewhat broken down.

Yi. From the outer trench above, a slope of about 15ft. brings us to the scarp of the uppermost terrace. Dimensions 48ft. by 30ft.
Whare: only one evident. S.W. corner, facing north. 9ft. by 11ft.

Yii. A short slope leads to the upper edge of the second terrace, with a scarp of 12ft. The south end of this terrace is protected by a short embankment connected with the end of the main outer trench which occurs at this point. This may represent a *waharoa* or passage behind a gate, as this seems a strategic point for an entrance. Dimensions 80ft. by 25ft.

Yiii. The next terrace is 12ft. below the last.
Dimensions, 90ft. by 30ft.
Whares: Three at south end facing north.

Yiv. A ten foot drop brings us to a narrow ledge, two feet above the level of the next terrace. There is at least one *rua* cut into the scarp on this ledge. There are probably others buried under the fallen soil.
Dimensions, 54ft. by 33ft.
Whares: Two at the south end, facing north.
One at the north end, facing south.
The west and south boundaries of this terrace are well marked, the southwest corner being particularly well preserved.

Yv. A slope of about 12ft. leads to the lowest distinct terrace in this series, one which has no special features. At this point the slope is getting too steep for more than just comparatively narrow ledges, though quite some seven yards below there is a minor terrace about 24ft. by 18ft. This does not seem to have been used as a living terrace.

Terrace Series Z.

The fourth series was in a better state of preservation than the other three, particularly the walls on the south side. The curved mud wall previously mentioned formed the boundary on the east side, i.e., on the up slope. Between it and the upper terrace there is an unbroken slope, with no evidence of trenching or terracing. The distance from the mud wall to the terrace was about 10ft. There was also no evidence of a trench protecting the series to the south, but here there is a slope sufficiently steep to need not more than a strong palisade, with perhaps towers.

Zi. Below the level of Yiii.
Dimensions, 60ft. by 24 ft.
Whares: Two, at the south end, each 12ft. by 9ft., facing north. One in the north-east corner, of the same size, facing south.

Zii. 6ft. below the level of Zi. A passage at the south-east corner leads behind a *whare.* This terrace is below the level of Yiv.
Dimensions, 50ft. by 24ft.
Whares: One large one in south-east corner, 21ft. by 9ft.

Ziii. This terrace was separated from the last by a long slope which terminates abruptly in a scarp ten feet high. A pathway leads behind the whares at the south-east corner.
Dimensions, 78ft. by 24ft.
Whares: Two at the south end, each 12ft. by 9ft. facing north. One, small, 9ft. by 6ft., at the north end, facing south.
Rua. Evidence of several down the middle of the terrace.

Ziv. A 12ft. drop brings us to the next, which reaches to the sudden steep slope of the valley below.
Dimensions, 51ft. by 30ft.
Whares: A site in the south-east corner and what appears to have been the base of a watch tower, i.e., four walls 12ft. by 16ft., enclosing a space, at what must have been a very strategic spot in the pa.

The absence of protection on this side is remarkable. If there were strong palisades, there is no remaining evidence of them. Below this series is a short length of trench overlooking the steep slope below. On the gentler slopes, below, i.e., to the south of this trench, there are traces of other living terraces which would have been outside the *pa* proper, but would have been on the direct route to the water supply below.

AREA III. THE NARROW RIDGE.

Between the above mentioned series of terraces and the stronghold proper there still remains an interesting area, the softer part of which has been more or less obliterated by cattle, but at about twenty-five yards from the lower terraces, the harder rhyolite rock comes to the surface, and the remaining part of the pa remains well defined, with the exception of some of the other lower pathways.

This area may have been protected from above by a palisade.

The terraces from here forward, have been lettered, commencing from the extreme western point of the headland.

Terrace H.

This is a raised structure apparently further heightened by some of the rubble from the main fosse. There are traces of its being divided into two whares sites at the side nearest the fosse. To the north side it is excavated for the greater part of its length out of the solid rhyolite down to the level of the floor of the fosse itself, leaving a butt that was probably roofed over.

Terrace M.

Almost immediately below H., on the north side, and some twenty feet down, is the terrace M., also cut out of the rock and forming what must have been a fighting platform 30ft. by 15ft., with a sheer drop from the edge. It is prolonged into a narrow path to the east, which narrows down to 3ft. in about 30ft., and so shrinks till it becomes part of the cliff.

In the sloping rock above the vertical wall is a gutter cut from one corner and then down at the east end; this appears to have been a water channel or possibly the support of a gangway leading from above to the floor of the terrace itself.

Terrace N.

On the south side of the Terrace H., we have a terrace N, apparently not connected with the other lower terraces. This is 12ft. by 15ft., below the level of H. with which it is parallel. To the east it is cut back into the rock and in each corner is a deep food pit of the cave type. Deep grooves are cut into the sides and back at the level of the top of the terrace, probably for roofing. The terrace drops off abruptly some feet at the fosse end and probably was not intended to communicate with terraces beyond the fosse.

Terrace O.

Below N. is a similar terrace, O., somewhat wider with evidences of rubble walls both between it and N., and between it and R., below. O ends abruptly at the fosse end, but it is almost at the level of P. mentioned below, with which it may have been connected by a bridge.

Terraces R. and S.

These are both about 5 yards wide and lead down to below the living terraces of series Z. They possess no special features and are rather indistinct, but a lot of work seems to have been done here in the matter of building rubble walls, particularly in the outside of terrace S.

The terraces of the above group form a distinct unit on the upward side of the fosse and in themselves must have been particularly strongly palisaded to protect them against attacks from below.

The Fosse.

The fosse, as usual, is sited at the narrowest constriction of the headland, and is excavated, at first, in the softer subsoil and below in the rhyolite.

On the side of the terrace H., i.e., the uphill side, it rises to a height of twelve feet, while on the headland side its wall is 18ft.

high, with but a slight slope out of the perpendicular. At either end the fosse falls away abruptly to the valley below.

To the north side it has no connection with the other terraces, but to the south it is cut away abruptly at the level of the terrace N., and has in the corners two pits similar to those described on the terrace N. Below this it may have been cut away further but debris from above has obliterated any sign of this. It was probably cut deeply, leaving a wide gap between terraces O. and P., and Q. and R.

At the east side of the fosse is an interesting series of pits with masoned doorways to be described later, and there occurs at least one pit on the other side in the north-west corner. There may be others but they could easily be concealed by the debris now lying on the floor of the trench.

AREA IV.

This area is the *pa* proper, consisting of five larger terraces and a number of narrow pathways leading back to the ends of the fosse across which there may have been bridges. Immediately above the fosse is the high rampart G., the upper part of which consists of rubble excavated from the fosse itself. The level top of this rampart is 30ft. by 9ft. On the flanks it falls away at a steep angle around which it would have been impossible to climb. On the fosse side is a drop of 18ft. to the bottom of the ditch, while on the other side it is 6ft. higher than the first terrace of the stronghold. This area was probably enclosed by a high palisading and on the fosse side are depressions that seem to be the remnants of the post holes.

Terrace F.

At the fosse end this is the same width as the rampart above, but it widens to about 50ft. Its width from back to front is 27ft. On it there are traces of whares and rua. There are no pathways to the rear.

Terrace E.

A drop of 8ft. brings us to the more or less rectangular terrace E. This is 66ft. by 30ft. At the south end it falls away slightly. At this end there is evidence of a small whare, and here there were some small pieces of palisading still in place. At this point also steps are cut, leading to the pathway P., below, and, probably, continued to Q., and also to Qi. below that. There are traces of several rua on this terrace.

At the north side a wing leads to the pathway J. above which is an interesting group of *rua* (described later), cut in the wall below the terrace F. Similar pits are to be found above the pathway P.

Pathway K. (Pl. 8, North elevation)

From the pathway J., there is a small track leading to the narrow pathway K. in the wall of which are further rua.

Terrace L. (Pl. 8, North elevation)

Still further down below K., is a narrow rock-cut terrace of the same form as M., described above, situated on the edge of the precipice. At one end of this are well-cut steps in the rock. At its widest the ledge is 9ft. wide. The back wall is cut clean for a height of 12ft. There were two well cut pits in the inner angle, and at least one in the process of excavation. The east end is a perpendicular wall, and to the west it tapers off to a small sub-terrace slightly above its own level.

Terrace D.

Returning to terrace E. a passage leads past two food pits to D. on which are the remains of whare sites, and from which the pathway P. actually starts. A *whare* has been built on the east side against the wall which is 6ft. high. D. is 72ft. by 30ft. The north wing is led back below the level of E. to become the terrace K. though the connection is rather vague. On the other side, the wing leads back to become the terrace P. on the upward side of which there are rua, with circular doorways. This pathway leads back to the fosse at the level of O.

Terrace C.

From D. to C. there is a 12ft. drop. On it is a large number of rua, well preserved. C. is 90ft. by 33ft. At the south side a wing goes back to become the pathway Q. Below that, at about the junction of E. and F. there is, several feet below, a small ledge Qi. a few yards long and hardly a yard wide, with a sheer drop below. Where Q. leads off from the terrace C. there is a small whare placed obliquely on an area 15ft. wide, narrowing to the back. On the north side the terrace ends abruptly, but 25ft. below is another ledge similar to Qi. on the other side. In the extreme north-west corner is a mud wall that is built on the brink and may have been the site of a tower.

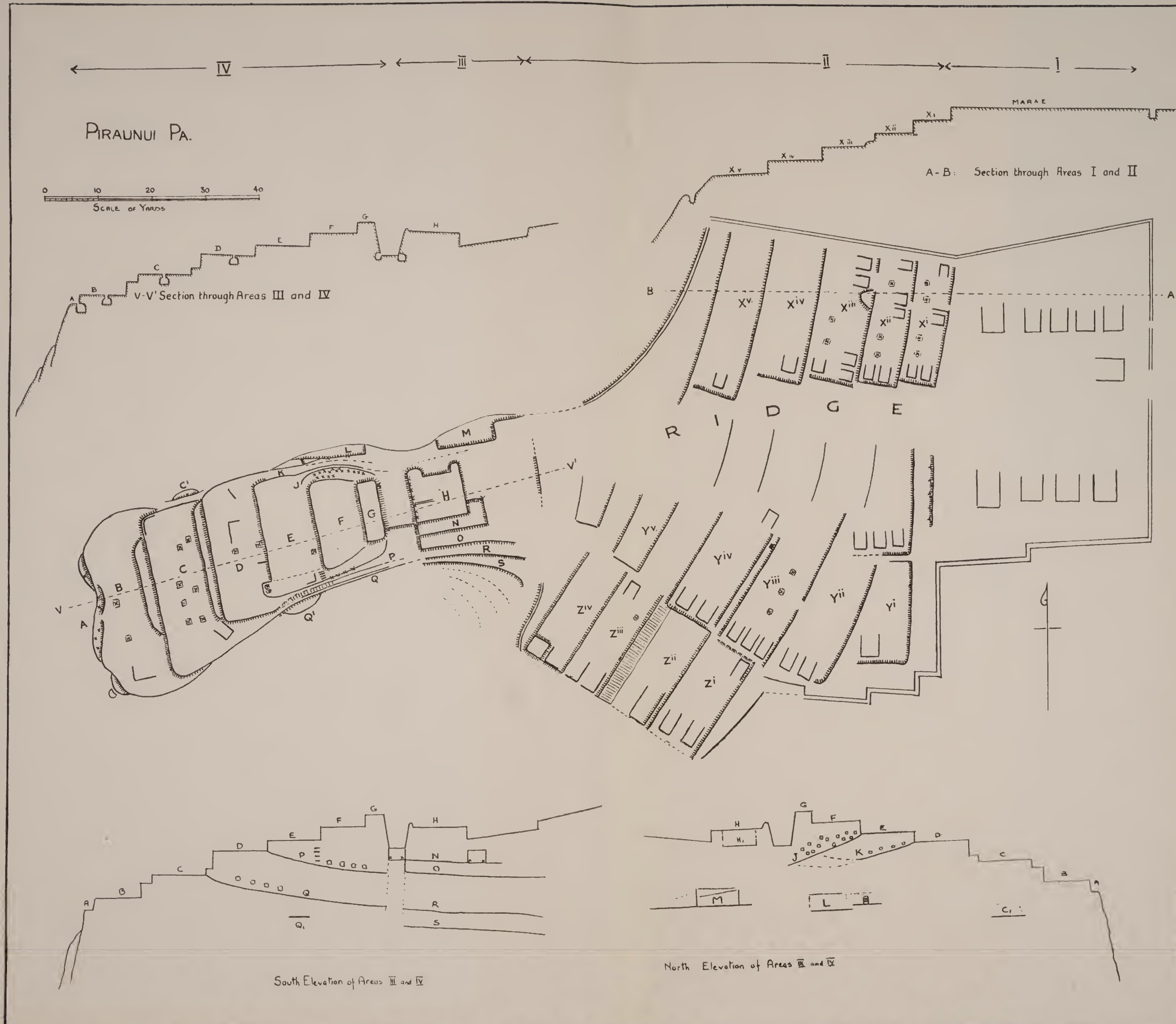
Part of the drop between C. and D. consists of a ledge about 3ft. wide and 3ft. above the terrace below.

Terrace B.

Between C. and B. for part of the distance there is a terrace 6ft. wide and 50ft. long, about 4ft. below C. Below this a 9ft. drop brings us to B. itself, which is the last well defined terrace on which habitation would have been possible. At its widest it is 30ft. and its longest dimension is 100ft. On the south side there is a well marked building site. Narrow wings lead back to below the level of the terrace C., but these are not continued. There are several food pits on this terrace.

Terrace Group A.

At the extreme end of the strongholds the terrace B. leads to a number of sub-terraces, with just room for movement. These we have grouped as A. On these terraces are several *rua* of a combined type of pit and cave, and the mouth of one of these


IV
III
II
I
PIRAUNUI PA.
0 10 20 30 40
SCALE OF YARDS
MARAE
A-B: Section through Areas I and II
V-V' Section through Areas III and IV
RIDGE
South Elevation of Areas III and IV
North Elevation of Areas III and IV

still retains the totara slabs and part of the lid. To the south-west some feet below the level of B. there is another small ledge, with a bare rock still further down, which it would have been possible to reach by means of a ladder. This would give a commanding view of the whole forward face of the stronghold.

This completes the description of the terracing of the hill as far as we were able to map it. There is evidence of terraces in several places outside the pa, particularly below the south side of the fosse and also over the hill beyond the series of terraces Z.

RUA.

The Piraunui pa is very rich in store-pits of both the usual types, viz., RUA KOPIHA (subterranean) and RUA TAHUHU (semi subterranean).

Rua Kopiha.

In general the *rua kopiha* was built wherever the flat ground was available, but in addition, *rua tahuhu* were found at the base of some of the terrace walls. We had little opportunity of investigating them beyond noting their position, and inspecting their entrance. Stock had damaged a great number of them, and Mr. Commons told us that he had lost a considerable number of fat beasts and also a thoroughbred mare in them. Unfortunately several, which, he said, were large, had had to be filled in.

Those that are situated on the living terraces are usually from 6ft. to 9ft. in diameter and 5ft. to the top of the dome. On Piraunui we came across one cut in the rhyolite, and containing only an inch or two of debris. On cleaning this out we found that a ledge had been left on one side, and also partitions to divide the floor into bins, which would indicate use for the storage of roots.

In no cases, on the living terraces did we find the slabs used to cover the mouths, but on one of the subterraces of A. we came across one with the original door frame-pieces still in place. These were tightly fitted to keep out the loose soil at the side of the mouth and, resting on the upper edge of one of them was a slab, the wood being well cut and originally about 2in. in thickness.

The position of the *rua* on each terrace was more or less uniform, being in one or two rows down the middle and at intervals of 6ft. to 9ft. This would bring their division walls quite close together, and from those that we saw elsewhere there were doubtless, in some cases, holes connecting them.

The pits in the angles of the walls were sunk below the entrance level, and were thus exactly similar to those in the open.

In the stronghold proper, there were still several *rua kopiha,* those on terraces C. being well preserved. Again there were also several in the angles of the scarps between the various terraces. Those at the extreme western end of the pa were filled with debris but their proximity to the precipice makes them particularly interesting.

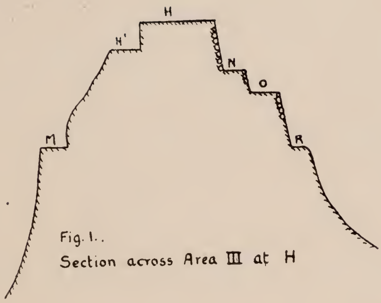


Fig. 1..
Section across Area III at H

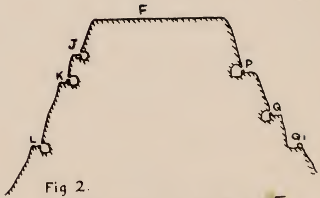


Fig 2.
Section across Area III at F

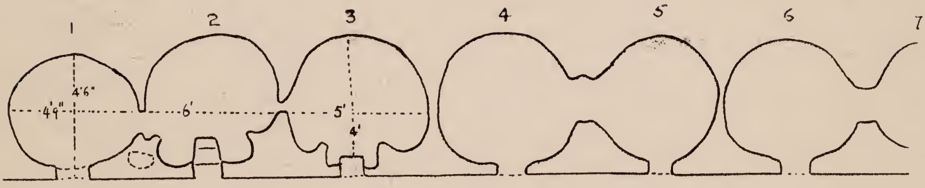
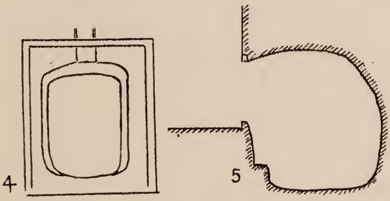


Fig. 3. Group of Rua in East Wall of Fosse.



Type in Group in Fosse.

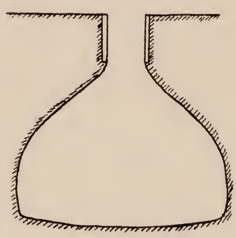


Fig. 9. On the flat on all Terraces.

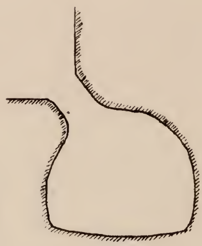


Fig. 10 In angle of Wall and Floor in N etc.

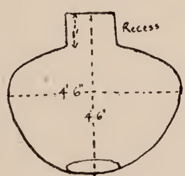


Fig 6.
Plan.

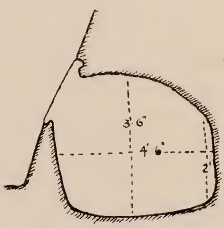


Fig 7.
Section.

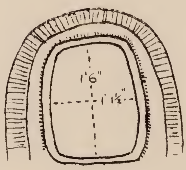


Fig 8. Doorway

Type on Pathways J K P.Q

The *rua* penetrated the loose subsoil into the semi-hard rhyolite. The instrument used had been about 2½in. in width, and the stroke a short one from above downwards. In some pits were fairly large blocks of stone that had not fallen from the roof. The walls and domes were still intact, and it would seem that the method was to work in behind blocks of stone and so break off large pieces. Finally the rock was carefully trimmed and shows a finish that would not disgrace a mason of the present day, with his efficient tools.

Rua Tahuhu.

In and about the fosse, and in the steep walls on either side of the headland, we found groups of *rua tahuhu*, cut, for the most part, in the rhyolite.

In the fosse, these were situated in the eastern side at the foot of the wall, with the lower ledges of their vertical doorways at ground level. The floor of the rua would be from one to three feet below the level of the fosse. In this row were seven, all the same level. (Text Fig. 3.)

No. 1 is 4ft. 9in. across and 4ft. high. To the right of the door a niche was cut in the wall. The walls and dome are roughly trimmed and still as white as when they were finished. This *rua* leads by an opening large enough for the passage of a man into No. 2, the main part of which is 4ft. 6in. in diameter. Below the doorway a stone step has been left projecting 1ft. 6in., leaving two niches 1ft. deep and 1ft. 6in. wide. A small hole connects 2 and 3.

No. 3 is similar in shape but smaller in size, being 4ft. from door to back and 5ft. long. Here again there are projections on either side of the door, leaving recesses about 1ft. in depth. The height from floor to roof is 3ft.

No. 4 and No. 5 are similar to the last and are joined so as to form one large rua.

No. 6 and No. 7 are connected in the same way, while from the floor of No. 7 a shaft appeared to be responsible for light shining in a *rua* in the angle of the step below, where terrace N. joins the fosse.

The doorways of these last *rua* are interesting. The best was that of number 4. The outer aperture measured 1ft. 6in. by 2ft. 6in. Within this the rock was cut away behind, leaving a rebate all round. The rock between presented a flat surface except at the top where there was a piece cut out as if for a keystone. The whole gives the impression of having been closed by a trap door lifting vertically.

In all terraces cut from the solid rock there occur *rua* in the corners, some of these are unfinished and several are only started. But in all cases they show the same careful workmanship.

The next group of rua occur in the terrace J. (Text Figs. 6-8) These are in two rows in the steep side of the headland under the terrace F. Their doorways are well cut, and are just wide enough to admit a man; being from 1ft. 6in. to 2ft. high and 1ft. 3in. to 1ft. 6in. wide, and at times more nearly circular than those already described. In most cases there was a deeply cut groove round the doorway, giving evidence of their being closed when not in use. Their average dimensions are 4ft. 6in. from back to front and 4ft. 6in. wide. At the back the dome meets a vertical wall about 2ft. in height, while in some there was a pronounced recess 1ft. deep.

In most cases there was a ledge or step 18in. below the opening. The walls were clean and in several the floor was damp, but this may have been a recent accumulation. These seemed more likely to have been for water storage, which would have been very necessary in the stronghold itself, but in two cases they were connected to the neighbouring rua by small holes. The first and second from the fosse, in the lower level, were similarly connected, as were three towards the other end of J. In the latter case one in the upper set was joined with those on either side of it in the lower set.

A single row of rua occur in the pathway P. (Pl. 8, south elevation) on the other side of the stronghold; these were of the same form as those in J. and were situated at the level of the pathway.

It should be mentioned that, in the pastures behind Piraunui, there are literally hundreds of other holes or traces of them. They may, however, as a local maori suggested, have been rat-catcher's pits.

Any house walls that may have existed on this upper undefended area would have long ago been obliterated by the trampling of stock.

GENERAL.

Immediately below the front of the pa, where the steep slope eases off on to the river terraces, was a large flat sided boulder that had fallen at some time or other from the headland above. This was deeply grooved in a vertical direction and the opinion is expressed locally that it is a *hoanga*. It seems to be a very soft rock for sharpening tools; but why else the grooves?

One other object of interest was observed. By the creek on the south side of the pa, was a trough cut out of a boulder. We excavated at least 2ft. at the sides and at one end without coming to the underside of the boulder and we assumed that the trough had been cut *in situ*. It was 6in. thick all round, 20in. long, and 16in. wide at one end, and 11in. at the other. The trough was about 18in. deep. It may have been used to facilitate the filling of water vessels. One of us (L.W.D.) has noticed a similar trough in a small creek near a *pa* on the Mercury Islands.

Near the homestead on the station is a tree of peculiar shape, the trunk being much thinner near the ground than it is for most of its length. This, Mr. Commons has been asked not to cut down, as it contains the spirit of a long dead chief, and it is believed that a dog or a horse tied to it for a night will be found in the morning to have sore feet, due to its following the nocturnal perambulations of the chief.

The life on this pa leaves little to the imagination. Below, on the fertile river terraces of the Waikato, there was ample room to grow the food necessary for the inhabitants. The river and its creeks were always there for fishing, and the forest behind must have abounded in bird life and in edible plants. On the vast pumice plains around would have grown sufficient fern to supply any number of people. The main difficulty must have been the carriage of water and of stones for hurling down on the enemy. Further up the river there is reported to be an outcrop of a stone hard enough for the ordinary implements.

The history of the *pa* is vague. No definite time can be ascertained for its abandonment. It is known that the tribe which built it and inhabited it were the NGATIRAUKAWA. A legend prevalent among the Maori in the district is that this tribe joined a tribe from nearer the slopes of Maungatautiri on a raid to Taupo. They were returning, successful, from this raid when they were mistaken by the remnant of their own tribe, who had been left behind, and in the ensuing melee in the forest above Piraunui a great number were slain. This may or may not have caused the remnant to abandon the *pa*. Another version is that a shot of welcome (?) killed an important chief of their allies and the chief of the Ngatiraukawa delivered himself up to satisfy the *utu,* which placed the Ngatiraukawa in a servile position to the tribe from beyond the river, and led to their abandonment of the fortress of Piraunui.

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The Vegetation of Maungapohatu.

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In this account of a visit paid in March, 1930, to the summit of the botanically unexplored mountain named Maungapohatu, situated in the Urewera country (East Cape Bot. Dist.), we describe briefly the primitive and induced plant communities seen. It is hoped that this description, incomplete as it is, together with a list of the species collected, will help to bridge the gap in the present knowledge of the high mountain vegetation and flora between the more northerly Mount Hikurangi of greater altitude (1710 m.) and the Kaimanawas to the south.

The mountain lies north of Lake Waikaremoana, the approach being from the highest point on the new Rotorua-Te Whaiti-Wairoa Road, 17.6 kilometres north-west of the lake. A bridle track leads from this Papatotara saddle some 16 kilometres, through *Nothofagus* and *Beilschmiedia tawa* forest, according to altitude, to the Maori settlement of Maungapohatu—Rua's stronghold. This is about 750 metres above sea-level, and is dominated by the mountain of the same name (c. 1359 m.), which forms the culminating point of one of the many interknit ranges of the Huiarau. On the west, north, and east, the mountain rises from the forest in precipitous lime-stone cliffs, grotesquely sculptured, with immense flat-topped pillars standing out from the main mass. In order to gain access to the summit it is perhaps necessary, and at least customary, to skirt the base of the abrupt northern face and so attack the terminal part of the mountain from the eastern side remote from the village. The track rises in the course of this last 10 or 11 kilometres to 1,050 metres before the actual ascent begins. It then turns sharply upwards, a series of rock ledges being scaled with the help of twisted roots, and so the top of the main ridge is reached. This is followed for some distance before crossing a broad, shallow, easterly valley, on the northern flank of which the track peters out on the comparatively level stretch extending to the very edge of the cliffs where the trig station stands.

It is important to note that in the whole of this area no sign was seen of deer, wild pigs or cattle, considered very common in the rugged Urewera country, or of the damage one might confidently expect of them here. Bird song was occasionally heard, otherwise the stillness was broken only on the summit by the monotonous hum of innumerable blowflies.

The first part of the route after the clearings and burns of the settlement are passed, traverses a narrow fringe of subtropical rain-forest such as is characteristic of lower slopes throughout the Urewera country. *Beilschmiedia tawa* is dominant, accompanied by magnificent trees of *Dacrydium cupressinum, Podocarpus spicatus* and *Metrosideros robusta,* all considerably taller than the general level of the forest, while large areas, especially in gullies, show almost pure *Fuchsia excorticata.* Cockayne (1928 p. 4) writes concerning this species as it occurs in the Urewera country, "there are considerable stands . . . . but such are quite primitive and represent a stage of forest development or retrogression." *Hoheria sexstylosa* and *Aristotelia serrata* are especially plentiful in indigenous-induced communities about streams and old tracks, while the small creeping herb *Pratia angulata,* because of its abundance of showy white flowers and purple fruits, was, at the time of our visit, the most conspicuous floor-species.

This "tawa forest" very quickly here gives place to the higher mountain beech association of *Nothofagus Menziesii* and *Nothofagus fusca,* co-dominant, and characterised by a rich undergrowth of *Blechnum discolor, Leptopteris superba, Wintera colorata, Ixerba brexioides, Melicytus lanceolatus, Fuchsia excorticata, Nothopanax* spp., *Griselinia littoralis, Coprosma* spp., etc. *Elytranthe Colensoi,* in places still bearing flowers, was commonly parasitic on the beeches. The tuft-tree *Cordyline indivisa* becomes conspicuous with higher altitude.

At about 1,050 metres *Nothofagus fusca* disappears, *N. Menziesii* being from there dominant up to 1,260 metres altitude. Numerous trees about 45 centimetres in diameter of *Nothopanax Colensoi,* and *N. Sinclairii* make contrasting patches much inferior in height in openings between the southern beeches. An old clearing where surveyors had camped was taken up mainly by *Arundo conspicua,* a form of *Hebe salicifolia* and species of *Coprosma.* Here occurred a striking swarm of hybrid coriarias, including *C. arborea* and a form agreeing with Petrie's specimens of *C. thymifolia* var. *undulata* in the Dominion Museum. On the forest floor *Ourisia macrophylla* is abundant, *Ranunculus insignis* attains great size and beauty among rocks, and a small mat of the dainty *Jovellana repens* was seen. Species of *Olearia* form a large proportion of the second tier of vegetation, *O. Colensoi* becoming increasingly common until at c. 1,200 metres it was observed to form small colonies. At about this height, too, *Nothofagus Menziesii* becomes lower, its gnarled and moss-covered limbs being sufficiently open to permit the development in the undergrowth of the divaricating shrubs, *Pittosporum rigidum* and *Suttonia divaricata,* a marked increase of *Coprosma foetidissima,* and, as a lower tier, the grass *Microlaena avenacea* in place of the *Leptopteris, Enargea, Libertia,* etc., of the forest. From this timberline fringe the transition to subalpine-scrub is quite abrupt, *Nothofagus Menziesii* dropping out and adult *Olearia Colensoi* and *Dacrydium biforme* appearing almost simultaneously.

On the main ridge one association appeared to be primitive, the *Olearia* subalpine-scrub which still occupies large areas as a pure association, its uniformly greyish, slightly hummocky roof showing neither stem nor trunk in sharp contrast with the rich golden green of the taller pyramidal cupressoid *Dacrydium biforme* which merges into co-dominance locally, becoming, in fact, dominant on the top of the ridge where it is narrow and exposed.

Over a large area of the shallow easterly valley this primitive *Olearia-Dacrydium* association was represented by bleached, widely branching limbs of dead *Olearia* and stouter bare reddish trunks of *Dacrydium* still conspicuous above a dense, almost impenetrable scrub, with the *Coprosma*-form dominating. There was no transition girdle between this induced *Coprosma* and the primitive living *Olearia* association, the junction of the two forming a distinct line, the direction of which was apparently influenced by proximity to water, since the *Olearia* projects in a long tongue into the *Coprosma* near the little stream (reduced at this time of the year to a chain of deep waterholes) which drains the valley.

Judging by the presence of dead trunks, it appears that this *Olearia* scrub had, at one time, covered the whole summit of the mountain, except where bog or rock occurred. Though there were few charred branches etc., to support the theory, there can be little doubt that the destruction of the primitive vegetation was due to fire. It has been replaced by two different though intergrading associations, that dominated by *Coprosma* already mentioned, and herbfield.

This latter occurs about the trig station on a fairly level area cut by approximately parallel depressions, at times almost trenches, running from south-west, north-east. The largest of these depressions is broad and shallow, about 150 metres by 30 metres, and is occupied at its higher south-west end by *Sphagnum* bog. At least one other—probably more beyond the area explored—contains a shallow tarn (30 metres by 10 metres), bordered on one side by the *Olearia* scrub and on the other by an induced community containing species representative of both *Coprosma* scrub and herbfield, but with *C. depressa* perhaps dominant. The outlet of this tarn is evidently by seepage into an adjacent parallel trench, which, however, itself ends blindly, not in any stream.

Nearby, almost on the edge of the bog, there is a regular conical basin, some 3 metres across and of approximately the same depth, evidently at times almost filled with water, but at the time of our visit lined to within a couple of feet of the top with a fine net of filamentous green algae. *Ourisia macrophylla* formed the lowest girdle of seed-plants in the basin, while *Danthonia* tussocks clothed the actual rim. These depressions are evidently the sinkholes regarded by McKay (1895, p. 157) as due to solvent action on limestone of carbon-dioxide in solution.

Of the flat areas the two largest are a comparatively broad one, perhaps 100 metres wide, separating the shallow easterly valley and the bog, and another, somewhat narrower, on which the trig station stands. The terminal rock faces are not sheer, but cut by a series of clefts and ledges, offering ample foothold for herbaceous and semi-woody plants, and, in places, an easy descent for those studying them.

From the base of these cliffs stretches a sheltered valley, opening towards the north-east and enclosed on the far side by a lower rock wall joining the main range to the west. Huge irregular rock masses occur here and there on the valley floor, the whole of which showed the dead trunks denoting the former existence of *Olearia* scrub. The association induced by the destruction of the latter, perhaps because of its more sheltered situation, here contained a considerable proportion of *Griselinia littoralis* and a profusely-flowering large leaved form of *Hebe*, belonging to the *H. salicifolia* group.

The plant communities of the mountain may therefore be divided into the following formations:—

(1) Forest. (a) Tawa. (b) Southern-beech. Both types being common to the whole Urewera country, need no further description, though it might be remarked that no *Nothofagus cliffortioides* was seen even at the highest altitudes. *Libocedrus Bidwillii* also appeared to be absent.

(2) Subalpine-scrub. (a) *Olearia Colensoi.* Pure *Olearia Colensoi* association occupies large areas of the upper parts of the mountain and evidently originally was considerably more extensive. It is closed and possesses very little undergrowth, *Hymenophyllum multifidum* being almost the only species. The general height of the *Olearia* is about 1.8 metres.

An *Olearia Colensoi-Dacrydium biforme* sub-association forms relatively small communities enclosed within, but distinguished from the pure *Olearia* community by the presence of the physiognomically-important *Dacrydium biforme* in fairly large numbers. Beneath, on the narrow exposed ridge, was an open undergrowth of *Gahnia procera, Astelia nervosa* var. *sylvestris, Pittosporum rigidum, Suttonia divaricata,* species of *Nothopanax,* and *Dracophyllum longifolium,* or, alternatively, a scanty floor covering, nowhere more than 60 cm. high, of *Phyllocladus alpinus, Gaultheria* spp., and the herbaceous *Gentiana bellidifolia.*

(b) Indigenous-induced scrub. This covers, as already mentioned, fairly large areas, except on the flattest parts of the mountain top, the general height being about 1.2 metres, with coprosmas dominant, *C. foetidissima* and *C. pseudocuneata* being almost equal in size and number of individuals, the quantity of *C. depressa* increasing towards the margin, i.e., near the track or at the junction with herbfield. Throughout and locally forming almost pure colonies were gaultherias presenting a series of forms from *G. rupestris* to *G. antipoda*—obviously a hybrid swarm. Two species of *Nothopanax (N. Colensoi* and *N. Sinclairii), Olearia arborescens, Astelia nervosa* var. *sylvestris, Polystichum vestitum, Histiopteris incisa,* *Blechnum procerum*, a form of *Acaena Sanguisorbae*, and *Ourisia macrophylla* were common constituents, while *Griselinia littoralis* and a variety of *Hebe salicifolia* were particularly important in the similar taller community of the deep rocky valley below the trig station. *Olearia Colensoi* seedlings were frequent throughout except where *Coprosma depressa* formed a deep tangle.

(3) Herbfield. This was characterised throughout by the presence of species common to the formation, e.g., *Celmisia spectabilis, Ranunculus insignis, Anisotome aromatica, Oreomyrrhis andicola* (an apparently constant form of this linneon), *Euphrasia tricolor, Pentachondra pumila, Aciphylla squarrosa*, etc., with *Olearia* seedlings and shrubs of indigenous-induced scrub species more or less widely separated. *Olearia ilicifolia, Cassinia Vauvilliersii* and *Hebe buxifolia* also occurred here. *Dracophyllum longifolium* in places and *Danthonia Raoulii* were physiognomic, a special division being that at the drier end of the depression, where *Sphagnum* bog occurred. Here, tussock and ball-like *Hebe buxifolia* were co-dominant, moss and true herbfield species covering the ground in the comparatively small spaces between them. Occurring on the most level parts, but extending down the clefts of the terminal cliff face and occupying rock ledges, was a community which approached fellfield in floristic composition and in its open nature. *Geum parviflorum* and *Wahlenbergia albomarginata* were seen only in this part, while relatively large areas of dry friable soil, thinly covering the underlying rock, were quite bare of vegetation.

(4) Bog. This is confined, as regards the part of the mountain investigated, except for a few square metres at the junction of forest and subalpine scrub, to the one depression already described.

This is typical *Sphagnum* bog, sopping wet and cold, containing large quantities of *Carpha alpina* and *Schoenus pauciflorus* and rounded cushions, about 60 centimetres in diameter, of *Oreobolus pectinatus*. It merged gradually with increase of tussock into the *Hebe*-tussock herbfield. The whole channel was bordered on either side, and the bog limited at its south-west end by *Coprosma* scrub, in places giving way, only a few feet from the bog, to *Olearia Colensoi* scrub.

SUMMARY.

A description of the vegetation is given, showing briefly the altitudinal range of species and plant communities. Though there is little that could not have been predicted, interesting points are (1) the absence of *Nothofagus cliffortioides* and *Libocedrus Bidwillii*, (2) the presence of true herb-field and (3) the extent and nature of indigenous-induced summit communities. In the appended list some attempt is made to indicate the frequency of species in their respective communities.

LIST OF SPECIES COLLECTED.

Abbreviations: d., dominant; c-d., co-dominant; a., abundant; f., frequent; o., occasional; r., rare; l., local; ‡, present, frequency undetermined; fl., flowering; fr., fruiting. Surveyor's clearing—in southern beech at c. 1,050 m.

SPECIES.	COMMUNITY.		REMARKS.
LICHENES.			
Cladonia retipora Floethe	Herbfield	f.	
MUSCI.			
? *Sphagnum subcuspidatum* C.M. et Warmst	Summit bog	d.	
Dicranoloma pungens (H.f. et W.) Par.	Herbfield	a.	
Rhacomitrium hypnoides (L.) Lindb. var. *pruinosum* H.f. et W. ..	Summit	f.	
Rhizogonium mnioides (Hook.) Schimp.	Herbfield	‡	
Bartramia papillata H.f. et W. ..	Summit rocks	‡	With *Hymenophyllum multifidum.*
Breutelia pendula (Hook.) Mitt. ..	Summit bog	f.	With *Shoenus pauciflorus.*
	Summit rocks	f.	With *Deyeuxia setifolia.*
Rhacocarpus australis (Hampe.) Par.	Herbfield	‡	
Ptychomnion aciculare (Bird.) Mitt	Summit	‡	
Drepanocladus uncinatus (Hedw.) Warmst	Herbfield	a.	
Polytrichum juniperinum Willd. ..	Herbfield	v.a.	fr., very dry.
Dendroligotrichum dendroides (Hedw.) Broth.	Beech forest	o.	
	Summit stream	‡	One patch seen.
HYMENOPHYLLACEAE.			
Hymenophyllum sanguinolentum (Forst. f.) Swartz	Beech forest	o.	
H. demissum (Forst. f.) Swartz ..	Beech forest	o.	On rock.
H. multifidum (Forst. f.) Swartz ..	Beech forest	f.	Epiphytic.
	Olearia scrub	a.	Terrestrial.
	Summit rocks	a.	Terrestrial.
Trichomanes venosum R.Br. ..		‡	
DICKSONIACEAE.			
Dicksonia fibrosa Col.	Tawa forest	l.a.	
D. lanata Col. var. without trunk ..	Beech forest	f.	
CYATHEACEAE.			
Hemitelia Smithii Hook.	Forest	f.	
Alsophila Colensoi Hook. f. ..	Beech forest	‡	
POLYPODIACEAE.			
Polystichum vestitum (Swartz) Presl.	Tawa forest	f.	
	Beech forest	f.	
	Induced scrub	o.	
Asplenium lucidum Forst. f. ..	Beech forest	o.	
A. bulbiferum Forst. f.	Beech forest	o.	
Blechnum Patersoni (Spreng.) Mett. var. *elongata* (Hook. et Bah.)	Beech forest	l.a.	
Blechnum discolor (Forst. f.) Keys	Beech forest	a.	
B. penna-marina (Poir.) Kuhn. ..	Summit bog	o.	In *Oreobolus* cushions.
B. procerum (Forst. F.) S. G. Anders	Induced scrub	a.	
B. fluviatile (R.Br.) Salom	Tawa forest	a.	
	Beech forest	f.	
Hypolepis millefolium Hook. ..	Induced scrub	l.f.	Margin of bog.
Histiopteris incisa (Thumb.) J. Sm.	Induced scrub	o.	Blackened as if by frost.
OSMUNDACEAE.			
Leptopteris hymenophylloides (A. Rich.) Presl.	Tawa forest	a.	
	Lower beech forest	f.	
L. superba (Col.) Presl.	Beech forest	a.	
	Summit stream	‡	Small plants seen.
LYCOPODIACEAE.			
Lycopodium fastigiatum R. Br. ..	Herbfield	f.	
L. scariosum Forst. f.	Tawa forest	‡	Clearings.
	Surveyor's clearing	‡	

SPECIES.	COMMUNITY.		REMARKS.
PODOCARPACEAE.			
Podocarpus totara A. Cunn.	Beech forest	r.	
	Tawa forest	o.	
P. ferrugineus D. Don.	Tawa forest	a.	
P. spicatus R. Br.	Tawa forest	a.	
P. dacrydioides A. Rich.	Tawa forest	a.	
Dacrydium biforme (Hook.) Pilger ..	*Olearia* scrub	l.c-d.	
D. Bidwillii Hook. f. ex T. Kirk ..	Upper beech forest		
D. cupressinum Sol. ex Forst. f. ..	Tawa forest	v.a.	
Phyllocladus alpinus Hook. f. ..	*Olearia-Dacrydium* scrub	l.a.	Stunted.
GRAMINEAE.			
Microlaena avenacea (Raoul) Hook f.	Upper beech forest	l.a.	
Hierochloe Fraseri Hook. f. ..	Summit	‡	Flowering.
Deyeuxia setifolia Hook. f. ..	Summit rocks	f.	fr.
Danthonia Raoulii Steud. var. ..	Herbfield	a.	fr.
Arundo conspicua Forst. f. ..	Surveyor's clearing	l.d.	fr.
Poa anceps Forst. f.	Summit	‡	fl.
Poa caespitosa Forst. f.	Summit	‡	fr.
P. imbecilla Forst. f.	Summit rocks	f	fr.
Festuca sp.	Summit	‡	
CYPERACEAE.			
Scirpus inundatus (R.Br.) Poir. var. *verus* Carse	Summit bog	‡	fl.
Carpha alpina R.Br.	Summit bog	v.a.	fr.
Schoenus pauciflorus Hook. f. ..	Summit bog	a.	fr.
Gahnia procera Forst.	*Olearia-Dacrydium* scrub	f.	fl.
Oreobolus pectinatus Hook. f. ..	Summit bog	a.	fr., deep cushions.
Uncinia caespitosa Boott. var. *minor* Kukenth.	Beech forest	‡	c. 1,110 m.
U. unciniata Kukenth. var.	*Hebe*-tussock	f.	fr.
JUNCACEAE.			
Luzula campestris D.C.	Herbfield	‡	Several puzzling forms.
LILIACEAE.			
Enargea parviflora (Hook. f.) Skottsb.	Beech forest	o.	l.a. at timber line Fl., fr.
Cordyline indivisa (Forst. f.) Steud.	Beech forest	f.	
Astelia nervosa Banks et Sol. var. *silvestris* Ckn. et Allan	*Olearia-Dacrydium* scrub	f.	fr.
	Induced scrub	o.	
Phormium Colensoi Hook. f. ..	Beech forest	r.	On rock.
	Summit rock	f.	
Chrysobactron Hookeri Col.	Herbfield	‡	Near bog, fr.
	Summit rocks	o.	fr.
IRIDACEAE.			
Libertia pulchella Spreng.	Beech forest above 900 m.	o.	fr.
ORCHIDACEAE.			
Thelymitra sp.	Herbfield	o.	fr.
Prasophyllum Colensoi Hook. f. ..	Herbfield	o.	fr.
Pterostylis Banksii R.Br.	Induced scrub	r.	Seen in one place, fl.
Corysanthes triloba Hook. f. ..	Beech forest c. 1,080 m.	‡	
C. macrantha Hook. f.	Summit rocks	‡	One colony seen, fl.
FAGACEAE.			
Nothofagus Menziesii (Hook. f.) Oerst.	Forest, 840-1,050 m.	c-d.	
	1,050-1,260 m.	d.	
N. fusca (Hook. f.) Oerst	Forest, 840-1,050 m.	c-d.	
URTICACEAE.			
Urtica incisa Poir.	Beech forest	l.a.	
Australina pusilla Gaud.	Tawa forest	l.a.	Under *Fuchsia*.
LORANTHACEAE.			
Elyranthe Colensoi (Hook. f.) Engl.	Beech forest	f.	On beech fl. & fr.
Tupeia antarctica (Forst. f.) Cham. et Schlch.	Tawa forest	f.	On *Nothopanax arboreum*, second growth, fruiting.
RANUNCULACEAE.			
Ranunculus insignis Hook. f. ..	Beech forest above 1,050 m.	o.	
	Induced scrub, Herbfield	f.	
	Summit rocks	a.	
R. hirtus Banks et Sol. ex Forst. f.	Surveyor's clearing	‡	

SPECIES.	COMMUNITY.		REMARKS.
MAGNOLIACEAE.			
Wintera colorata (Raoul) Chm. ..	Forest c. 735-1,170 m.	f.	
LAURACEAE.			
Beilschmiedia tawa (A. Cunn.) .. Benth. et Hook.	Forest—840 m.	d.	
CRUCIFERAE.			
Cardamine heterophylla (Forst. f.) O. E. Schulz.	Herbfield	f.	fl. & fr.
SAXIFRAGACEAE.			
Quintinia serrata A. Cunn.	Beech forest—1,050 m.	o.	
Ixerba brexioides A. Cunn.	Beech forest—1,050 m.	a.	fr.
PITTOSPORACEAE.			
Pittosporum tenuifolium Banks et Sol. ex Gaertn.	Tawa forest	‡	Form with very small capsules.
Pittosporum sp.	Tawa forest	f.	Tree 6 m. high with large light green leaves and solitary axillary capsules.
P. rigidum Hook. f.	1,170-1,275 m.	f.-a.	
CUNONIACEAE.			
Weinmannia racemosa Linn. f. ..	Tawa forest	f.	fr.
ROSACEAE.			
Rubus australis Forst. f.	Tawa forest	l.a.	fr. profusely.
	Surveyor's clearing	‡	
R. schmidelioides. A. Cunn. var. *coloratus* T. Kirk	Tawa forest	f.	Especially near road.
Geum parviflorum Sm.	Summit rocks	l.f.	
Acaena sanguisorbae Vahl. var. ..	Induced scrub	l.a.	Near track, Trig. station, etc.
	Herbfield	l.a.	
LEGUMINOSAE.			
Edwardsia tetraptera (Mill) W. R. Oliv.	Beech forest	‡	One plant seen on rock.
CORIARIACEAE.			
Coriaria arborea Lindsay	Surveyor's clearing	‡	fr.
	Summit rocks	‡	fr.
Coriaria thymifolia H. & B. var. ..	Lowland streams	a.	fr.
	Surveyor's clearing	‡	fr.
	Summit rocks	‡	fr.

Where these two forms occurred together hybridism was rife, many of the progeny having the undulate margins characteristic of the variety of *thymifolia* found in the Urewera country.

SPECIES.	COMMUNITY.		REMARKS.
ICACINACEAE.			
Pennantia corymbosa J. R. et G. Frost.	Lowland clearings	l.f.	fr.
ELAEOCARPACEAE.			
Elaeocarpus Hookerianus Raoul ..	Beech forest	‡	One juvenile plant c. 1,050 m.
Aristotelia serrata (Forst.) W. R. Oliv.	Tawa forest	l.a.	fr.
	Beech forest	‡	Noted at 1,110 m.
MALVACEAE.			
Hoheria sexstylosa Col.	Tawa forest	l.a.	fl.
VIOLACEAE.			
Viola filicaulis Hook. f.	Beech forest	f.	fl.
	Margin of summit bog	o.	fr.
Melicytus ramiflorus J. R. et G. Forst.	Forest 930 m.	o.	
M. lanceolatus Hook. f.	Beech forest	f.	
MYRTACEAE.			
Metrosideros robusta A. Cunn. ..	Tawa forest	o.	
M. Colensoi Hook. f.	Forest 900 m.	a.	
ONAGRACEAE.			
Epilobium erectum Petrie	Summit bog	o.	fr.
E. pedunculare A. Cunn.	Herbfield	f.	fr.
Fuchsia excorticata Linn. f. ..	Tawa forest	l.d.	fr.
	Beech forest	o.	
	Herbfield	o.	

SPECIES.	COMMUNITY.		REMARKS.
ARALIACEAE.			
Nothopanax simplex (Forst.) Seem.	Beech forest	‡	
N. Edgerleyi (Hook. f.) Harms ..	Forest	‡	
N. Sinclairii (Hook. f.) Seem.	Beech forest	f.	
	Olearia-Dacrydium scrub		
N. Colensoi (Hook. f.) Seem. ..	Induced scrub	f.	
N. arboreum (Forst. f.) Seem. ..	Lower forest	f.	
Schefflera digitata Forst.	Forest 1,110 m.	‡	
UMBELLIFERAE.			
Schizeilema Allanii Cheesem. ..	Beech forest above 1,050 m.	o.	
	Herbfield	f.	fl. & fr.
Oreomyrrhis andicola Endl. ..	Herbfield	f.	fr.
Aciphylla squarrosa Forst.	Herbfield	f.	fr.
Anisotome aromatica Hook. f. ..	Herbfield	a.	fr.
CORNACEAE.			
Griselinia littoralis Raoul	Forest above 735 m.	o.	
	Induced scrub	o.-f.	
ERICACEAE.			
Gaultheria antipoda Forst. var. ..	Surveyor's clearing	‡	
	Herbfield	f.	
G. rupestris (Forst.) R. Br., crossing with *G. antipoda* and ? *G. depressa*.	*Olearia-Dacrydium* scrub	a.	One plant seen epiphytic on *D. biforme*.
			fl. & fr.
	Induced scrub	a.	fl. & fr.
	Rocky ledges	‡	fl. & fr.
EPACRIDACEAE.			
Pentachondra pumila (Forst. f.) R.Br.	Herbfield	l.a.	fl. & fr.
Cyathodes empetrifolia Hook. f. ..	Herbfield	o.	
Dracophyllum longifolium (Forst. f.) R.Br.	*Olearia-Dacrydium*	o.	fl.
	Herbfield	l.f.	Young.
MYRSINACEAE.			
Suttonia salicina Hook. f.	Tawa forest	‡	
S. divaricata Hook. f.	Timberline and *Olearia Dacrydium* scrub	a.	fr.
GENTIANACEAE.			
Gentiana bellidifolia Hook. f. ..	*Olearia-Dacrydium* scrub	f.	fl. & fr.
	Herbfield	f.	fl. & fr.
APOCYANACEAE.			
Parsonsia sp.	Tawa forest	f.	fr.
BORAGINACEAE.			
Myosotis Forsteri Lehm.	Beech forest	‡	fl.
Myosotis sp.	Summit rocks	‡	

Undetermined species of *amabilis-saxosa* group. Leaves crowded on semi-erect branched rhizomes resembling those of specimens collected by Aston at Titiokura, type locality of *M. saxosa*, and tentatively referred by Cheeseman to that species. In its larger size and nature of hairiness it approaches *M. amabilis*. Fls. not seen.

SPECIES.	COMMUNITY.		REMARKS.
SCROPHULARIACEAE.			
Jovellana repens (Hook. f.) Kranzl.	Beech forest	‡	fl. 1,140 m.
Hebe salicifolia (Forst. f.) Pennell	Lowland second growth	f.	fl.
	Surveyor's clearing	a.	fl.
	Induced scrub	o-a.	fl.
Hebe buxifolia (Benth.) Ckn. et Allan	Herbfield	l-a.	fl.
Veronica sp.	Herbfield	f.	Agrees with Colenso's specs. of *V. Olseni* in Cheeseman's Herbarium.
Ourisia macrophylla Hook.	Beech forest above 990 m.	f.	fr.
	Induced scrub	o.	fr.
	Herbfield	a.	fl.
Euphrasia tricolor Col.	Beech forest above 1,050 m.	r.	fl. In clearing and on rock.
	Herbfield	a.	fl.
RUBIACEAE.			
Coprosma grandifolia Hook. f. ..	Forest	‡	
C. tenuifolia Cheesem.	Forest	o.	
	Induced scrub	o.	fr.
	Summit rocks	‡	fr.
C. myrtillifolia Hook. f.	Beech forest	o.	
	Induced scrub	o.	fr.

SPECIES.	COMMUNITY.		REMARKS.
C. brunnea Ckn.	Surveyor's clearing	o.	fr.
	Induced scrub	o.	fr.
C. foetidissima Forst.	Beech forest	a.	
	Induced scrub	c.-d.	
C. foetidissima x. C. Colensoi, etc.	Beech forest	a.	
C. Banksii Petrie	Beech forest	‡	
C. pseudocuneata W. R. Oliv. ..	Induced scrub	c.-d.	fr.
C. depressa Col. ex. Hook. f. ..	Induced scrub	v.a.	Encroaching.
C. Colensoi Hook. f.	Beech forest	a.	
CAPRIFOLIACEAE.			
Alseuosmia quercifolia A. Cunn. ..	Tawa forest	‡	
CAMPANULACEAE.			
Pratia angulata (Forst. f.) Hook. f.	Forest—1,050 m.	a.	fl., fr.
Wahlenbergia albomarginata Hook. ..	Summit rocks	f.	fl.
STYLIDACEAE.			
Forstera Bidwillii Hook. f.	Summit bog	r.	fr.
COMPOSITAE.			
Olearia Colensoi Hook. f.	Subalpine scrub forest from 1,050 m.	d.	Regenerating all over summit.
O. aborescens (Forst. f.) Ckn. et R. M. Laing.	Induced scrub	f.	fl.
	Beech forest	o.	Seedlings.
O. capillaris Buch.	Summit	o.	fl.
	Surveyor's clearing	‡	
O. ilicifolia x arborescens (*O. macrodonta* Barker)	Beech forest	o.	Young plants.
O. ilicifolia Hook. f.	Herbfield	‡	Two plants seen.
O. rani (A. Cunn.) Ckn.	Beech forest	o.	Young plants.
Celmisia spectabilis Hook. f. ..	Herbfield	a.	fr.
Helichrysum bellidioides (Forst. f.) Willd.	Herbfield	a.	fl.
Cassinia Vauvilliersii (H. & J.) Hook. f.	Herbfield	‡	fl. One plant seen.
Craspedia uniflora Forst. f. var. ..	Herbfield	l.a.	fr.
	Beech forest	r.	fr. on rock.
Brachyglottis repanda Forst. ..	Beech forest	o.	Last noted at 1,110 m.
Senecio latifolius Banks et Sol. ex Hook. f.	Forest from 1,050 m.	o.	fl.
	Summit rocks	a.	fl.
S. Kirkii Hook. f. ex T. Kirk. ..	Beech forest	f.	Terrestrial.
S. elaeagnifolius Hook. f.	Beech forest above 1,050 m.	f.	Confined to forest.
Taraxacum sp.	Summit	o.	fl.

For assistance in the identification of species and for encouragement at all times our thanks are due to Dr. L. Cockayne, C.M.G., F.R.S., of Wellington.

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Some Notes on Maori Agricultural and Earth-Working Implements.

By V. F. FISHER, Assistant Ethnologist.

The main purpose of this paper is to describe certain wooden implements of the Maori that have recently been added to the collections in the Auckland Museum. It is hoped that this will assist students in other areas to make comparisons with material they possess, and possibly add something to our stock of knowledge concerning them. Too often specimens of interest to students of ethnology lie undescribed in our Museums, and a worker has no knowledge of their existence. It is necessary to have measurements, illustrations, notes concerning the locality of their origin, and deductions as to their possible use.

With regard to the nomenclature used, it is difficult at the present time to elicit any reliable information from the people concerning the names of the implements described, owing to the fact that these primitive implements were early displaced in most districts with more serviceable pakeha tools. Hence it is only a few old men who can supply the needed information. Consequently, for the most part, names applied by the late Mr. E. Best to similar implements in his excellent article on "Maori Agriculture," in the Dominion Museum Bulletin, No. 9 have been used.

The majority of the articles dealt with have been discovered in swamps, which demonstrates the fact that they are of considerable age, even though in some cases it might be difficult to say definitely whether they were pre-pakeha or not. The use to which certain implements of the shovel type were put must be largely a matter of conjecture, as very little information can be gleaned from Maori sources. It is probable that most were used for agricultural purposes though one or two may have been used in digging out, or shaping the earthworks of which there are so many remnants in New Zealand.

IMPLEMENTS OF THE TIMA TYPE.

Of the implements known as *tima, timo,* or *timotimo* very few examples have been preserved in Museums. The *tima* was definitely used for agricultural purposes, as various writers have mentioned. When in use, the worker adopted a squatting attitude, and used the *tima* as a grubber for loosening soil around growing crops, such as *kumara,* or to enable weeds to be removed more easily. On one occasion an elderly native, after being questioned concerning the manner in which the *tima* was used, proceeded to demonstrate in typical Maori fashion. Placing his watch on the floor, he assumed a squatting position, *tima* in hand, while he industriously loosened imaginary weeds which were supposed to be growing around the watch, *alias* the *kumara* plant.

The Auckland Museum possesses three specimens, all recently acquired. The Dominion and Wanganui Museums have each six specimens, Canterbury two and New Plymouth one. Mr. J. H. Burnet, Director of the Wanganui Museum, informed me that the *tima* "was still in use on the upper Wanganui River, or was until recently."

The dimensions of the specimen illustrated in Plate 9, Fig. 1, are as follows: Length of handle, 3 feet 6 inches; length of blade, 1 foot 10 inches. The diameter of the handle is two inches at the point of junction with the blade, tapering to $\frac{3}{4}$ of an inch at the bottom. A decided curve is noticeable in the handle. The blade tapers steadily to a rather blunt point. It was found under a house at Orakei.

The dimensions of that figured on Plate 9, Fig. 2, are as follows: Length of handle, 2 feet 10 inches; diameter of handle, $1\frac{3}{4}$ inches at the head, but tapering towards the bottom; length of blade, 1 foot 5 inches, and 1 inch in diameter, tapering to a sharp point. It was formerly the property of a native at Awataha, Shoal Bay, Auckland.

Both of these specimens are somewhat crude, and have not the finished appearance of the third illustrated (Plate 9, Fig. 3). Nevertheless, they were evidently considered suitable for the purpose in hand. It is interesting to note that the blade in Fig. 2 is just half the length of the handle, while in Fig. 1 it is just slightly more than half. In all the typical examples figured by Best, the blade is as long as, or longer, than the handle. In Plate 9, Fig. 3, we have a more typical example. Considerable care has been bestowed in fashioning and shaping it to the required size. The point of the blade is definitely flattened, while the bottom of the handle terminates in a slight knob, which enabled the cultivator to secure a firmer grip of the implement. This specimen has evidently been fashioned with steel tools.

The dimensions are as follows:

Handle, 1 foot $2\frac{1}{2}$ inches long and 1 inch in diameter. The blade is 11 inches long. This would be a much more serviceable implement than either of the other two described. A fact worthy of notice is that none of these specimens show any signs of carving. So far as is known, only two carved specimens exist, one in the Dominion Museum, the other in the Canterbury Museum. This would lead us to infer that implements of this class were not highly valued, hence it was seldom that an owner troubled to ornament them with a carved design.

Mr. Best pointed out that the *tima* was used more particularly "for loosening soil too hard to be worked with a broad bladed tool." Usually implements of the *tima* type were made from a forked branch.

Mr. Best reproduces, in the Polynesian Journal, an illustration from "Wonders of the Past," which shows that the dwellers on the Nile used a similarly shaped implement 3,000 years ago.

Leaving the *tima,* let us now consider a few implements of the *kaheru* type. Plate 8, Fig. 1, shows an interesting specimen found in a swamp at Waiuku. The total length is 3 feet 7 inches; length of blade 1 foot 2¾ inches, width 5 inches, and ¼ to ½ inch thick. This specimen is practically flat at the back, but has a slightly raised ridge in the front, which continues about one-third of the length of the blade. The handle is straight, except for a natural bend, which commences three inches from the top. There is a complete absence of carving.

The blade and handle are cut out of the solid. This specimen is evidently very old and shows signs of considerable use. It is interesting to note that Mr. Best figures an almost identical specimen in Dominion Museum Bulletin, No. 9, Fig. 17A, No. 4. The measurements correspond, and it is similar in shape, but lacks the bend at the top, while at the point of junction of the handle and blade it tapers more than the specimen figured here. Mr. W. H. Skinner informs me that the *kaheru* figured in the Dominion Museum Bulletin "was found in a swamp at Pungarehu, near Parihaka." Mr. Best says of this particular type of *kaheru* "that they are by no means common forms." Actually, the specimen described above is the only one of its type in the Auckland Museum collection. It suggests certain points of resemblance to a type of *kaheru* often called *pere* or *tipi,* which has a detachable blade. In all probability it was only used for light work, such as loosening weeds around growing crops.

In Plate 8, Fig. 2, we have a much more common type, and similar specimens are occasionally seen in collections. It was also found in a swamp at Puni. The total length is 3 feet 10½ inches; length of blade 2 feet, width 4¾ inches at the widest part. The handle is 1¾ inches wide.

It has evidently lain in the swamp for a considerable period, though probably made in comparatively recent times. The blade is rather thin and shows signs of decay towards the top. An implement such as this would last a considerable time in use, especially when we remember that for the most part it would only be used after the ground had been loosened with the *ko,* or digging stick.

The next specimen to be considered (Plate 9, Fig. 4) resembles the one just described in the shape of the blade; but has evidently been used for much heavier work. The two knobs carved at intervals along the handle are unusual features. It would seem they had been so carved to serve as hand-grips, thus enabling the worker to use the implement to better advantage. They are certainly spaced at a suitable distance for this purpose. When handled, the impression gained is that it would be rather a cumbersome implement to use. It is of recent make, though it has seen some wear. The weight would seem to preclude the possibility of its use as an agricultural tool. It is much more likely to have been used by toilers engaged in constructing earthworks for a *pa.* Against this supposition there is the fact that it was found in a swamp, though even this does not carry conviction of its being an agricultural implement.

The total length is 5 feet 6 inches; length of blade 2 feet 7½ inches, width of blade at the widest part 6 inches. At a distance of 4½ inches above the blade is a knob 2¼ inches wide and 2 inches thick, while 10½ inches above the first knob is another 1½ inches wide and 1¾ inches thick.

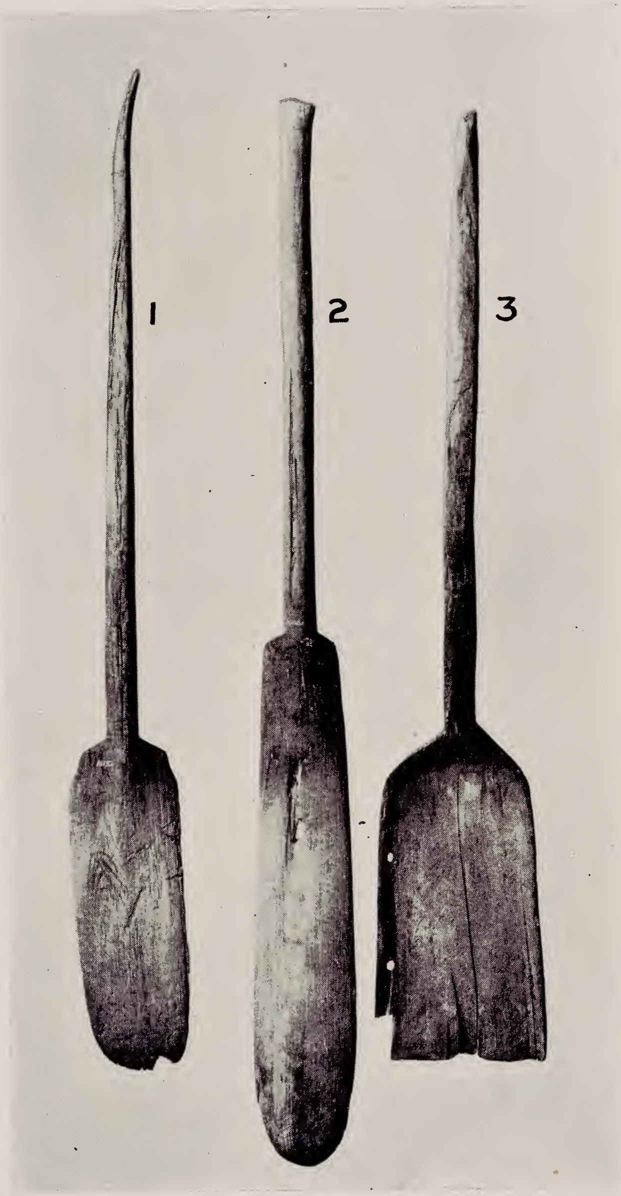
We have a very interesting specimen in Plate 8, Fig. 3. This was found on Mr. M. Buckland's property, Omokoiti, Kaipara, during drainage operations. It may be referred to the class known as *koko,* or shovel.

The total length is 3 feet 5 inches. The blade is 1 foot 2½ inches long and varies in width from 6 inches at the top to 7 inches at the bottom. There is also a rim ¾ inch high along the two outer edges.

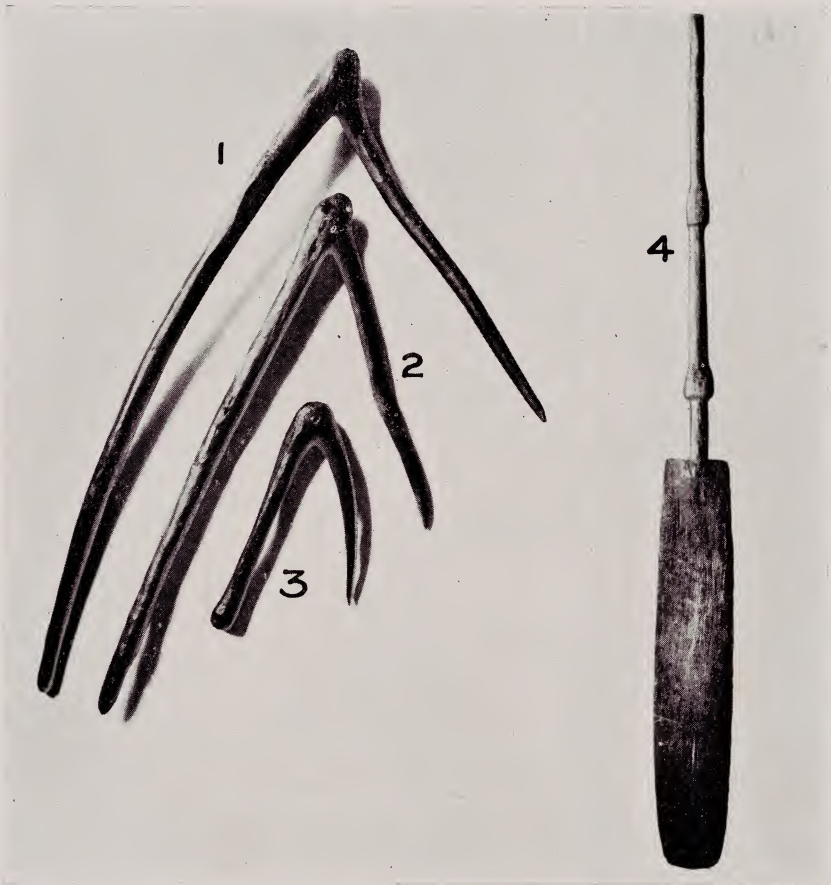
A portion of the handle has been broken off at the top. At one side, just where the rim merges into the blade, are two roughly made holes ⅜ inch in diameter. It would appear that these were for the purpose of lashing another piece of wood thereto, though for what purpose it is hard to conceive. None of the specimens figured by Mr. Best in the Dominion Museum Bulletin shows any sign of holes on the side. Another specimen of a shovel in the Auckland Museum has, however, three holes bored on each side, with some of the original lashing still attached. Possibly another piece of wood was lashed to the rim, thus enabling more soil to be shifted.

It is to be expected that greater numbers of implements similar to those described in this article will be discovered in country districts when drainage operations are in progress. It is to be hoped that owners will realise the value and interest attached to such relics, and will take steps to have them deposited where they will be safely preserved. There certainly is a great diversity of form in these and allied types. In this connection it might be possible to assign certain types to definite tribal areas, if sufficient numbers were available for comparison.

In conclusion I should like to record my appreciation for the information supplied by the following gentlemen, in addition to those already mentioned: Professor R. Speight, Messrs. W. R. B. Oliver, and H. D. Skinner.



Figs. 1, 2. Implements of the *kaheru* type.
Fig. 3. A *koko,* or shovel.



Figs. 1, 2, 3. Specimens of the *tima*.
Fig. 4. A *kaheru* with two knobs carved on the handle.

Waitotaran Faunules of the Wanganui System: and Descriptions of New Species of Mollusca from the New Zealand Pliocene.

By A. W. B. POWELL, Conchologist and Palaeontologist.

The fifty miles of coastal cliffs which extend north-west from the mouth of the Wanganui River to beyond Hawera, provide a wonderful sequence of Pliocene strata, richly fossiliferous throughout.

For many years these deposits have been the subject of stratigraphical and palaeontological inquiry and research, but much remains to be accomplished before even the molluscan faunules of these beds are adequately known.

Interest in the Wanganui System has been revived during the past decade by the appearance of two outstanding papers by Marshall and Murdoch—"The Tertiary Rocks near Wanganui" (1920) and "Tertiary Rocks near Hawera" (1921). These papers gave the first comprehensive set of locality lists, together with a wealth of information relating to probable conditions of deposition, contemporary climate, and other inferences.

Apart from a review of the Waitotaran faunules at Hawera and Waipipi, the present paper includes descriptions of twenty-two new species of fossil mollusca from the Waitotaran and other stages in the North Island Pliocene, and also the description of a new Recent subspecies.

ACKNOWLEDGMENTS.

The writer is indebted to Dr. J. Marwick for some opinions, the loan of types, and also for his generosity in permitting the description of a species which is based upon a specimen in the Geological Survey Collection. Also, thanks are due both to Mr. C. R. Laws for information relating to *Sinum* and *Heligmope,* and to Master C. A. Fleming, for his assistance in collecting during the field trip of January, 1931.

WAITOTARAN FAUNULES OF WAIHI, HAWERA AND WAIPIPI, NEAR WAVERLEY.

The cliffs at Waihi are moderately high, the lower fifty to sixty feet being composed of sandy blue-clay or papa. On top of this is a narrow shell-band, one to three feet in depth, which represents the raised Pleistocene Beach. Above this has accumulated over one hundred and fifty feet of Pleistocene to Recent (Notopleistocene of Thomson, 1917, p. 414.) stratified sands and gravels.

The soft nature of both the basal Waitotaran papa and the superimposed Pleistocene and Recent materials is the cause of frequent slips, it being a common occurrence for shells from the Pleistocene Beach to be found scattered among and even imbedded in the fallen masses of Waitotaran papa.

It seems evident that a few erroneous records, based upon shells from this uplifted Pleistocene Beach, have crept into Marshall and Murdoch's Hawera list and are one of the main causes of the relatively high Recent percentage given (indicated as 59 per cent.).

To cite examples, the writer has found that the following species of Marshall and Murdoch's list are common in the Pleistocene Beach deposit, but are absent from the Waitotaran papa, except as derived fossils:—*Ancilla depressa, Arca novaezelandiae, Calyptraea novaezelandiae inflata, Chione mesodesma, Thais* aff *lacunosa* and *Venericardia purpurata.*

An excellent account of this raised beach and its fauna has been published by Thomson—"*The Hawera Series, or So-called Drift Formation of Hawera*" (1917, p. 417). To this list, now must be added the following species:—*Emarginula striatula, Myadora striata, Dosinia maoriana, Dosinula zelandica, Paphirus largillierti, Austrofusus chathamensis, Gondwanula tumida, Baryspira depressa, Barnea similis* and *Lepsithais lacunosa.* Furthermore, Thomson's *Euthria linea* should be replaced by *Buccinulum caelatum* Powell 1929.

Thomson (l.c.) mentioned the occurrence in the Pleistocene beach deposit of a derived specimen of *Chlamys triphooki* and Dr. Marwick has informed the writer of a second derived Waitotaran form—*Glycymeris manaiaensis,* which he recently collected from the same bed.

A similar Pleistocene Beach deposit occurs above the papa at Waipipi. Here the fossiliferous band is very narrow, only about eight to ten inches in depth, and is composed of water-worn gravel, pebbles, and the following molluscan remains:—*Barbatia novaezelandiae, Dosinula zelandica, Tawera spissa, Modiolus areolatus, Chlamys zelandiae, Buccinulum caelatum, Sigapatella novaezelandiae, Emarginula striatula, Maoricolpus rosea, Baryspira mucronata, Herpetopoma larochei, Marginella* cf. *mustelina* (juvenile) and *Modelia* sp. (operculum).

Other supposed Recent species of Marshall and Murdoch's Hawera list have been described since or are herein described, as extinct forms ancestral to living species.

The field work at Hawera, amounting to about six whole days' collecting, was spread over a period of four years, so the list here published may be taken as fairly comprehensive, in spite of the relatively small number of species. This paucity in species is occasioned by the fact that only the larger forms are present in the beds. Even when the matrix is washed and sieved, the minute mollusca, foraminifera and bryozoa, so characteristic of the higher Wanganuian Beds are shown to be absent.

Only a short time was available for collecting at Waipipi, so this list cannot be considered representative. Marshall and

Murdoch enumerated seventy-two species for Waipipi, of which sixty-one per cent. were considered Recent. It seems evident that, as in the case of the Hawera Beds, the Recent percentage will be considerably reduced as the result of further investigation.

Revised Lists.			Corresponding Nomenclature of Marshall and Murdoch's lists (1920 and 1921).
PELECYPODA.	Waihi, Hawera	Waipipi	
Nuculana (Saccella) waihiana n. sp.	§	§	*Nuculana bellula* (A. Adams)
Neilo annectens n. sp.	§	§	—
**Anomia undata* Hutton	§	—	*Anomia huttoni* Suter.
**Glycymeris (Grandaxinaea†) laticostata* (Q & G) ..	§	2	*Glycymeris laticostata* (Q. & G.)
Glycymeris (Veletuceta†) manaiaensis Marwick	§	—	*Glycymeris subglobosa* Suter
Glycymeris (Veletuceta†) waipipiensis Marwick	—	§	*Glycymeris subglobosa* Suter
**Mytilus canaliculus* Martyn ..	§	—	—
Pedalion zealandicum (Suter) ..	§	§	*Melina zealandica* Suter
**Chlamys radiatus* (Hutton) ..	§	§	*Pecten zelandiae* Gray
Chlamys (Phialopecten) triphooki (Zittel)	§	§	*Pecten triphooki* Zittel
Sectipecten crawfordi (Hutton)	§	§	*Pecten semiplicatus* Hutton
Pallium (Mesopeplum) waikohuensis Marwick	§	—	—
Lima waipipiensis Marsh. & Murd.	§	§	*Lima waipipiensis* M. & M.
Mantellum marwicki (Powell)	§	2	*Lima angulata* Sowerby.
Ostrea (Crassostrea) ingens Zittel	§	§	*Ostrea ingens* Zittel
**Ostrea charlottae* Finlay ..	§	§	*Ostrea angasi* Sowerby.
**Atrina zelandica* (Gray) ..	§	§	*Atrina zelandica* (Gray)
Eucrassatella marshalli n. sp.	—	§	*Crassatellites obesus* (A. Ad.)
**Divaricella cumingi* (Ad. & Ang.)	§	§	*Divaricella cumingi* (Ad. & Ang.)
Miltha (Milthoidea) neozelanica Marsh. & Murd.	2	§	*Miltha "zelandiae"* M. & M.
Pteromyrtea dispar (Hutton) ..	§	§	*Lucinida levifoliata* M. & M.
Zemysia ampla (Hutton) ..	—	§	*Diplodonta ampla* (Hutton)
**Tellinella ferrari* Marwick ..	§	—	—
Tellinella cf. *eugonia* (Suter) ..	—	§	—
Eurytellina solitaria n. sp. ..	§	—	—
**Scalpomactra scalpellum* (Reeve)	§	§	*Mactra scalpellum* Reeve.
**Zenatia acinaces* (Q. & G.) ..	§	§	*Zenatia acinaces* (Q. & G.)
Lutraria solida (Hutton) ..	—	§	*Lutraria solida* (Hutton)
**Dosinia lambata* (Gould) ..	§	2	*Dosinia lambata* (Gould)
**Dosinia (Kercia) greyi* Zittel ..	§	§	—
Dosinia (Raina) nukumaruensis Marwick	§	—	*Dosinia subrosea* (Gray)
Dosinia (Raina) waipipiensis Marwick	—	§	—
Tawera errans Marwick ..	—	§	*Chione mesodesma* Q. & G.
**Dosinula zelandica* (Gray) ..	§	2	*Cytherea oblonga* (Hanley)
**Bassina yatei* (Gray)	2	§	*Chione yatei* (Gray)
**Paradione (Notocallista) multistriata* (Sowerby)	§	2	*Macrocallista multistriata* (Sowerby)
Marama murdochi Marwick ..	§	§	—
Eumarcia plana Marwick ..	—	§	*Cytherea enysi* (Hutton)

Revised Lists.			Corresponding Nomenclature of Marshall and Murdoch's lists (1920 and 1921).
Eumarcia (Atamarcia) benhami Marwick	—	§	*Paphia curta* (Hutton)
Cardium spatiosum Hutton ..	§	§	*Cardium spatiosum* Hutton.
**Nemocardium (Pratulum) pulchellum* (Gray)	§	§	*Protocardia pulchella* (Gray)
**Gari lineolata* (Gray)	§	2	*Psammobia lineolata* Gray
**Notocorbula zelandica* (Q. & G.)	—	§	*Corbula macilenta* (Hutton)
**Panope zelandica* (Q. & G.) ..	§	§	*Panope zelandica* Q. & G.
**Offadesma angasi* (Crosse & Fischer)	§	—	————
Myadora waitotarana n. sp. ..	§	—	————
Pholadomya waitotarana n. sp.	—	§	————
GASTEROPODA.			
Emarginula haweraensis n. sp.	§	—	————
Maurea hawera (Oliver) ..	§	§	*Calliostoma selectum* (Chemn.)
Maurea (Mucrinops) granti n. sp.	§	—	*Calliostoma pellucidum* (Val.)
Maoricolpus cf. *rosea* (Q. & G.)	§	§	*Turritella rosea* Q. & G.
**Zeacolpus vittatus* (Hutton) ..	§	—	*Turritella carlottae* Watson
Zeacolpus (Stiracolpus) haweraensis n. sp.	§	2	*Turritella symmetrica* Hutton
Struthiolaria (Pelicaria) incrassata n. sp.	§	—	————
Struthiolaria (Pelicaria) zelandiae Marsh. & Murd. ..	§	§	*Struthiolaria zelandiae* M. & M.
**Struthiolaria papulosa* (Martyn)	§	—	*Struthiolaria papulosa* (Martyn)
Maoricrypta wilckensi (Finlay)	§	§	*Crepidula gregaria* Sowerby.
Zegalerus crater Finlay ..	—	§	*Calyptraea alta* (Hutton)
Polinices ovuloides (Marwick)	§	§	*Polinices ovata* (Hutton)
Polinices waipipiensis (Marwick)	§	§	*Polinices sagenus* Suter
Tanea haweraensis (Marwick)	1	1	*Natica zelandica* Q. & G.
Friginatica marshalli Marwick	§	1	————
Sinum cf. *marwicki* Laws ..	§	—	————
Globisinum flemingi n. sp. ..	—	§	————
Xenophalium fibratum Marsh. & Murd.	§	2	*Phalium fibratum* Marsh. & Murd.
**Cirsotrema zelebori* (Dunker)	§	—	————
Heligmope postulatus (Bartrum)	§	—	————
Austrofusus cf. *pagoda* Finlay..	§	§	*Verconella nodosa* (Hutton)
Zelandiella pliocenica n. sp. ..	—	§	*Siphonalia subnodosa* Hutton
Austrosipho (Verconella) haweraensis n. sp.	§	—	*Verconella mandarina* (Duclos)
Austrosipho (Verconella) aff. *dilatata* (Q. & G.) ..	§	§	*Verconella dilatata* (Q. & G.)
Coluzea spectabilis n. sp. ..	§	—	*Fusinus* aff. *spiralis* aff. *dentatus* (Hutton)
Zeatrophon bonneti (Cossmann)	§	—	————
**Poirieria zelandica* (Q. & G.)	§	—	————
Alcithoe gatesi Marwick ..	§	§	*Fulgoraria morgani* M. & M.
Alcithoe whakinoensis Marwick	§	§	*Cymbiola (Miomelon) corrugata* (Hutton)
Alcithoe haweraensis Marwick	§	§	————
**Alcithoe larochei* Marwick ..	§	—	————
Olivella (Lamprodomina) neozelanica (Hutton)	§	§	*Olivella neozelanica* (Hutton)

Revised Lists.			Corresponding Nomenclature of Marshall and Murdoch's lists (1920 and 1921).
**Baryspira mucronata* (Sowerby)	§	§	————
Marshallena austrotomoides n. sp.	§	—	————
Comitas declivis n. sp.	§	—	————
Phenatoma decessor Marwick..	§	—	————
Zeacuminia murdochi n. sp. ..	§	§	————
Perirhoe (Dimidacus) bicorona (Hutton)	§	—	————
SCAPHOPODA.			
Dentalium solidum Hutton ..	§	§	*Dentalium solidum* Hutton
Dentalium (Laevidentalium) pareorense Pilsbry & Sharpe	§	§	*Dentalium pareoraensis* Pilsbry & Sharpe

†Iredale 1931. Rec. Aust. Mus. vol. 18, pp. 202-203.

*Species still living.

1. From Marwick's published papers (1923-1931, Trans. N.Z. Inst., vols. 54, 55, 56 and 57, and N.Z. Geol. Surv. Pal. Bull. No. 13).
2. From Marshall and Murdoch's lists (1920 and 1921, Trans. N.Z. Inst., vols. 52 and 53).

The suggested synonymy in the above list cannot be considered absolutely authoritative, as the writer has not seen the actual material upon which Marshall and Murdoch based their records.

SUMMARY.

Total of species from Waihi, Hawera 73
Number of extinct species 47
Percentage of Recent species 35.62

Total of species from Waipipi (not a representative collection) .. 61
Number of extinct species 43

Further collecting is necessary at this locality before a reasonably accurate Recent percentage can be given.

ANALYSIS OF THE FAUNULES.

A noteworthy feature of both the Waihi and the Waipipi faunules is the persistence of a number of long-range stragglers from Miocene times—*Zeacuminia, Marshallena, Comitas, Sinum, Eucrassatella, Pholadomya, Dentalium solidum, D. (Laevidentalium) pareorense, Cardium spatiosum, Pallium waikohuensis, Miltha, Zelandiella* and the large *Polinices.* The first six of the above mentioned genera make new records for our Pliocene, for it was formerly assumed that these genera became extinct in New Zealand with the close of Miocene times.

This does not imply that the Hawera beds are older than formerly supposed, for the genera cited above are represented by only odd occurrences, none characteristic of the beds and evidently all failed to survive the Waitotaran.

Probably their extinction, along with other warm-water types, was caused by a gradual change to a colder climate at about this time. This question of Wanganuian climate has been dealt with at some length by Marshall and Murdoch in their valuable paper on "Tertiary Rocks near Hawera."

Six genera represented in the Waitotaran Fauna and which are now confined to waters warmer than New Zealand Recent seas are *Pedalion, Miltha, Pholadomya, Olivella, Perirhoe* and *Sinum.*

The dominant shellfish at Waihi, arranged in their order of relative abundance, are: *Polinices waipipiensis, Ostrea* cf. *charlottae, Chlamys triphooki, Sectipecten crawfordi, Divaricella cumingi, Pteromyrtea dispar* and *Maoricrypta wilckensi.* Of these *Polinices* was a vigorous carnivore, as evidenced by the number of valves of *Pteromyrtea* and *Divaricella,* which exhibit naticoid radulæ borings. (Naticoid borings, particularly those produced by *Polinices,* are characterized by a large, smooth, circular depression, which, with the aid of an acid secretion, is formed by the under-side of the proboscis, the actual perforation, only, being the work of the radula.)

At Waipipi, the dominant species are *Cardium spatiosum, Eucrassatella marshalli, Baryspira mucronata, Glycymeris waipipiensis, Eumarca plana* and *Polinices waipipiensis.* This faunule showed a marked scarcity of *Polinices* and a preponderance of heavily-built pelecypods, suggesting shallower-water deposition than in the case of the Hawera faunule.

The genera *Sinum* and *Olivella* and the species *Struthiolaria papulosa* are typical of shallow-water sandy flats in clean-water locations, but, on the other hand, these are not present in quantity, and furthermore, *Chlamys radiatus, Poirieria zelandica, Scalpomactra scalpellum, Alcithoe larochei* and the analogous living species to *Coluzea spectabilis, Eucrassatella marshalli, Lima waipipiensis* and *Neilo annectens* are always associated with moderately deep water.

Moreover, the absence of shallow-water herbivorous gasteropods also indicates that these beds were laid down at a distance from littoral communities. All things considered, the Hawera faunule suggests depths between twenty-five and thirty fathoms, and probably slightly shallower in the case of the Waipipi beds.

Still another occurrence of more than ordinary interest is *"Turbo" postulatus* Bartrum, a recognisable fragment of which was found by Mr. C. R. Laws, imbedded in the matrix of a large *Chlamys triphooki* from Hawera.

Recently Finlay (1931, pp. 1-6) has demonstrated the importance of this type of shell in the correlation of widely separated faunules, pointing out that it belongs to a short-lived genus *Heligmope,* a probable member of the pelagic *Ianthinidae.*

The Kaawa fauna, which has been assigned to the Waitotaran by Marwick (1927, p. 576), is decidedly shallow-water in character, and there *Heligmope* occurred in abundance, but at Hawera it was absent except for the fragment referred to above. However, Dr. Marwick states that he has six specimens of this shell from near the mouth of the Waingongora, an adjacent locality, where the faunule and lithology are much the same as at Hawera beach.

The scarcity of *Heligmope* in the Waitotaran of South Taranaki may be attributed to the obviously deeper-water conditions of deposition than in the case of the Kaawa beds, for although Recent *Ianthina* is cast ashore in great abundance at certain seasons on most Australasian oceanic beaches, these shells are very light and buoyant, and on this account are seldom encountered in our offshore dredgings. Taking this into consideration, the scarcity of *Heligmope* in the Waitotaran of Hawera and Waipipi is not surprising.

DESCRIPTION OF SPECIES.

NUCULANIDAE.

Genus NUCULANA Link 1807.

Type (monotypy): *Arca rostrata* Linn.

Subgenus SACCELLA Woodring 1925.

Type (original designation): *Leda commutata* Philippi.

Nuculana (Saccella) waihiana n. sp. Fig. 15.

Shell somewhat similar in shape to the Lower Pliocene *N. tenellula* Bartrum and Powell from Kaawa Creek, but differing in the ribbing, which is a trifle coarser and of a distinctly flexuous pattern, and in the shape of the rostrum, which is not strongly uptilted. The usual concentric ridges, which are about three or four per millimetre at the middle of the shell, become suddenly decurrent towards the sides and then abruptly upcurved to the dorsal margin, almost at right angles. The posterior line of deflection occurs at a short distance below the strong ridge which runs from the umbo to the rostrum. On the anterior end, the line of deflection occurs at about a corresponding position. Posterior area broad, concave, free from sculpture, and bounded below by the strong ridge already referred to.

Height (estimated), 4.0 mm.; length, 7.5 mm.; thickness (1 valve), 2.0 mm. (holotype).

Height (estimated), 5.0 mm.; length, 10.0 mm.; thickness (1 valve), 2.0 mm. (paratype).

Holotype. In Auckland Museum. (Collected by the writer, Museum field trip, Jan., 1931.)

Localities. On the coast near mouth of Waihi Stream, Hawera. Lower Pliocene (Waitotaran) (Type); Waipipi, on coast near Waverley (Waitotaran).

The sole specimen from Waipipi, which locality has been considered to be four hundred feet higher in the series than Waihi, Hawera, has the posterior deflection of the sculpture less pronounced. It is typical in shape, however, the rostrum being neither strongly uptilted as in *tenellula,* nor sharply pointed as in the Recent *bellula.* The only fossil specimens of *bellula* the writer has so far examined are from the basal papa at Castlecliff.

MALLETIIDAE.

Genus NEILO Adams 1854.

Type (monotypy): *N. cumingii* Adams = (*Nucula australis* Q. & G.).

Neilo annectens n. sp. Fig. 25.

Shell of moderate size, apparently intermediate between the Miocene (Taranakian) *sublaevis* and the Recent *australis.* The sculpture consists of closely packed, weak, concentric growth folds, about five per millimetre. *Australis* has distant sharp, thread-like ridges, about one and a-half per millimetre, and *sublaevis* has the sculpture obsolete over the greater part of its surface, the little that is apparent (mostly on the anterior end) being similar in character to that of *annectens.* The Hawera species may be distinguished from *sublaevis* by the much shallower posterior concavity and the sculpture, which is evenly distributed, showing no tendency towards obsolescence. Hinge normal, imperfectly shown (paratype), but apparently similar to that of *australis* in the number and development of the teeth. The posterior end is truncated and almost vertical, with a slight sinus in the middle, but without a projecting upper rostrum, as in *australis.*

Length, 24.0 mm.; height, 13.0 mm.; thickness (1 valve), 4.5 mm. (holotype).

Length, 23.0 mm.; height, 13.0 mm.; thickness (1 valve), 4.5 mm. (paratype).

Holotype. In Auckland Museum. (Collected by the writer, Museum field trip, Jan., 1931.)

Localities. On the coast near mouth of Waihi Stream, Hawera. Lower Pliocene (Waitotaran); Waipipi, on coast near Waverley, ¾ mile west of the mouth of Wairoa Stream (Waitotaran). (A.W.B.P. Jan., 1931.)

Pectinidae.

Genus Pallium Schumacher 1817.

Type: *Pecten plica* Linn.

Subgenus Mesopeplum Iredale 1929.

Type (original designation): *Mesopeplum caroli* Iredale.

Pallium (Mesopeplum) waikohuensis Marwick 1931. Fig. 18.

N.Z. Geol. Surv. Pal. Bull. No. 13, p. 63. Type. Ormond Series; block II., Waikohu S.D. Upper Miocene (Taranakian).

A large specimen from Waihi, Hawera (Fig. 18) seems to be the adult of Marwick's species, for it has identical details of sculpture and the same curious apical-step development. In the holotype the large size of this step portion, relative to the later shell-growth, suggests that it is a juvenile. Dr. Marwick has seen a photograph of the Hawera shell and agrees that it is inseparable from his Ormond species.

Height, 15.0 mm.; length, 14.5 mm. (holotype).
Height, 52.0 mm.; length, 58.0 mm. (Hawera specimen).

Crassatellitidae.

Genus Eucrassatella Iredale 1924.

Type (original designation): *Crassatella kingicola* Lamk.

Eucrassatella marshalli n. sp. Figs. 21 and 22.

Shell moderately large, solid, elongated, and subtruncated posteriorly. Anterior end short, rapidly descending, convex, imperceptably merged into broadly convex ventral margin. Posterior end more gradually descending, almost straight. Truncation moderately wide, slightly oblique and subangled above and below. There is a very slight external fold running from the umbo to the lower angle of the truncation. Initial sculpture of coarse sulcations about one per millimetre and extending not more than eight millimetres down from the umbo, after which the shell is smooth except for faint lines of growth.

Hinge identical with that of the genotype, even to the characteristic downward bulge in the middle of the plate and the massive anterior cardinal of the left valve. Left valve with two cardinals, the massive anterior and a thin posterior bordering the chondrophore. Right valve with three cardinals, a narrow anterior and a massive median with an inconspicuous lamellate posterior diverging from its side. There is an anterior and a posterior lateral in each valve. Adductor muscle scars of identical shape to those of the genotype.

Height, 49.5 mm.; length, 65.5 mm.; thickness (1 valve), 13.5 mm. (holotype).

Height, 49.0 mm.; length, 68.5 mm.; thickness (1 valve), 14.0 mm. (paratype).

Height, 47.0 mm.; length, 64.0 mm.; thickness (1 valve), 12.5 (paratype).

Holotype. In Auckland Museum. (Collected by the writer, Museum field trip, Jan., 1931.)

Locality. Waipipi, coast near Waverley, at about $\frac{3}{4}$ mile west of the mouth of Wairoa Stream (shell-band in papa), Lower Pliocene (Waitotaran).

Although this species fades into insignificance when compared with the ponderous Oligocene and Miocene *ampla* and *attenuata,* it more nearly approaches the size of the Recent Australian genotype.

The extinction of this type of shell in the Lower Pliocene of New Zealand, along with a number of other species of warm-water facies, points to a definite climatic change at about this time, an observation which has been recorded by Marshall and Murdoch (1920, p. 125).

The above described species was recorded in Marshall and Murdoch's list (l.c.p. 124) as *Crassatellites obesus* A. Adams, but doubts have been expressed concerning the locality originally given for *obesus,* which was described as a Recent shell from New Zealand.

Adams' figure shows a shell with strong sulcations persistent over most of the shell, quite unlike any New Zealand *Eucrassatella* or *Spissatella.*

Iredale has suggested that this shell may not be Neozelanic at all, but a juvenile Australian *Eucrassatella* (Finlay, 1926, p. 257.) Dredging operations up to the present have failed in locating anything approaching *obesus* in New Zealand waters.

TELLINIDAE.

Genus TELLINELLA Morch 1853.

Type: *Tellina virgata* Linn.

Tellinella ferrari Marwick 1931.

N.Z. Geol. Surv. Pal. Bull. No. 13, p. 75.

Type. 1161, Pakaurangi Point, Kaipara. Upper Oligocene (Hutchinsonian).

Although the type is an early Tertiary shell and there is a closely related series, *eugonia,* from the Upper Pliocene, the Recent shells so far examined all conform to *ferrari.*

The writer has examined fossils referable to *eugonia,* from Castlecliff (type locality), Kai Iwi and Waipipi. These shells are characterised by fine, crowded, flattened ridges, with linear interspaces, whereas the sculpture in *ferrari* consists of sharp, concentric ridges with moderately wide interspaces. In addition to the Upper Oligocene type, and Recent specimens, the writer has examined three typical *ferrari* from Waihi, Hawera and another from Castlecliff.

Apparently the two species lived side by side throughout the Pliocene, but *eugonia* has not survived to Recent times.

Genus Eurytellina Fischer 1887.
Type (Monotypy): *Tellina punicea* Born.

Eurytellina solitaria n. sp. Fig. 40.

Although the hinge is badly damaged, the obsolete flexure, feeble concentric sculpture, presence of lateral teeth and elongate-oval outline, present a combination of characters suggestive of relationship with *punicea* Born, the Recent genotype, which is from the Pacific coast of Northern South America. This species is admirably figured by Chenu in his Manuel Conchyliologie. (1862, vol. 2, p. 67, figs. 278 and 279.)

Shell of moderate size, compressed and elongate-oval in outline. Umbones at the posterior three-eighths. Rostrum rounded, situated at about half the height; with obsolete flexure, but having a narrow flattened area defined by a slight ridge, which runs from the umbo to the base of the rostrum. Sculpture of fine raised concentric threads, three to five per millimetre. Hinge badly damaged, but showing definite traces of a posterior lateral.

Height, 15.0 mm.; length, 26.5 mm.; thickness (one valve), 3.0 mm.

Holotype (one right valve) in Auckland Museum. (Collected by the writer, Museum field trip, Jan., 1931.)

Locality. On the coast near mouth of Waihi Stream, Hawera. Lower Pliocene (Waitotaran).

Myochamidae.

Genus Myadora Gray. 1840.
Type (subsequent designation, Gray, 1847): *Pandora brevis* Sowerby.

Myadora waitotarana n. sp. Figs. 26 and 27.

This species is ancestral to the Recent *antipodum,* which it closely resembles in every particular except size. The Waitotaran fossil attains a length of more than twice that of the largest recorded Recent specimen. Also the Lower Pliocene shells from Kaawa Creek, recorded as *antipodum* by Bartrum and Powell (1928, p. 160) appear to be immature examples of this new species. Young specimens of the fossil species compared with typical *antipodum* of corresponding size, show that the former lack the strong convexity of the Recent shells.

Length, 28.00 mm.; height, 20.00 mm.; thickness, 6.00 mm. (holotype).

Length, 13.33 mm.; height, 9.00 mm.; thickness, 2.00 mm. (holotype of *antipodum*).

Length, 8.50 mm.; height, 5.75 mm.; thickness, 2.00 mm. (Average from series of *antipodum* from 30 fath. off Hen and Chickens.)

Holotype. In Auckland Museum. (Collected by the writer, Museum field trip, Jan., 1931.)

Locality. On the coast near mouth of Waihi Stream, Hawera. Lower Pliocene (Waitotaran).

PHOLADOMYACIDAE.

Genus PHOLADOMYA Sowerby 1823.

Type: *Pholadomya candida* Sowerby.

Pholadomya waitotarana n. sp. Fig. 16.

Shell elongate-oval, cuneate, moderately inequilateral. Umbones situated at a little in front of the middle. Anterior end short and flattened, with a slight ridge running from the base of the flattened area to the umbonal region. Posterior end produced and attenuated. Shell substance typical; thin and nacreous. Sculpture consisting of simple, distant, slender, radiate ribs, which are confined to the median portion of the valves. The ribs are twelve in number, the first, which is the strongest, being situated at a little behind the anterior fold, after which the ribs diminish in strength. The whole shell is crossed by irregularly developed concentric growth folds. The only specimen is badly crushed and in consequence the right valve appears to overlap the left, but normally the valves would be equal and the umbones level. However, the left valve has escaped distortion and presents the normal outline.

Height, 29 mm.; length, 53 mm.; thickness (left valve), 11.5 mm. (holotype).

Holotype. In Auckland Museum. (Collected by the writer, Museum field trip, Jan., 1931.)

Locality. Waipipi, on the coast near Waverley, near mouth of Wairoa Stream.

Lower Pliocene (Waitotaran).

Pholadomya is a very conservative genus of great geological antiquity, being known from as early as the Lower Lias. It reached its greatest development in the Mesozoic, declined during the Tertiary, and is to-day represented by but one solitary species, which lives in deep water in the West Indies.

New Zealand has Lower Tertiary members of this genus in *P. neozelanica* Hutton, which was described from an unknown horizon in the Oamaruian, and in a related new species from the Lower Miocene (Awamoan) of Awakino Valley.

The above described Pliocene species, however, is not closely related to either of these, being more ovate-oblong and less inequilateral; nearer in shape to *P. australica* Tate (1894, p. 187), which was described from the Australian Upper Tertiary.

FISSURELLIDAE.

Genus EMARGINULA Lamarck 1801.

Type: *Patella fissura* Linn.

Emarginula haweraensis n. sp. Fig. 17.

Shell very large, broadly ovate and spreading. Elevation moderate; apex recurved and situated at the posterior three-eighths. Sculpture consisting of moderately strong radials crossed by fine concentric cords. The radials are approximately equal in number to those of *striatula,* but differ in their development. Both primary and secondary radials are more nearly equal in size and have a tendency to become broader and flatter towards the margin, resulting in only linear interspaces. For this reason it is a difficult matter to sort out primary cords in the adult shell, but a half-grown paratype shows about 44. Furthermore, owing to these linear interspaces the concentric cords merely delicately imbricate the radials; definite reticulation being apparent only in the vicinity of the apex. In the holotype there are about 118 definite radials at the margin (including both primaries and secondaries), of which 86 extend to the apical area.

Length, 42.00 mm.; breadth, 33.75 mm.; height, 17.00 mm. (holotype).
Length, 17.00 mm.; breadth, 12.25 mm.; height, 8.00 mm. (Average dimensions of Recent *E. striatula.)*
Length, 26.00 mm.; breadth, 20.75 mm.; height, 11.00 mm. (Extra large specimen of Recent *E. striatula valentior* Finlay.)

Holotype. In writer's collection. (Collected Jan., 1927.) Two paratypes, one damaged and the other half grown, in Auckland Museum. (Collected by the writer, Museum field trip, Jan., 1931.)

Locality. On the coast near mouth of Waihi Stream, Hawera. Lower Pliocene (Waitotaran).

This is the largest species of the genus so far recorded for New Zealand.

CALLIOSTOMATIDAE.

Genus MAUREA Oliver 1926.

Type (original designation): *Trochus tigris* Martyn.
Subgenus MUCRINOPS Finlay 1926.

Type (original designation): *Zizyphinus spectabilis* A. Ad.

Maurea (Mucrinops) granti n. sp. Figs. 34 and 35.

Shell acutely conical, moderately solid, inperforate and subangled at the periphery. Spire one and one-half times height of aperture. Outlines straight. Whorls $10\frac{1}{2}$, including typical protoconch. Sculpture fine, consisting of numerous closely spaced beaded spiral cords and interstitial threads, crossed by dense microscopic axial growth striae. Early post-nuclear whorls with three beaded cords, later whorls with six, each interspace having a fine spiral thread, which becomes beaded towards the close of the penultimate whorl. Base with twelve beaded cords, four closely spaced at periphery, the remainder more distant; each with a plain interstitial thread. Periphery angled, but not acutely. Columella oblique, arcuate, rather massive.

Height, 34.25 mm.; diameter, 28.5 mm.; angle of spire, 62 degrees.

Holotype. In Auckland Museum. (Collected by the writer, Museum field trip, Jan., 1931.)

Locality. On the coast near mouth of Waihi Stream, Hawera. Lower Pliocene (Waitotaran).

This shell is ancestral to the living *osbornei* (Powell, 1926, p. 591), from 27 fathoms off Cape Barrier, Great Barrier Island.

However, *osbornei* differs in having a more acute spire and coarser sculpture, with obsolescent interstitial threads.

The species is named after Mr. James Grant, of Wanganui.

NATICIDAE.

Genus SINUM Roeding 1798.

Type : *Helix haliotoidea* Linn.

Sinum cf. **marwicki** Laws, 1930. Fig. 36.

Trans. N.Z. Inst., vol. 61, p. 551. Type. White Rock River. Lower Miocene (Awamoan).

A shell from Waihi, Hawera (Fig. 36) is referable to this species, the only difference being a slight variation in the sculpture, which may or may not be constant. Compared with *marwicki,* the Hawera shell has the ridges more closely spaced and the width of the interspaces a little less than that of the ridges. However, in size, shape, basal characters and dimensions the Hawera specimen is so close to the White Rock River species that separation is not justifiable upon the basis of the available material.

Mr. Laws kindly supplied information concerning his *S. marwicki* and Marwick's *S. infirmum,* both of which, he states, have the interspaces wider than the ridges.

Height, 5 mm.; minimum diameter, 11.5 mm.; maximum diameter, 15 mm. (Hawera specimen.)

Height, 5 mm.; minimum diameter, 11.0 mm.; maximum diameter, 14 mm. (Holotype).

Genus GLOBISINUM Marwick, 1924.

Type (original designation) : *Sigaretus drewi* Murdoch.

Globisinum flemingi n. sp. Figs. 10A and 10B.

In possessing a narrow umbilical chink, the Waipipi shell more closely resembles the Awamoan *miocaenicum* and *crassiliratum* than the Upper Pliocene *drewi* and *wollastoni.*

It is difficult to gauge the original strength of the sculpture, as the surface is worn, but it was certainly stronger than that of the two Upper Pliocene species, but probably not quite so pronounced as in *miocaenicum.*

Unfortunately the solitary specimen has been slightly distorted by pressure; originally the sides were probably not so flattened.

However, the most distinctive character of the Waipipi shell is the umbilical chink. This is narrower than in either of the two Awamoan species and is situated lower down, almost at half the height of the aperture.

It is interesting to note that the position and development of the umbilical chink in the Waipipi shell indicates an intermediate position between the Awamoan and the Castlecliff species.

Height, 21.5 mm.; diameter, 19.0 mm.

Holotype. Presented to the Auckland Museum by Master C. A. Fleming.

Locality. Waipipi, coast near Waverley, near mouth of Wairoa Stream. Lower Pliocene (Waitotaran).

The writer is indebted to Master C. A. Fleming for this species, which was discovered in the matrix of a large *Cardium spatiosum.*

TURRITELLIDAE.

Genus MAORICOLPUS Finlay 1926.

Type (original designation): *Turritella rosea* (Q. & G.).

Maoricolpus cf. **rosea** (Q. & G.).

Locality. On the coast near mouth of Waihi Stream, Hawera. Lower Pliocene (Waitotaran).

These shells are almost identical with Recent specimens, differing only in having a slightly smaller spire angle and a comparatively straight outline, which is the result of more or less equal development of the biangulate cords. The sculpture, however, is extremely variable, making it a difficult matter to cite any true differentiating characters. Moreover, typical *rosea* certainly lived in Waitotaran times, for the writer collected a specimen at Waipipi, which locality has been estimated by Marshall and Murdoch (1921) to be 400 feet higher in the series than Waihi, Hawera.

From there it continued to Recent times with little variation in either spire angle or sculpture, always characterized by a greater prominence of the lower biangulate cord, which imparts a slightly gradate outline to the spire.

There is a second Recent form which seems to have diverged from the lower Waitotaran type of shell by becoming considerably narrower, whereas *rosea* has developed a wider spire-angle and a greater prominence of the lower cord of the biangulation.

The only relatively constant character in the *rosea* series is the spire angle. In typical *rosea,* taking series ranging from Waipipi to Recent times, this angle is 19.5 to 21 degrees, whereas in the second Recent form its maximum variation is between 14 and 16 degrees. However, in the Hawera fossils the spire angle is intermediate, having a range between 17 and 18 degrees, so it is not considered advisable to separate these shells from *rosea,* particularly as the sculpture is variable.

On the other hand, the narrow Recent form is well worthy of separation, as it seems to represent the culmination of a divergence foreshadowed in the Lower Pliocene.

Maoricolpus rosea manukauensis n. subsp. Figs. 9 and 10.

The distinguishing characters of this shell are shown in the following table by comparison with a series of specimens of *rosea* from Recent and fossil localities.

rosea manukauensis.

Height.	Diameter.	Spire angle.
59.00 mm.	13.00 mm.	14 degrees (holotype)
56.00 mm.	13.50 mm.	16 ,,
55.00 mm.	12.50 mm.	15.5 ,,

rosea (Recent).

Tasman Bay, Nelson.		
70.00 mm.	21.50 mm.	22 degrees
53.00 mm.	19.00 mm.	22 ,,
57.50 mm.	19.50 mm.	22 ,,
Picton.		
62.00 mm.	18.25 mm.	21 degrees
56.00 mm.	18.25 mm.	22 ,,
43.00 mm.	13.75 mm.	21 ,,
Stewart Island.		
40.00 mm.	13.50 mm.	21 degrees
38.00 mm.	13.00 mm.	22 ,,
Tauranga.		
59.00 mm.	20.00 mm.	22 degrees
56.00 mm.	18.00 mm.	21.5 ,,
Auckland Harbour, 6 fathoms.		
47.00 mm.	14.50 mm.	19.5 degrees
41.00 mm.	12.75 mm.	19.5 ,,
Parua Bay, Whangarei.		
74.00 mm.	22.50 mm.	21 degrees
45.50 mm.	14.00 mm.	21 ,,
Kawhia Harbour.		
48.00 mm.	15.00 mm.	21 degrees
42.00 mm.	14.00 mm.	22 ,,

rosea (fossil).

Castlecliff (Castlecliffian).		
86.50 mm.	25.50 mm.	21 degrees
69.00 mm.	22.00 mm.	22 ,,
Maraekakaho, H.B. (Nukumaruan).		
66.00 mm.	17.00 mm.	22 degrees
30.00 mm.	10.50 mm.	22 ,,
Waipipi (Waitotaran).		
65.00 mm.	19.50 mm.	19.5 degrees
Waihi Beach, Hawera (Waitotaran).		
80.00 mm.	19.50 mm.	17.75 deg.
68.00 mm.	17.00 mm.	17 ,,

As shown by the above table, *manukauensis* is considerably narrower than any of the normal variations of Recent *rosea*. The whorls in *manukauensis* are much more tightly coiled, a specimen 56 mm. in length having 15 post-nuclear-whorls, whereas *rosea* of the same length develops only 13. Also the cords of the biangulation are never so prominent as in *rosea*, consequently the spire outline is straighter, not noticeably gradate or indented at the sutures.

Apparently this is not merely an ecological form due to station, for series from the tidal mud-flats are identical with those from the clean-swept shell-banks in the deeper-water channels.

It seems to be confined to the Manukau Harbour, for all specimens that have been examined from other Recent localities are true *rosea,* even to a series from Kawhia Harbour, which is on the same coast, and where the habitat closely resembles that of the Manukau.

Holotype. (Fig. 9.) Presented to the Auckland Museum.

Habitat. Manukau Harbour. A dominant type on the tidal mud-flats and in the shallow-water channels. Type from mud-flats between mouth of Big Muddy Creek and Cornwallis.

Genus ZEACOLPUS Finlay 1926.

Type (original designation): *Turritella vittata* Hutton.

Subgenus STIRACOLPUS Finlay 1926.

Type (original designation): *Turritella symmetrica* Hutton.

Zeacolpus (Stiracolpus) haweraensis n. sp. Fig. 7.

This species differs from Recent *symmetricus* in having only two spiral keels, which divide the height of the whorls evenly into thirds. The secondary sculpture consists of moderately strong spiral threads, three to five per intercarinate space. The base is flattened and crowded with fine spiral threads. Protoconch imperfect in all available specimens. Early post-nuclear whorls bicarinate as in later whorls, but the upper keel is a trifle weaker than the lower one. Spire angle about the same as in Recent *symmetricus.* Whorls 7 to 9 (the holotype has 9), exclusive of the damaged apical whorls.

Height (estimated), 22 mm.; diameter, 7 mm. (holotype).

Holotype and several imperfect paratypes in Auckland Museum. (Collected by the writer, Museum field trip, Jan., 1931.)

Locality. On the coast near mouth of Waihi Stream, Hawera. Lower Pliocene (Waitotaran).

This bicarinate species is not the direct ancestor to *symmetricus,* for a form of that species occurs in beds of Waitotaran age at Kaawa Creek, and furthermore there is an earlier Tertiary tricarinate form in *kanieriensis* (Harris).

STRUTHIOLARIIDAE.

Genus STRUTHIOLARIA Lamarck 1816.

Type (monotypy): *Buccinum papulosum* Martyn.

Subgenus PELICARIA Gray, 1857.

Type (monotypy): *Buccinum vermis* Martyn.

Struthiolaria (Pelicaria) incrassata n. sp. Figs. 30-33.

This species is characterized by its massive outer lip, prominent parietal tubercle, small aperture, canaliculate suture and strongly bicarinate body-whorl. The upper carina bears rather closely spaced blunt nodules, undeveloped except over the body-whorl, where they gradually gain strength towards the aperture. There are faint traces of an obsolete third spiral situated midway between the two carinae. The aperture is proportionately small and very much thickened all round. In *vermis* and *tricarinata* the aperture is much larger and the outer-lip callus extends to about half way between the main carinae, whereas in *incrassata* it terminates very little above the level of the lower carina.

Whorls four to five (five in holotype), exclusive of the missing nuclear whorls. Spire normally, about equal to height of aperture. The holotype has been slightly flattened and elongated by pressure, the smaller specimen exhibiting the true proportions. Suture deeply canaliculate, almost comparable to that of *zelandiae.* The base exhibits a primitive condition in the development of only five basal spirals.

It is difficult to place this species in its true phylogenetic position, but judging from the abnormally crass nature of the shell, deeply channelled suture and comparatively few basal spirals, it is probably a gerontic offshoot from the main line, originating from a type like Suter's *parva,* the locality and horizon of which is unknown.

Marwick in his stratigraphical table (1924, p. 172) has queried *parva* as belonging to the Nukumaruan, but, as stated above, the locality for this species is unknown and may well be from a lower horizon.

Height, (actual) 23.50 mm. (estimated) 24.75 mm.; diameter (actual), 16.00 mm. (holotype).

Height (actual) 33.00 mm., (estimated) 34.50 mm.; diameter (actual), 21.00 mm., (estimated) 19.00 mm. (paratype).

Holotype. (Figs. 30 and 31.) In Auckland Museum. (Collected by the writer, Museum field trip, Jan., 1931.) Two paratypes in writer's collection (collected Jan., 1927).

Locality. On the coast near mouth of Waihi Stream, Hawera. Lower Pliocene (Waitotaran).

NEPTUNIIDAE.

Genus ZELANDIELLA Finlay 1926.

Type (original designation): *Neptunea subnodosa* Hutton.

Zelandiella pliocenica n. sp. Figs. 11 and 12.

A Pliocene relative of *subnodosa,* the lower Miocene genotype, differing in the subobsolescence of the nodules on the subsutural fold, more twisted canal and deeper basal constriction above fasciole. Also the nodules on the biangulate keels of the body-whorl are smaller, weaker and more numerous than in *subnodosa,* and exhibit a tendency towards lateral compression and subobsolescence on nearing the aperture.

There is another Waitotaran species, *kaawaensis*, but this is more closely allied to *subnodosa* than to *pliocenica*.

Whorls six, exclusive of the nucleus which is worn away. Spire-whorls with a weak subsutural fold, a median concavity and a prominent, nodulous, lower fold. There are fourteen rounded nodules on this lower fold, on the penultimate, and about sixteen on the body-whorl. Secondary sculpture of moderately strong rounded spiral cords; about thirty-five on the body-whorl. Aperture with a deep posterior sinus and a considerably twisted anterior canal, which gives rise to a prominent fasciole, bordered above by a sharp projecting rim and separated from the base by a deep constriction.

Height, 36.5 mm.; diameter, 24.0 mm. (holotype).

Localities. 1171, cliffs on coast, half a mile north-west of Patea River. (Waitotaran) Lower Pliocene (holotype); Waipipi, coast near Waverley at about one mile west of the mouth of Wairoa Stream, in yellowish-brown sandstone. (Waitotaran).

Holotype. In N.Z. Geological Survey Office, Wellington. Waipipi specimen in Auckland Museum. (Collected by the writer, Museum field trip, Jan., 1931.) The writer is much obliged to Dr. Marwick for offering the Patea shell as a more suitable holotype than the badly damaged Waipipi specimen.

Marshall and Murdoch's record of *Siphonalia subnodosa*, in their Waipipi list (1920, p. 125), probably refers to the above described species.

BUCCINULIDAE.

Genus AUSTROSIPHO Cossman 1906.

Type (original designation): *Fusus roblini* T. Wds.

Subgenus VERCONELLA Iredale 1914.

Type (original designation): *Fusus dilatatus* Q. & G.

According to Clench (1930, p. 21), the above names as applied to New Zealand shells must both be suppressed in favour of *Penion* Fischer 1884.

The genus name *Penion* was rejected by Iredale (1914, p. 175), on the grounds that it was a homonym of *Penium* Philippi 1865, as both were derived from the same Greek root.

However Clench states that *Penion* is a direct transliteration from the Greek, and that *Penium* is a latinized form of the same word, and, further, points out that according to one of the recommendations to "Article 36" of the "International Rules," names of this sort, differing slightly in termination, should be avoided, but once introduced must not be rejected on this account.

In rejecting *Penion*, Iredale cited "Article 19" of the "Rules," which allows an emendation in the cases of—error of transcription, lapsus calami and typographical error.

A decision hinges on whether *Penium* be considered an error of transcription or not. In any case, the extracts from the "Rules" quoted above are somewhat contradictory.

As a decision either way would not be unanimously accepted if given herein, perhaps the best course is to refer this special case to the International Rules Commission. Pending a decision, the use of *Austrosipho* and *Verconella* is continued.

Austrosipho (Verconella) haweraensis n. sp. Figs. 28 and 29.

Shell ancestral to the Recent *mandarina,* which it closely resembles in form and size, but not in the details of sculpture. A comparison of the sculpture on the penultimate whorl in both species shows the following points of difference. In *mandarina* there are from ten to twelve primary spiral cords, with two, three and occasionally as many as six spiral threads per interspace, compared with nine primary cords and only one thread per interspace in *haweraensis.* The fossil species is most distinctive in its early whorls, which are crossed by distant broad axial folds, nine to thirteen per whorl. These persist over all the post-nuclear whorls, although subobsolete in development. Typical *mandarina* never has axials on the later whorls, although there are from eighteen to twenty-one closely spaced axial folds on the early spire whorls.

Whorls estimated at about nine. The protoconch is missing in the holotype, but a paratype shows a well preserved nucleus of three whorls, as figured for *adusta* (Powell, 1927, p. 550, text fig. 10). The spiral cords, which number nine on the penultimate and about twenty-four on the body-whorl, show a tendency to widen rather than to become prominently elevated, as in *mandarina.* The true outline of the Hawera species is a little narrower than shown in the holotype, which has been subjected to dorso-ventral pressure in the matrix.

Height (apex missing), 123 mm.; diameter (actual) 58 mm., (estimated normal) 56 mm. (holotype).

Height (apex missing), 130 mm.; diameter (actual), — mm., (estimated normal), 57 mm. (paratype).

Holotype (Fig. 28) and two juvenile paratypes in Auckland Museum. (Collected by the writer, Museum field trip, Jan., 1931.) Figured paratype in the writer's collection. (Collected Jan., 1927.)

Locality. On coast near mouth of Waihi Stream, Hawera. Lower Pliocene (Waitotaran).

In the figure of paratype some of the ribs appear as paired closely spaced threads, but this is only the result of decortication.

Volutidae.

Genus Alcithoe H. and A. Adams 1858.

Type (subsequent designation, Cossmann, 1899): *Buccinum arabicum* Martyn.

Alcithoe larochei Marwick 1926.

Localities. Recent; off Opotiki in 30 fathoms (type); near mouth of Waihi Stream, Hawera. Lower Pliocene (Waitotaran). (Collected by Master C. A. Fleming, Jan., 1931.)

This proved to be moderately plentiful at Waihi, Hawera, but no perfect examples were obtained. However a specimen showing almost the whole of the body-whorl and another complete except for the basal portion, are identical with the holotype of *larochei*.

This record extends the ancestry of *larochei* to a much lower horizon than recorded for *swainsoni*.

Columbariidae.

Genus Coluzea Allan 1926.

Type (original designation): *Fusus dentatus* Hutton.

Coluzea spectabilis n. sp. Figs. 1 and 2.

This species is important, as it helps to fill a gap in the *dentata-spiralis* line. It is quite distinct from its ancestral relatives and its more recent derivatives in having far more numerous peripheral spines, which are weak and closely spaced, resulting in only a slight nodulation of the carina. Shell very large for the genus. Spire tall, about three-fourths height of aperture plus canal (estimated from decollated paratype with complete canal). Whorls about ten, strongly convex and much indented at sutures. Sculpture consisting of prominent spiral carinae crossed by numerous regularly spaced axial growth folds, which render the carinae slightly nodulous at points of intersection. There are about fifty peripheral nodules on the penultimate whorl. On the upper spire-whorls there are three strong carinae above the periphery, then a moderately flat shoulder overhung by the preceding whorl, and below a single strong carina between the periphery and suture. In the holotype there is a weak thread in each intercarinal space. On the base and canal there are fifteen carinae, which gradually become weaker and more closely spaced, finally fading out at about half way down the canal.

Height (actual), 76 mm.; height (estimated), 90 mm.; diameter, 30 mm. (holotype).

Holotype and fragmentary paratype in Auckland Museum. (Collected by the writer, Museum field trip, Jan., 1931.) Two fragmentary paratypes in the writer's collection. (Collected Jan., 1927.)

Locality. On the coast near mouth of Waihi Stream, Hawera. Lower Pliocene (Waitotaran).

The Mid-Pliocene form, *C. espinosa* Finlay, which was described from Petane, Hawke's Bay, and is intermediate between the Lower Pliocene *spectabilis* and the Upper Pliocene-Recent *spiralis*, is represented in the writer's collection by a specimen from the blue clay band at Nukumaru Beach.

TURRIDAE.

Genus MARSHALLENA Finlay 1926.

Type (original designation): *Belophos incertus* Marshall.

Marshallena austrotomoides n. sp. Figs. 5 and 6.

The two available specimens are imperfectly preserved, but the characters of the species are so distinctive that it is well worthy of description, particularly as the range of the genus is hereby extended to a much higher stage in the Tertiary than hitherto recorded. Large size and prominent axials, combined with subobsolete spiral sculpture, separate this species from any previously described. Its nearest relative appears to be *M. celsa* Marwick (1931, p. 147), from the Tutamoe Series, Gisborne (Lower Miocene). However, this species is not nearly so large, and has a shorter spire, with more numerous axials, which extend over the body-whorl.

Shell very large, with a tall gradate spire, estimated to be a little taller than height of aperture. Post-embryonic whorls seven, angled at about three-fourths their height, with a concave shoulder above and vertical sides below. Body-whorl large, slightly inflated above and contracting slowly over base. Although the end of the canal is missing in both specimens, the growth lines indicate the absence of an anterior notch. There is also a simple shallow arcuate posterior sinus typical of *Marshallena* and quite unlike that of *Austrotoma*, to which genus the Hawera shell is superficially similar. Sculpture of strong forwardly-inclined axials, which become subobsolete on the body-whorl. The spiral sculpture is also subobsolete, being traceable with difficulty on the spire whorls and upper part of body-whorl, although it becomes moderately strong on the base. The axials number about fourteen on the spire whorls, and the subobsolete spirals about nine. The body-whorl has about twenty irregularly developed spiral cords, which are subobsolete above, but become rather strongly developed below, where they are broad and rounded, with two or three spiral threads per interspace. Shoulder concave with broadly arcuate lines of growth corresponding to the simple shallow sinus.

Height (estimated), 78 mm.; diameter, about 24 mm. (holotype).

Holotype (Fig. 5) in Auckland Museum. (Collected by the writer, Museum field trip, Jan., 1931.)

Locality. On the coast near mouth of Waihi Stream, Hawera. Lower Pliocene (Waitotaran).

Genus Phenatoma Finlay 1924.

Type (original designation): *Pleurotoma novaezelandiae* Reeve.

Phenatoma decessor Marwick 1928.

The type is from Whenuataru Peninsula, Pitt Id. Chatham Islands.

Marwick (1928, p. 435) remarked upon the strong Wanganuian affinities of the fossils from this locality.

A single specimen was found in the blue clays at Waihi Beach, Hawera, and it compares well with the original description and figure.

Height (estimated), 19.5 mm.; diameter, 6.25 mm.

Genus Comitas Finlay 1926.

Type (original designation): *Surcula oamarutica* Suter.

Comitas declivis n. sp. Fig. 41.

Shell of moderate size, fusiform, with long straight canal and relatively short spire. Aperture plus canal one and a third times height of spire. Protoconch relatively large, of one and a-half smooth, bulbous whorls. Post-nuclear whorls six, subangled below the middle, almost at lower third of whorl-height. Upper slope steep, slightly concave above and below the subangle. Body-whorl rapidly contracted to a long straight canal without a fasciole. Axial sculpture of eleven or twelve strong rounded knobs per whorl, with about equal interspaces. Spiral sculpture obsolete on spire-whorls, but there are about eighteen poorly developed, flattened cords on the lower part of body-whorl and neck of canal. Three of these, situated on the base at a short distance below the nodulous subangle, are a trifle more prominent than the rest. Suture with a slight bulge below, but not definitely submargined. Outer-lip with a deep angular sinus, its apex at about the middle of the shoulder.

Height, 19.0 mm.; diameter, 6.3 mm. (holotype).

Holotype. In Auckland Museum. (Collected by the writer, Museum field trip, Jan., 1931.)

Locality. On the coast near mouth of Waihi Stream, Hawera. Lower Pliocene (Waitotaran).

The species is nearest allied to *C. bilix* Marwick (1931, p. 137), from the Ormond Series, Gisborne, but differs in being much more elongated and with less prominent basal cords.

Terebridae.

Genus Zeacuminia Finlay 1930.

Type *Z. tahuia* Finlay (= *Terebra sulcata* Marshall).

Zeacuminia murdochi n. sp. Fig. 42.

Shell moderately large, attenuated. Spire two and one-fifth times height of aperture, plus canal. Outline of whorls flatly-convex, with a slight constriction towards the upper third of the height of the spire whorls. The protoconch is imperfect in the two available specimens, but the holotype exhibited a perfect polygyrate apex prior to becoming damaged while being worked from the matrix. Whorls estimated at about 12, including protoconch. Sculpture of strong, widely spaced axial costae (12 on the penultimate), which are rendered slightly sinuous by the subsutural spiral constriction. In addition, there is secondary sculpture of indistinct irregularly developed axial growth folds, varying from three to five per intercostal space. On the body-whorl the costae rapidly diminish below the rounded periphery, and become obsolete on the base. The base is deeply contracted towards the fasciole and the canal is short, obliquely twisted, terminating in a broad arcuate sinus. Fasciole well developed, bordered above by a prominently raised rib, which issues from within the aperture and traverses the inner lip.

Height, (actual) 30.50 mm. (estimated) 31.25 mm.; diameter, 8.25 mm. (holotype).

Height, (actual) 22.50 mm. (estimated) 23.00 mm.; diameter, 7.00 mm. (paratype).

Holotype. In the Auckland Museum. (Collected by the writer, Museum field trip, Jan., 1931.) Paratype in the writer's collection. (Collected Jan., 1927.)

Localities. On the coast near mouth of Waihi Stream, Hawera. Lower Pliocene (Waitotaran); Waipipi, coast near Waverley, at about $\frac{3}{4}$ mile west of the mouth of Wairoa Stream. (Shell-band in papa). Lower Pliocene (Waitotaran).

This is the first known Pliocene species referrable to *Zeacuminia,* the range of the genus being thus considerably extended. It is quite distinctive in having strong, widely spaced axials which become obsolescent, not nodulous at the periphery of the body-whorl.

Z. murdochi has a superficial resemblance to *Pervicacia,* but it can be readily distinguished by the prominent ridge bordering the fasciole. The species is named after the late Mr. R. Murdoch, in recognition of his excellent malacological and palaeontological work.

Genus PERIRHOE Dall 1908.

Type (original designation): *Terebra circumcincta* Dall.

Subgenus DIMIDACUS Iredale 1929 (for *Terebrina* Bartsch, preoccupied).

Type: *Terebra cingulifera* Lamk.

Perirhoe (Dimidacus) bicorona (Hutton). Figs. 3 and 4.

1885. *Cerithium bicorona* Hutton. Trans. N.Z. Inst. vol. 17, p. 328.

1915. *Terebra catenifera* (Suter) non Tate. N.Z. G.S. Pal. Bull. No. 3, p. 43, Plate 4, fig. 19.

1924. *Terebra bicorona* (Hutton) Marwick. Rep. Aust. Ass. Adv. Sci. (1923) vol. 16, p. 327.

1926. *Acuminia bicorona* (Hutton) (provisional) Finlay. Trans. N.Z. Inst. vol. 57, p. 435.

Two imperfect specimens (Figs. 3 and 4) were collected by the writer from the blue clays at Waihi Beach, Hawera.

Height (estimated), 44 mm. (actual), 27 mm. for $7\frac{3}{4}$ whorls; diameter, 7.0 mm.; spire angle, 10°.

Height (estimated), 54 mm. (actual), 31 mm. for $6\frac{1}{2}$ whorls; diameter, 9.5 mm.; spire angle, 10°.

This is an interesting record from a stratigraphical point of view, as hitherto the species was known only from the fragmentary holotype, which was found at Tutaekuri, Hawke's Bay.

The greatly attenuated spire, heavy subsutural collar, and twisted, recurved canal, separate this species from the *Zeacuminia* series. Living species of *Perirhoe* are known from New South Wales, Queensland and the tropical Pacific.

NEW SPECIES OF MOLLUSCA FROM THE NEW ZEALAND PLIOCENE.

Crassatellitidæ.

Genus Talabrica Iredale 1924.

Type (original designation): *Crassatella aurora* Ad. and Ang.

Talabrica senecta n. sp. Figs. 23 and 24.

Shell ovate-subtrigonal, about the same size as the Recent New Zealand *bellula,* but more massive and less equilateral. Sculpture consisting of coarse, regular, concentric folds, diminishing in strength towards the posterior end, but nowhere flexed or undulating, as in the Recent species. The folds are about one and a-half per millimetre, except towards the umbo, where they are smaller and more closely spaced. They number about twenty-four in the adult shell, with interspaces about half the width of the folds.

The posterior end is slightly longer than the anterior, its dorsal slope straight and descending to an indistinct subtruncation below. Hinge-plate solid and deep, with teeth arranged and formed as in *bellula,* but much more massive. Valve margins smooth.

Height, 15.00 mm.; length, 18.50 mm.; thickness (1 valve), 4.75 mm. (holotype).

Height, 14.50 mm.; length, 17.25 mm.; thickness (1 valve), 4.50 mm. (paratype).

Holotype (Fig. 24) presented to Auckland Museum. (Collected by the writer, Jan., 1926.)

Locality. Castle Point, East Coast, Wellington (in arenaceous deposits above the limestone), in the immediate vicinity of the lighthouse. Mid Pliocene (Nukumaruan).

Talabrica nummaria n. sp. Figs. 19 and 20.

Shell subcircular, massive, very little inflated; posterior end truncated and slightly shorter than anterior end. Beaks small, erect, contiguous. Sculpture of coarse, unevenly developed, concentric folds, diminishing in strength towards the sides, but nowhere flexed as in the Recent *bellula*. The folds are about one per millimetre and number about twenty-one for the entire shell, having interspaces varying from approximately equal to a little greater than width of folds. Both anterior and posterior dorsal margins descend at about equal angles, but the posterior end is slightly shorter owing to a broad truncation. Hinge massive, but typical in its formation. Valve margin smooth.

Height, 20.50 mm.; length, 22.50 mm.; thickness (2 valves), 10.25 mm. (holotype).

Holotype in Auckland Museum. (Collected by the writer, Museum field trip, Jan., 1931.)

Locality. Nukumaru Beach, north-west of Wanganui. In sandy pockets in the shell-rock, together with *Barytellina crassidens* Marwick and *Anomia undata* Hutton. Mid Pliocene (Nukumaruan).

This species is possibly a descendant from the New Zealand Miocene *cordiformis* (Suter 1917), but that species differs in its greater inflation, swollen beaks and linear intercostal spaces.

KELLYIDAE.

Genus PUYSEGERIA Powell 1927.

Type (original designation): *P. cuneata* Powell.

Puysegeria wanganuica n. sp. Fig. 39.

This species is the Pliocene ancestor to the Recent *cuneata*. Although the genotype was described from a deep-water station (170 fathoms), there is no bathymetric significance attached to the fossil occurrences, as the Pliocene species is found at Castlecliff, not only in the papa, which has every indication of having been deposited in moderately deep water, but also in a sandy upper stratum which obviously represents shallow-water conditions of deposition, as evidenced by the presence of cake-urchins *Arachnoides placenta*, and the molluscs *Amphidesma pliocenica* and *Zethalia*. The same species of *Puysegeria* is common also in the loose sands at Nukumaru, where it occurs, associated with *Lutraria, Zethalia, Panope, Myadora striata* and other typically shallow-water species.

The new species differs from the genotype in being slightly longer and more oblong, with a straighter dorsal margin. The most striking difference, however, is in the shape of the cardinal of the left valve. This is broadly triangular, with the anterior side produced along the hinge-plate and only a faint suggestion of bifurcation. In *cuneata*, this cardinal of the left valve differs in being definitely bifid and narrowly triangular without the anteriorly produced side. Surface smooth and polished.

Height, 1.20 mm.; length, 0.80 mm. (holotype, left valve).

Height, 1.16 mm.; length, 0.78 mm. (paratype, figured right valve).

Holotype. In Auckland Museum. (From material collected by the writer, Museum field trip, Jan., 1931.)

Localities. Castlecliff (sandy upper bed) (type), Castlecliff (papa), Wanganui, Upper Pliocene (Castlecliffian); Nukumaru (loose sands), Mid. Pliocene (Nukumaruan).

Genus Virmysella Iredale 1930.

Type (original designation): *V. spernax* Iredale.

Virmysella hounselli n. sp. Figs. 13 and 14.

This shell is allied to the New South Wales genotype, but it differs in being considerably smaller and more quadrate in outline.

Shell small, thin, compressed, equivalve, and subquadrately elongate-oval. Surface smooth, apart from faint irregular lines of growth. Anterior end produced and broadly rounded; posterior end short and subtruncated. Umbo situated at the posterior third. Hinge, muscle-scars and pallial line typical. Resilium-pit deep, trigonal.

Right valve with an oblique lamellate cardinal bordering the anterior side of the resilifer and a shorter, more upright one at the posterior side. There is a socket in front of the anterior cardinal and another immediately behind the posterior cardinal, both of which are for the accommodation of thickened margins in the opposite valve. Apart from these thickened margins in the left valve, there is a small socket which is in apposition to the posterior cardinal of the right valve.

Height, 4.25 mm.; length, 6.25 mm.; thickness (one valve), 1.00 mm. (holotype).

Holotype. (Fig. 13.) In Auckland Museum. (Material collected by the writer, Museum field trip, Jan., 1931.)

Locality. Castlecliff (basal papa), Wanganui. Upper Pliocene (Castlecliffian).

The New Zealand Recent *"Montacuta" tellinula* Odhner 1924, seems referrable to *Virmysella,* and a second North Auckland Recent species, at present undescribed, combines the hinge development of *tellinula,* with a shape more like that of the Pliocene species.

The species is named after Mr. W. K. Hounsell, who discovered the specimens while sorting through sievings of the Castlecliff matrix. The writer wishes to acknowledge the considerable voluntary assistance rendered by Mr. Hounsell during the past two years.

Myochamidae.

Genus Myadora Gray 1840.

Myadora kaiiwiensis n. sp. Figs. 37 and 38.

This species is nearest allied to the Recent *boltoni* Smith, but differs in being more ovate and differently proportioned. In *boltoni* the anterior is considerably longer than the posterior end, but in the fossil species the beaks are nearly central and the ends approximately equal.

Shell of moderate size, transversely elongate-oval, posterior end broadly truncated. The convex right valve has a ridge running from the umbo to the lower extremity of the truncation, and this cuts off a shallowly-concave posterior area. Sculpture consisting of irregularly developed concentric ridges (about 22), which are subobsolete, except towards the margins and where they intersect the posterior ridge. Left valve almost flat, often very slightly convex. Posterior area marked off by a slight flattening. Sculpture of subobsolete flattened concentric ridges, very irregular in their development.

Height, 10.50 mm.; length, 13.75 mm.; thickness, 2.90 mm. (holotype).

Holotype. In Auckland Museum. (Collected by the writer, Museum field trip, Jan., 1931.)

Locality. Kai Iwi, on the coast, half a mile north-west of the Kai Iwi Stream. Upper Pliocene (Castlecliffian).

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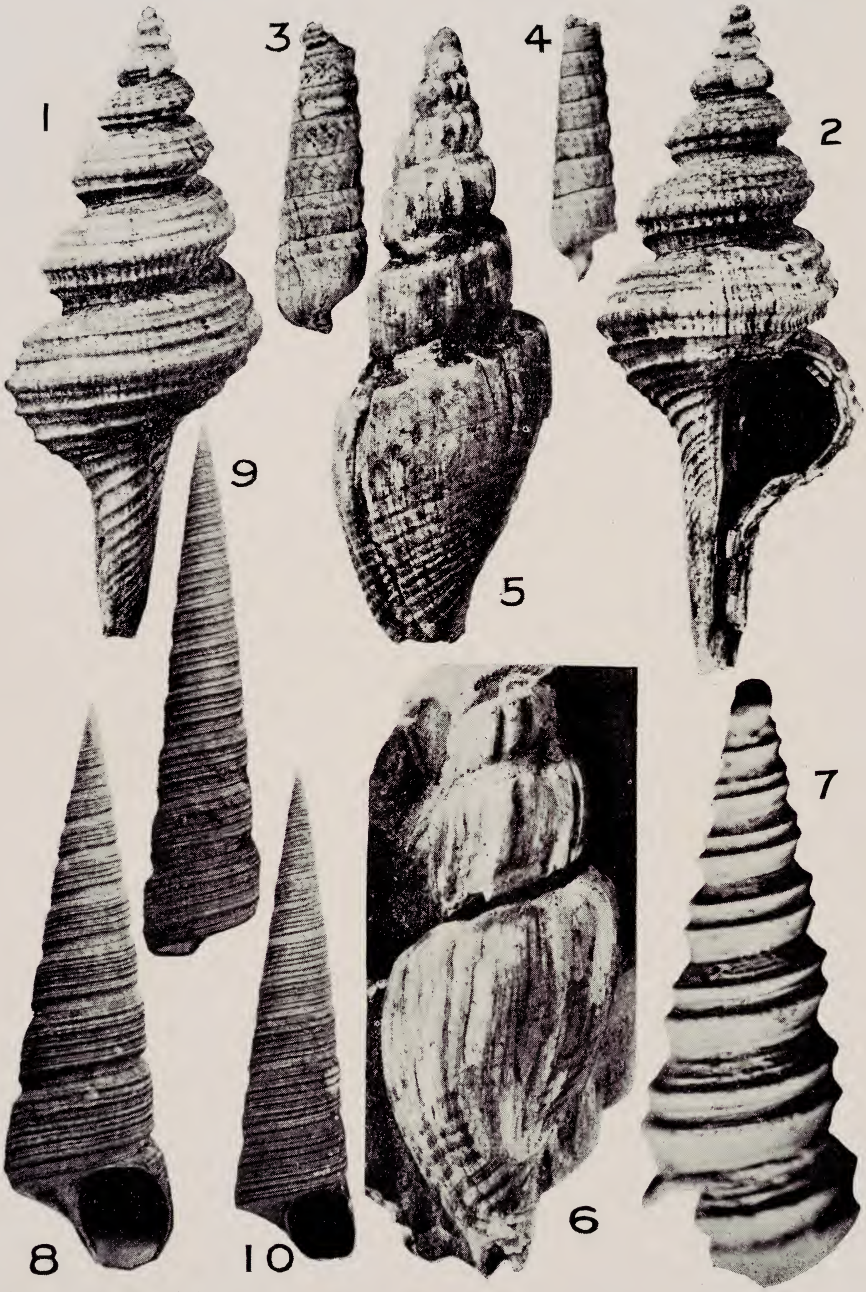
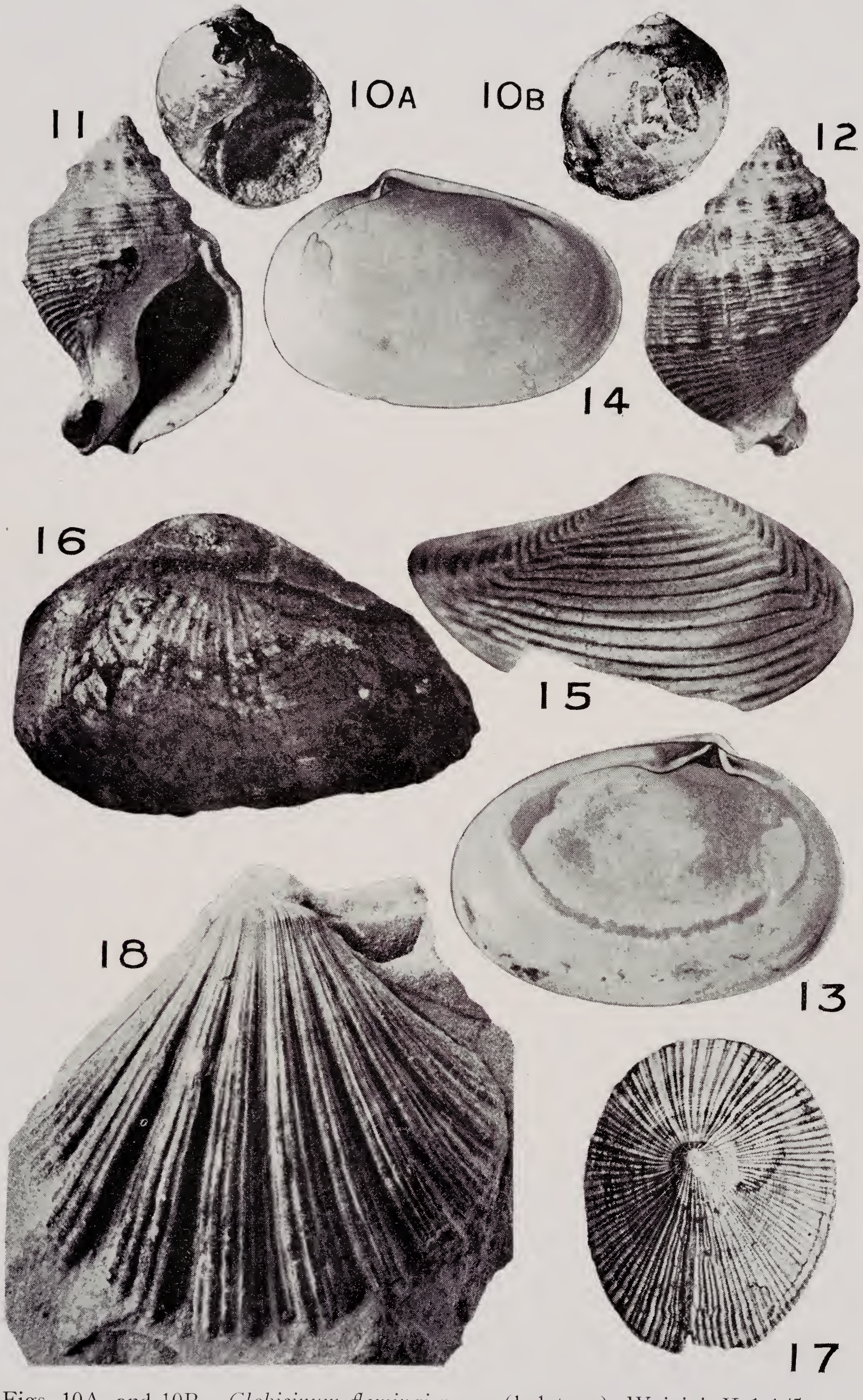
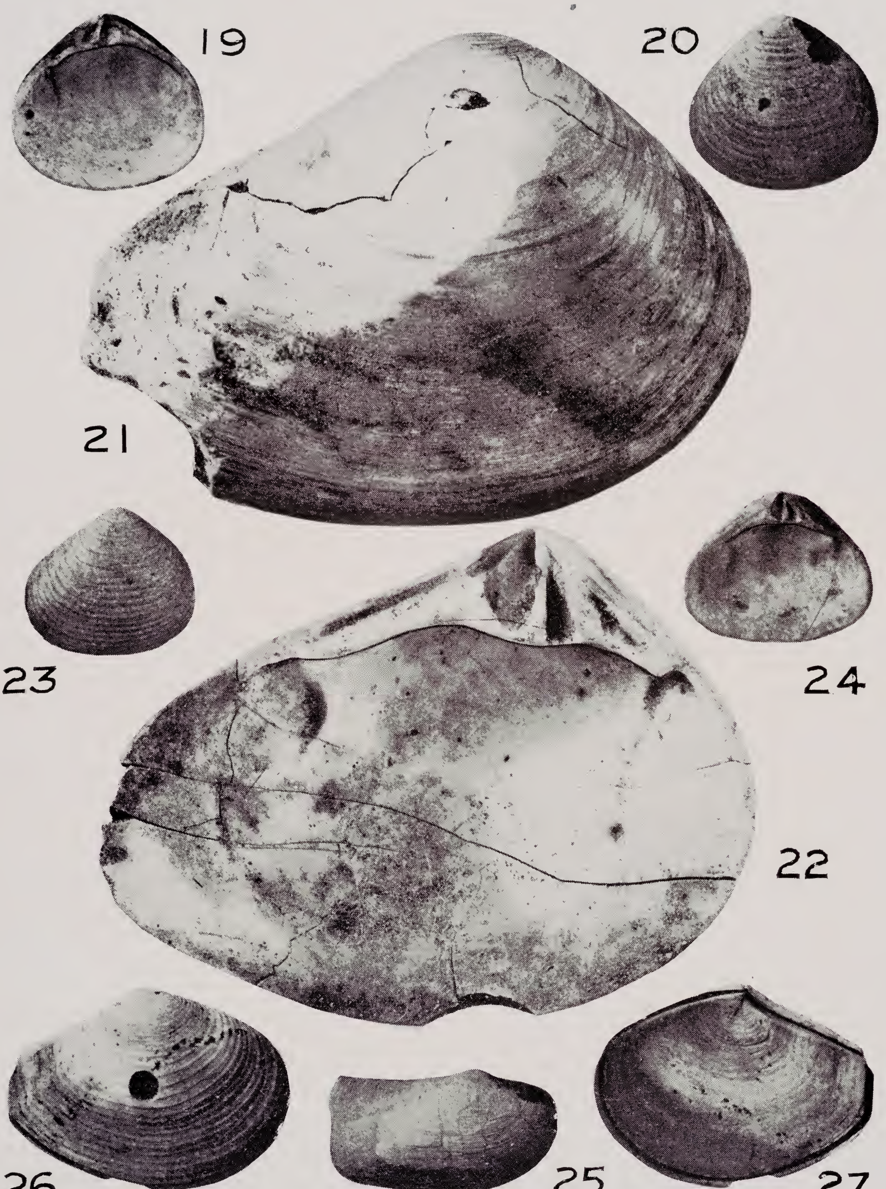


Figs. 1 and 2. *Coluzea spectabilis* n. sp. (holotype), Waihi, Hawera, X 1.
Figs. 3 and 4. *Perirhoe (Dimidacus) bicorona* (Hutton), Waihi, Hawera. X 1-1/6.
Fig. 5. *Marshallena austrotomoides* n. sp. (holotype), Waihi, Hawera, X 1-1/10.
Fig. 6. *Marshallena austrotomoides* n. sp. (paratype), X 1-1/3.
Fig. 7. *Zeacolpus (Stiracolpus) haweraensis* n. sp. (holotype), Waihi, Hawera, X 3-1/2.
Fig. 8. *Maoricolpus rosea* (Q. & G.), Recent, Picton, X 1-1/6.
Fig. 9. *Maoricolpus rosea manukauensis* n. subsp. (holotype), Recent, Manukau Harbour, X 1-1/6.
Fig. 10. *Maoricolpus rosea manukauensis* n. subsp. (paratype), X 1-1/6.



Figs. 10A. and 10B. *Globisinum flemingi* n. sp. (holotype), Waipipi, X 1-1/5.
Figs. 11 and 12. *Zelandiella pliocenica* n. sp. (holotype), Patea, X 1-1/7.
Fig. 13. *Virmysella hounselli* n. sp. (holotype), Castlecliff, Wanganui, X 8-1/3.
Fig. 14. *Virmysella hounselli* n. sp. (paratype), X 8-1/3.
Fig. 15. *Nuculana (Saccella) waihiana* n. sp. (holotype), Waihi, Hawera, X 7-3/4.
Fig. 16. *Pholadomya waitotarana* n. sp. (holotype), Waipipi, X 1-1/7.
Fig. 17. *Emarginula haweraensis* n. sp. (holotype), Waihi, Hawera, X 1.
Fig. 18. *Pallium (Mesopeplum) waikohuensis* Marwick. Waihi, Hawera, X 1-1/10.

PLATE 12.



Figs. 19 and 20. *Talabrica nummaria* n. sp. (holotype), Nukumaru, X 1-1/16.
Figs. 21 and 22. *Eucrassatella marshalli* n. sp. (holotype), Waipipi, X 1-1/3.
Fig. 23. *Talabrica senecta* n. sp. (paratype), X 1-1/3.
Fig. 24. *Talabrica senecta* n. sp. (holotype), Castle Point, X 1-1/3.
Fig. 25. *Neilo annectens* n. sp. (holotype), Waihi, Hawera, X 1-1/5.
Figs. 26 and 27. *Myadora waitotarana* n. sp. (holotype), Waihi, Hawera, X 1-1/4.

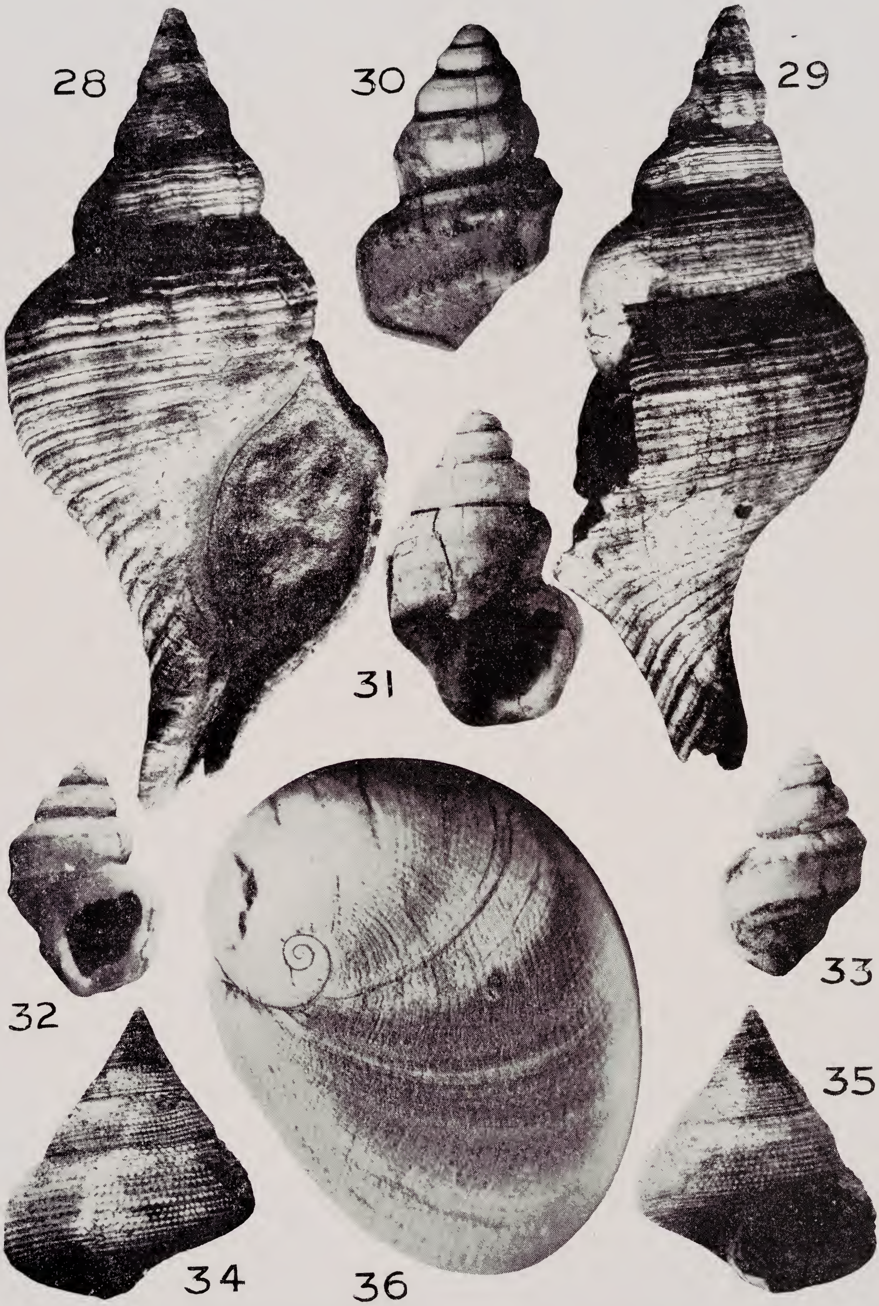
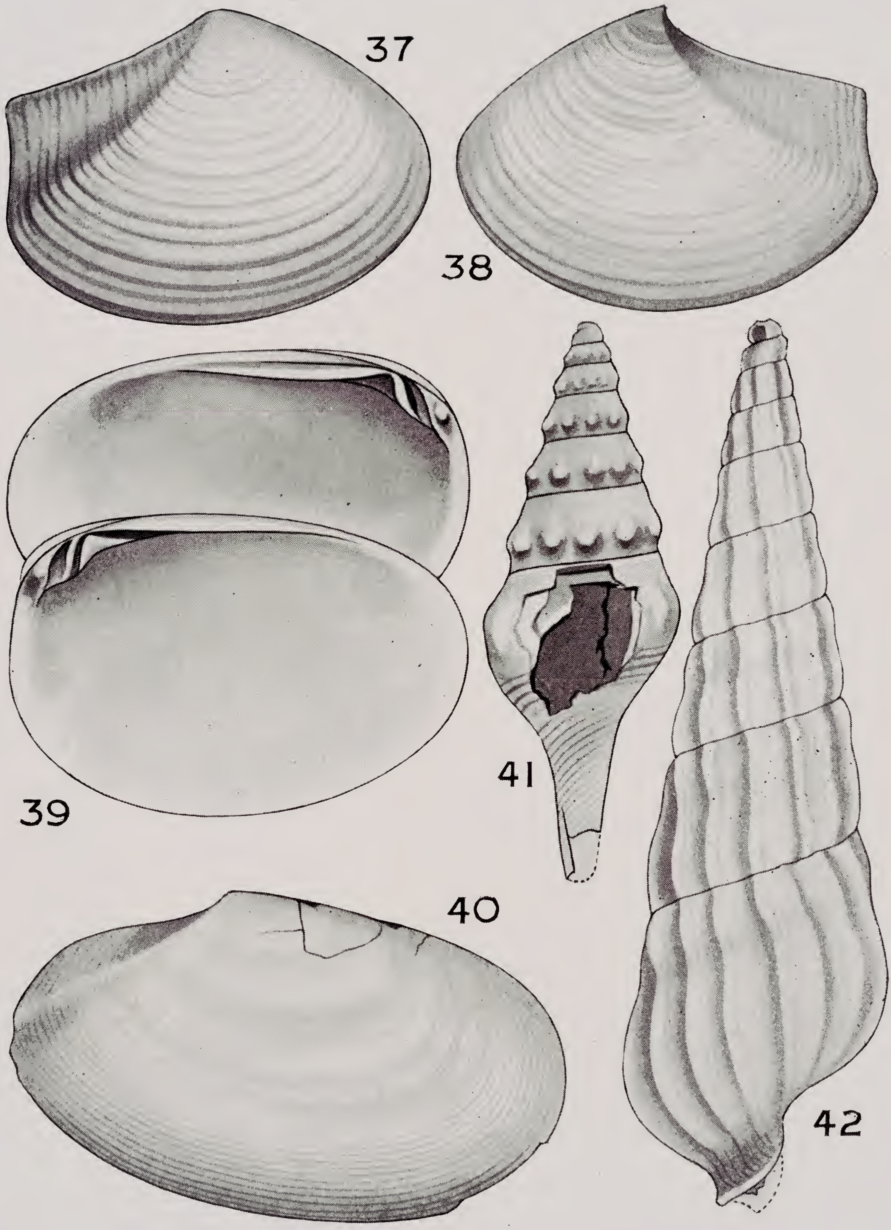


Fig. 28. *Austrosipho (Verconella) haweraensis* n. sp. (holotype), Waihi, Hawera, X 4/5.
Fig. 29. *Austrosipho (Verconella) haweraensis* n. sp. (paratype), X 4/5.
Figs. 30 and 31. *Struthiolaria (Pelicaria) incrassata* n. sp. (holotype), Waihi, Hawera, X 1-1/5.
Figs. 32 and 33. *Struthiolaria (Pelicaria) incrassata* n. sp. (paratype), X 1-1/5.
Figs. 34 and 35. *Maurea (Mucrinops) granti* n. sp. (holotype), Waihi, Hawera, X 1.
Fig. 36. *Sinum* cf. *marwicki* Laws, Waihi, Hawera, X 4-2/3.

Plate 14.



Figs. 37 and 38. *Myadora kaiiwiensis* n. sp. (holotype), Kai Iwi, X 3-3/4.
Fig. 39. *Puysegeria wanganuica* n. sp. (holotype, left valve), Castlecliff, Wanganui, X 72-1/2.
Fig. 40. *Eurytellina solitaria* n. sp. (holotype), Waihi, Hawera, X 2-2/3.
Fig. 41. *Comitas declivis* n. sp. (holotype), Waihi, Hawera, X 3-2/3.
Fig. 42. *Zeacuminia murdochi* n. sp. (holotype), Waihi, Hawera, X 3-2/3.

Notes on Sub-Fossil Bird Remains.

By GILBERT ARCHEY, Director.

(a) Moa Eggs from Doubtless Bay.

Complete, or nearly complete, moa eggs are so rare that any new discovery calls for a record of locality, mode of occurrence, dimensions and other particulars which might indicate the species to which the egg belonged.

The two eggs which form the subject of this note were discovered as far back as 1900 in the sand-dune area which extends inland for some chains from the beach of Doubtless Bay, North Auckland.

The finder was Mr. L. J. Matthews of Mangonui, who for over thirty years preserved, not only the specimens themselves, but also a discreet silence as to his discovery. Last March the Assistant Director, Mr. L. T. Griffin, was visiting Mangonui and was shown the eggs by Mr. Matthews, who very readily and generously agreed to present them to the Museum.

Both eggs were discovered in the sand-dune area at the southern end of Doubtless Bay, seven miles north of Mangonui Harbour. The first, an imperfect specimen, was found protruding from the vertical bank of a small stream, which here cuts a fairly deep bed through the semi-consolidated dune. It was carefully removed and no part left in the bank, so it appears that the portion missing from one end had broken away before the egg was buried.

The second egg is perfect: it was found by Mr. Matthews some weeks later in the sand-dune area itself. This is described by Mr. Griffin as comprising a double line of sand-hills near the beach, separated by a 30 yard wide depression from another line of more consolidated hills. Inland from this is another long depression, or shallow valley, 75 yards wide, which leads across to the still more consolidated scrub- and grass-covered plain.

The egg was found in the sandy floor of this second depression, and was filled with sand which had entered by a small opening, no larger than an egg-blowing hole, at one end. Bones in vast numbers were scattered over the valley, and included those of moa, kaka, gull, shag and other birds, as well as jaws of the tuatara. All that were in a transportable condition at the time of Mr. Griffin's visit were collected by him and brought to Auckland.

Numerous portions of egg shell were among the bones, and Mr. Griffin envisaged the possibility of determining male and female skeletons from the presence or absence of egg fragments. Unfortunately the winds had scattered the bones, and remains of two or more birds occurred in each heap; nevertheless two species of moa, and only two, can be identified as occurring in the area.

The imperfect egg (Pl. 15) is 12.1 cm. long (approximately) and 9.73 cm. in diameter, and the shell is 0.9 mm. thick. Its surface is slightly decomposed, and is chalky-white in colour, with the pits corroded to wide circular depressions, except in one small unimpaired area in which they appear as minute punctures, as they also appear in one or two places elsewhere where the surface is only slightly affected.

The other egg (Pl. 16, 1) is 12.0 cm. long and 9.10 cm. in diameter. The small hole mentioned above, occurs on the edge of what was apparently the underside as it lay in the sand. Around this edge of the "undersurface" a certain amount of corrosion has widened the pits, as in the imperfect egg, giving the appearance of small craters, a few of which extend to the interior. It appears, as might have been expected, that corrosion has been most active at the level of the surface of the sand in which the egg rested, i.e. where air and moisture would have a combined effect, for the central portion of the "under-surface" is hardly affected.

Otherwise the surface of the egg is smooth, shining and fresh looking; with the pits appearing as punctures, with, here and there, the form of minute slits such as are mentioned below as occuring on other shell fragments. It is not possible to measure the thickness of its shell the hole being too small for the insertion of an instrument, but an examination of its edge shows the thickness to be approximately the same as that of the imperfect egg.

The only differences between the two eggs are in the slight surface decomposition of the imperfect specimen and its rather greater diameter, and I am of the opinion that they should be referred to the same species.

Measurements of the thickness of the other egg-fragments collected by Mr. Griffin show that they fall into two groups, one with a thickness of 0.5 to 1.0 mm., and the other with a thickness of 1.3 to 1.7 mm. Only in the former is there as much curvature as will fit over all portions of the two complete eggs, although of course it is possible that the most-curved portions of the thicker eggs have not been found. The surface pitting of the thin shells (Pl. 16, 2) is also finer, comprising minute punctures and short fine slits, agreeing with the condition of the unimpaired surface of the complete eggs. The thicker fragments (Pl. 16, 3) have coarser pittings, which show as distinct slits on the undecomposed surface, and never as minute circular punctures as on the thinner shell. The thinner shell (and the complete eggs) have about 50 pits to the square centimetre, the thicker fragments having about 35 per square centimetre.

Measurements of the leg bones collected show that two species of moa are represented in the area, i.e., *Cela geranoides* (Lyd.) and *C. curtus* (Owen) in approximately equal numbers, from which it would appear that the two eggs and the thinner shell-fragments belong to the latter and the thicker fragments to the former. I should add that, from time to time, I have received bones of *Dinornis ingens* from this district; but this is a much larger bird and the possibility that the eggs belonged to it is very remote—moreover none of its bones was recovered from this particular "colony."

It will be noted that I have retained the name *Cela geranoides* for this coastal species, although Oliver (1930, p. 49) has referred the Amodeo Bay specimen which I had identified with *C. geranoides* Lyd. (Archey 1927, p. 151) to *Emeus exilis* (Hutton). The type of *E. exilis* and the Amodeo Bay skeleton are certainly similar, but they also agree with *A.? geranoides* Lydekker (Lydekker 1891, p. 288), which has six years' priority over *E. exilis.* I have retained the genus *Cela* for *geranoides* and *curtus* because the proportions of a series of leg bones of both species are intermediate between those of *Anomalopteryx* and *Emeus,* as given in Oliver's convenient key to genera, and there is also a correspondingly intermediate position in skull-proportions. The latter was pointed out by Hutton (1897, p. 554) and is confirmed by a series of skulls of *C. curtus* from Waikaremoana and Doubtless Bay.

Referring the eggs found by Mr. Matthews to *Cela curtus,* we may then picture a moa of about the bodily bulk of a white swan, laying an egg somewhat heavier than a swan's, or one of about the same size as that of the emu; the eggs of *Cela geranoides,* a bird 3 feet high, would appear to have been proportionally larger.

The following table gives dimensions of the moa eggs now known with the species to which some have been tentatively referred.

Locality.	Date.	Condition.	Museum.	Size (Cm.)	Species.
Kaikoura	1860	Perfect	Rowley	25.3 x 17.8	*Dinornis ingens* Rowley, p. 244.
Molyneaux R.	1866	Broken	Dominion	22.6 x 15.5	
Molyneaux R.	1901	Perfect	Tring	20.1 x 13.8	*Megalapteryx huttonii.* Rothschild, p. 200.
Molyneaux R.	1925	Perfect	Otago	20.0 x 13.8	
Molyneaux	1901	Perfect	Otago	19.5 x 13.5	*Euryapteryx elephantopus or E. ponderosus.* Benham, p. 151.
Waingongoro	1847	Broken	British	19.0 x 15.0	*Emeus crassus.* Owen p. 320.
Doubtless Bay	1900	Imperfect	Auckland	12.1 x 9.73	*Cela curtus.*
Doubtless Bay	1900	Perfect	Auckland	12.0 x 9.10	*Cela curtus.*

The possibility that the largest egg is that of the largest moa, *D. maximus,* has been suggested by Oliver (1930, p. 32); but the paucity of remains of this species in comparison with the relative abundance of those of *D. ingens* rather supports Rowley's original reference of it to the latter. On the other hand the Molyneaux River egg in the Dominion Museum might be that of *D. ingens.*

The other three eggs from the Molyneaux River, i.e., those in the Otago Museum and that at Tring, appear to be of the same species, and the relative abundance of bird remains suggests their reference to a species of *Euryapteryx* rather than to *M. huttonii.*

The reference of the Waingongoro egg to *E. crassus* rests upon the size and proportion of the egg itself; and the reference of the Doubtless Bay egg to *C. curtus* is based upon the evidence given above.

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(b) Skeleton of an Australian Pelican found with Moa Bones.

In July, 1930, Mr. W. H. Gregory, Resident Engineer of the Lake Waikaremoana Hydro-electric Station, discovered moa remains in some of the deep narrow caves which are a feature of the broken slip-country forming the lake barrier; and in the following November Mr. F. Crossley Mappin kindly conducted a party, which included Sir Carrick Robertson, Mr. A. T. Pycroft and the writer, to investigate the area. A thorough search resulted in the recovery of a considerable amount of material, including six partially to nearly complete moa skeletons. This material will form the subject of a later report.

In addition to the moa remains, those of smaller birds, such as the kiwi and weka, were sometimes found, and also, as purely surface deposits, those of black swan and wild pig.

The black swan was, at the time, considered to be from the introduced stock, and is still so considered; but the possibility that it might be an extra-limital bird from Australia was occasioned serious consideration by a later discovery, by Mr. Pycroft, among some buried moa bones of the much decayed and friable bones of a large flying bird, which proves to be the Australian Pelican, *Pelecanus conspicillatus.*

The cave in which the pelican bones occurred had two narrow, partially concealed entrances, which would readily entrap a bird. The entrance we negotiated, by the aid of a rope, was a steep "slide" through a narrow cleft. It led to a fairly lofty cavern some fifty feet long, at the far end of which, on the floor, some partly-buried moa bones were found.

After these had been secured attention was turned to a steep earth slope, formed by material fallen from the end wall of the cave. Moa bones protruded from the bottom of the slope, and it was while excavating for these that the pelican bones were found. They were about 18 inches below the surface, just above the moa bones and slightly scattered through the downward movements of later accretion to the slope.

These details are mentioned as bearing on the age of the deposit. Our experience in the moa caves generally was that the remains were found as far as possible from the entrance to the cave, in some cases most inconveniently far down and almost inaccessible. Not only had the pelican died in like circumstances, but it had also been buried under the apparently steady forward fall from the back wall of the cave, and from its position in the slope it is inferred that it had become entombed at all events nearer to the time of burial of the moa bones than to the present time.

I have had for comparison a skeleton of *P. conspicillatus* from South Australia kindly presented to this museum by the Trustees of the Australian Museum, and a skeleton from Goolwa, South Australia, kindly sent by the Director of the South Australian Museum; in addition the Directors of the Australian Museum and the Queensland Museum have been good enough to supply dimensions of specimens of *P. conspicillatus* in their respective collections. Table A, below, gives comparative dimensions of the bones found at Waikaremoana and those from Australia.

Table A gives dimensions of *P. conspicillatus* from Waikaremoana (N.Z.), Australian Museum (A.M.), South Australian Museum (S.A.), and Queensland Museum (Q.M.).

Note: The column "Q.M. max." gives the largest dimensions found among all the Queensland Museum specimens; otherwise the dimensions are those of individual birds.

TABLE A.

	N.Z.	A.M. 1014	A.M. 1207	A.M. S.728	Q.M. indiv.	Q.M. max.	S.A. indiv.
Femur:							
Length mm.	128	118	108	116	98	116	103
Prox. width	36	32	31	31.5			27.1
Dist. width	38	33	30	33.4	30	35	29.0
Mid. diameter	16	14	13	14.0	12	14	12.0
Tibio-tarsus:							
Length	203	178	178	193			176
Prox. width	37.7	31	31	39.1			30.6
Dist. width	26.2	26	22	23.8			21.4
Tarso-metatarsus:							
Prox. width	25.0	25	24				22.4
Dist. width	26.9	27	27		21.5	24.0	21.8
Humerus:							
Length	357	335	309	334	292	340	303
Prox. width	59	54	51	57.3	51	60	49
Dist. width	48	44	39	46.2	40		40.5
Mid. diameter	23	17	18	19.5			16.8
Ulna:							
Dist. width	25.0	22	21				21.6
Radius:							
Length	371	345	325	355	320	352	317
Prox. width	22.5	21	20	22.5			14.0
Dist. width	15.5	14	14	14.7			20.0
Coracoid:							
Length	145	130	119		120	143	117

In addition to the full details, set out in Table A for completeness of record, two further comparative tables are given below: i.e., Table B, comparing the *range of variation*, in the more important dimensions of the Australian Birds with the dimensions of the New Zealand skeleton, and Table C, giving the *percentage of variation from the mean of each dimension* of (a) Australian skeletons only, and, (b) the Australian and New Zealand taken together.

TABLE B.

Chief dimensions of New Zealand specimen compared with range of variation of Australian.

	Australian.	New Zealand.
Femur: Length	98-118	128
Mid. diameter	12-15	16
Tibiotarsus: Length	176-193	203
Tarso-metatarsus: Dist. width	24-27	26.9
Humerus: Length	292-340	357
Radius: Length	320-355	370
Coracoid: Length	117-143	145

TABLE C.

Percentages of variation about the Mean Dimensions of *P. conspicillatus* and of *P. onocrotalus* and *P. roseus*.

	Australian only.	N.Z. & Aust.
P. conspicillatus		
Femur, length	9.2	13.1
Tibio-tarsus, length	4.6	6.7
Tarso-metatarsus, width	11.3	11.3
Radius, length	5.6	7.8
Humerus, length	7.5	4.6
Coracoid, length	5.2	10.6
P. onocrotalus (Ogilvie-Grant)		
Culmen, length	4.9	
Wing, length	6.3	
Tarso-metatarsus, length	4.6	
P. roseus (Ogilvie-Grant)		
Culmen	18.0	
Wing	5.0	
Tarso-metatarsus	10.0	
P. onocrotalus, E. Galicia (Domaniewski)		
Culmen, males	25.0	
Culmen, females	10.5	
Wing, males	7.3	
Wing, females	3.3	
P. onocrotalus (Dombrowski, *teste* Domaniewski)		
Wing, males	6.2	
Wing, females	6.47	
P. roseus (Dombrowski, *teste* Domaniewski)		
Wing, males	8.1	
Wing, females	7.6	

It will be noted that I have included in Table C the *variation percentages* of culmen, wing and tarsus of cabinet skins of *P. onocrotalus* and *P. roseus,* compiled from dimensions given by Ogilvie-Grant (1898, p. 465) and Domaniewski (1928, p. 72). These, while affording no direct comparison of the variation of specific bones of the Australian and Northern Hemisphere forms, do indicate the considerable variation which occurs in dimensions of pelicans, even, in one case given, in individuals from one breeding area (Eastern Galicia; Domaniewski).

From the above tables it is evident that the Waikaremoana specimen is, bone for bone, larger than the Australian skeletons examined, and the question of its specific distinction from *P. conspicillatus,* on account of greater size, has had to be considered.

Mathews (1912, p. 244) separated the West Australian pelican, under the name *P. c. westralis* from *P. c. conspicillatus,* in which he was followed by Mathews and Iredale (1921, pp. 70-71), who maintained its distinction "on account of its smaller size throughout, but no long series are available." The degree of separateness is not, however, indicated by figures.

The question of variation in pelicans has recently been investigated by Domaniewski (1928), who has reviewed the status of *P. onocrotalus,* which ranges from south-eastern Europe to Persia and India, and its smaller congener *P. roseus,* which occurs from central Asia to China, wintering in southern Asia and Malaysia.

These had been formerly separated by Ogilvie-Grant (1898) on account of the following dimensional differences, the distinction being maintained by Harteret (1912).

	Total Length.	Culmen.	Wing.	Tarsus.
P. onocrotalus	185.4 Cm.	43.2	66.0 to 73.6	14
P. roseus	157.4	40.6	63.5 to 70.2	11.5 to 14

Domaniewski, however, draws attention to the presence in certain districts, particularly in the Central Black Sea and Caspian Sea areas, of transition-forms; he has also recorded a wide range of variation in specimens from one breeding area. He also quotes an observation by Dombrowski that the supposedly separate species wander together, and supports this with a personal observation of the same nature. He concludes that there is but one species, exhibiting considerable variation, which becomes most marked at either end of the distribution area.

It may be added that Murphy and Harper (1921, p. 529) record variations, from the average dimensions, taken from an extensive series of diving petrels, of from 13.6 to 23.6 cm., i.e., a variation of 27.7 per cent. from the mean.

Returning to the Waikaremoana specimen, we find that while the difference between it and the largest Australian specimen is readily apparent, nevertheless this difference is considerably less than the amount of variation displayed by the quite few specimens available for comparison.

Dimensions from a large series of skeletons would very probably decrease this disparity. It should also be noted that in some dimensions the Australian forms equal the New Zealand.

In view of the known very considerable range of variation in size among pelicans elsewhere, the differences between the New Zealand skeleton and the relatively few Australian specimens which I have had for comparison are not marked enough to warrant the separation of the local form from *P. conspicillatus.*

Moreover, male pelicans are generally larger than female, and our specimen may be no more than a large male.

In connection with the large size of the Waikaremoana form it may be of interest to refer to the considerably larger *Pelecanus grandiceps* and *P. proavus* De Vis (1905, pp. 16-17), from Pliocene and Early Pleistocene deposits around Lake Eyre. Although the material available was limited and fragmentary, de Vis described it in certain particulars as "premonitory of modern pelicans," the differences recorded being chiefly in size. If the Pliocene and Pleistocene species are to be regarded as ancestral to the modern *P. conspicillatus,* the New Zealand form might be regarded as indicating the general diminution in size reached by sub-Recent times.

The Waikaremoana specimen is not the only record of an Australian pelican reaching New Zealand, for Buller (1893, p. 61) recorded the shooting of a specimen by a Maori on the Wanganui River bank about a mile above Hiruharama in 1890.

The body of the bird was devoured by pigs, but the head and neck were taken to Wanganui for identification.

In conclusion I desire to thank Mr. W. H. Gregory for inviting me to investigate the very interesting and extensive moa remains which he discovered, and for his keen interest and help in exploring the area. I am also much indebted to Mr. Mappin for arranging and conducting our expedition, and to his, and Sir Carrick Robertson's and Mr. Pycroft's assiduous and energetic participation in the search we were thereby able to make.

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Imperfect Moa Egg from Doubtless Bay.

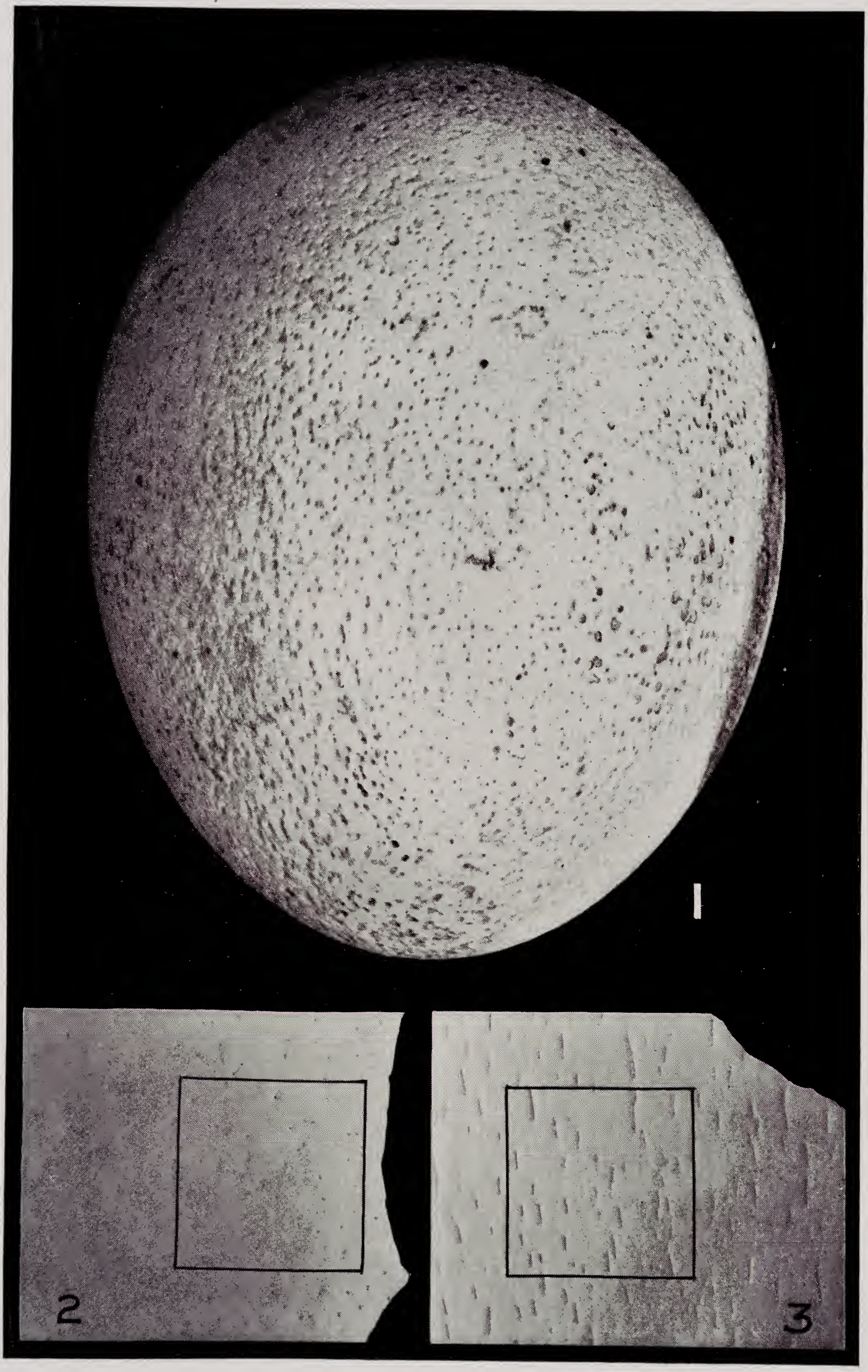
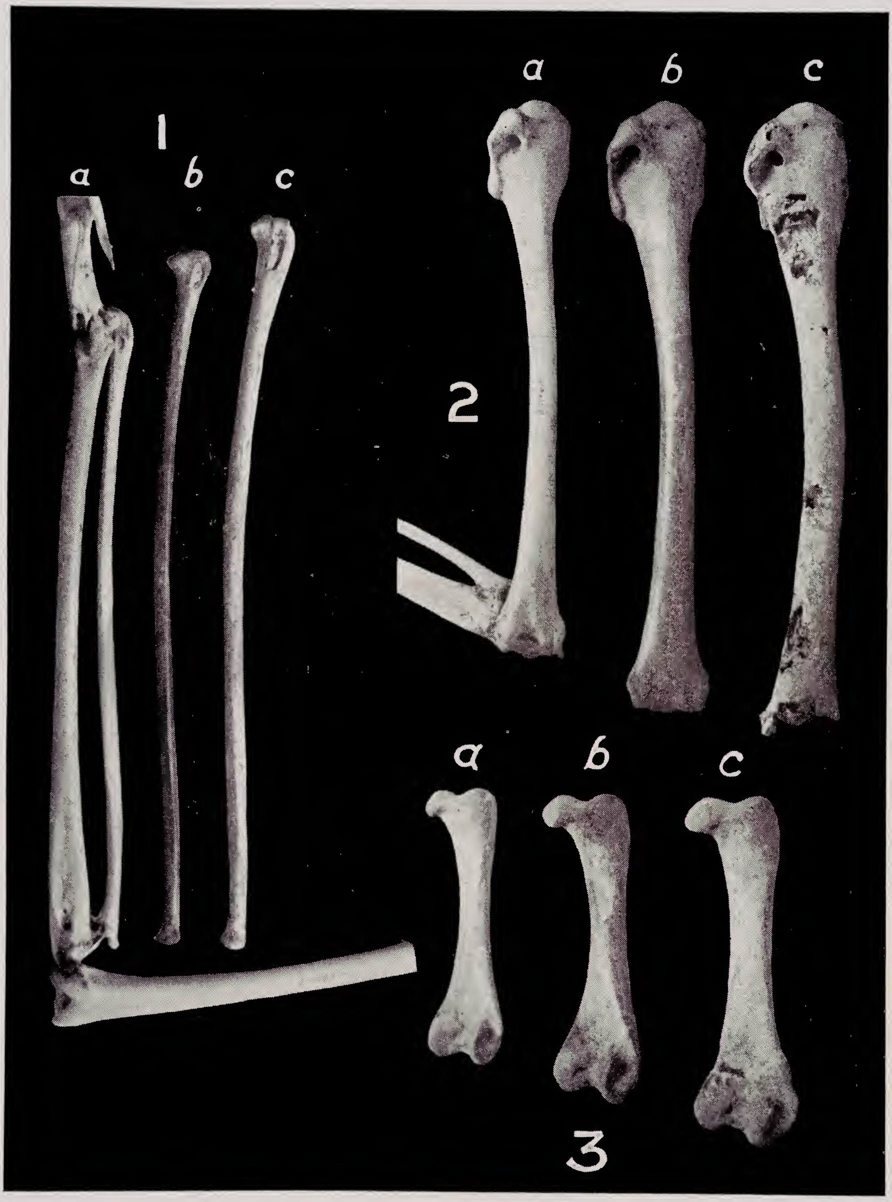


Fig. 1. Perfect Moa Egg from Doubtless Bay.
Fig. 2. Moa Egg shell from Doubtless Bay, 0.75 mm. thick, with about 50 punctures per sq. cm., × 2.5.
Fig. 3. Moa egg shell from Doubtless Bay, 1.5 mm. thick, with about 35 slits per sq. cm., × 2.5.



Comparison of radius (Fig. 1), humerus (Fig. 2), and femur (Fig. 3) of specimens of *P. conspicillatus* from S. Australian Museum—"S.A. indiv." of Table A—(a), Australian Museum No. S. 728 (b), and Waikaremoana, N.Z. (c).

A Revision of the Carangid and Seriolid Fishes of New Zealand.

By L. T. GRIFFIN, F.Z.S., Assistant Director.

(Plates 18-24.)

The recent changes in generic and specific names of the *Carangidae,* together with some uncertainty as to the identity of some of our species, have indicated the need for a revision of the New Zealand members of the family, in preparing which an attempt has also been made to distinguish New Zealand from closely related Australian forms. Fresh specimens of all the local species have been examined, including a satisfactory series of the trevally; the latter exhibits a considerable degree of variation among individuals from the same locality, which indicates the need for careful consideration before establishing new species on slight differences in fin formula or even in body proportions.

I wish to acknowledge the assistance afforded me by Mr. Archey, Director of the Auckland Museum, and by Mr. G. Whitley, of the Australian Museum, and to thank Professor R. Speight, Curator of the Canterbury Museum, Mr. J. J. Enwright, Marine Superintendent of Sanford's, Ltd., and Messrs. Deighton and Shirley, of the Auckland Fishermen's Co-op., for supplying specimens for examination.

Key to the New Zealand genera of *Carangidae* and *Seriolidae.*

A.	Caudal peduncle with a series of enlarged bony scutes on the lateral line	i. Fam. *Carangidae*
B.	Lateral line armed along its whole length ..	1. *Trachurus*
BB.	Lateral line armed on part only of its length	
C.	Dorsal and anal fins each with a detached posterior ray	2. *Decapterus*
CC.	Posterior dorsal and anal rays not detached..	3. *Usacaranx*
AA.	No bony scutes on caudal peduncle	ii. Fam. *Seriolidae*
D.	Caudal peduncle with a keel on each side ..	4. *Naucrates*
DD.	Caudal peduncle without lateral keels.. ..	5. *Regificola*

It may be mentioned here that *Evistius* Gill, orthotype *Platystethus huttoni* Guenther, has been included in the New Zealand list of Carangids by various writers.

After having examined a specimen, I am satisfied it does not belong to this family at all, but is included in the family *Labracoglossidæ,* referred to by McCulloch, 1923, Rec. Austr. Mus., Vol. xiv., No. 2, p. 121, and by Jordon, 1923, Class. Fish., Vol. iii., No. 2, p. 203.

Genus TRACHURUS Rafinesque.

Key to the New Zealand species:—

A. Depth 4.7 to 5.2 in the length; more than 73 scutes on the lateral line. Body rather robust .. .. .. 1. *novae-zelandiae*

B. Depth 4 to 4.4 in the length; less than 73 scutes on the lateral line. Body rather depressed .. .. 2. *declivis*

Trachurus novae-zelandiae Richardson.

Horse Mackerel, *Hature.*

(Plate 18.)

1843. *Trachurus novae-zelandiae* Richardson, 12th Rep. (year 1842) Brit. Assn. Adv. Sci., p. 21.
1872. *Trachurus trachurus,* Hutton, Cat. Fish. N. Zeal., p. 16, pl. 3, fig. 23 (not *T. trachurus* Linn).*
1911. *Trachurus picturatus,* Waite, Rec. Cant. Mus., vol. 1, p. 232 (not *T. picturatus* Bowdich).
1915. *Trachurus novae-zelandiae* Hutton, McCulloch, Biol. Res. Endeavour, vol. 3, p. 123.**
1921. *Trachurus novae-zelandiae* Cuv. and Val. Phillipps, N.Z. Journ. Sci. and Tech., vol. 4, p. 117.
1927. *Trachurus novae-zelandiae* Richardson, Phillipps, N.Z. Marine Dept. Fish. Bull., No. 1, p. 34.

Br. 6. D. viii/I/XXXIV.; A. ii/I/XXX.; P. XXV.; C. xvi/3-3; V. i/V.

Depth before second dorsal rather more than 4.24 in the length from the premaxillary symphysis to posterior margin of middle caudal rays; head 3.97 in same. Eye 4.28 in head and 1.56 in snout. Adipose eyelid 1.75 in the eye. Pectoral nearly 4 in the length and subequal with the head.

Body elongate, robust, the dorsal and ventral profiles nearly subequal, the back being a little flattened at base of first dorsal fin.

Snout long, pointed, lower jaw slightly the longer. Two nostrils close together about the middle of snout. Maxillary reaches or extends very slightly beyond the vertical from the anterior border of eye. Adipose eyelid moderately developed. Scales are present on top of head as far as anterior margin of eye, on cheeks, operculum and maxillary, the snout preorbital and lower jaw being naked.

*In his original description Richardson credits this species to Cuvier and Valenciennes, Hist. Nat. Poiss. ix., p. 26; but although there is a description therein of "Le Saurel de la Nouvelle-zelande" there is no binomial designation.

Hutton in his synonymy (1872) also includes *T. novae-zelandiae* C. & V., no doubt through copying Richardson, and Phillipps (1921) has repeated this attribution.

**McCulloch credited the name *novae-zelandiae* to Hutton because, as he states, "I have failed to find any reference to it" [in Cuvier and Valenciennes]. He was apparently unaware of Richardson's description.

Minute teeth present in both jaws in a single series, those in the lower jaw being the more developed; teeth also present on the vomer, palatine bones and tongue. Gills, 4; gill-rakers 30 on the lower half of the anterior limb.

Body covered with moderate cycloid scales completely covering the breast. Lateral line commencing at upper margin of operculum gradually curving downward to beneath the fifth-sixth rays of the dorsal, thence straight to caudal. I count 93-95 scutes in my specimen, the largest being considerably greater than the eye. Three small procumbent spines, deeply embedded in the skin, precede the dorsal fin. Third dorsal spine longest. Anterior rays of both dorsal and anal longest, very gradually decreasing backward, the last again becoming much longer and separated by moderately deeply excised membrane; both fins are protected by a very low scaly sheath. Pectoral subfalcate, reaching backward as far as the vertical from the space between the first and second dorsal. Caudal moderately forked. Origin of ventral below middle of base of pectoral and at great distance from the vent.

Colour: Above lateral line dark greenish-blue, below scutes paler, with a golden hue, blending into creamy-white on the ventral surface. Dorsal fin *terra vert* colour. Pectoral, caudal and anal greenish yellow. Ventrals, pinkish-white.

Described and figured from a specimen which is 429 mm. from the pre-maxillary symphysis to posterior margin of middle caudal rays. Greatest height, 100 mm.; eye, 25 mm.; caudal peduncle width, 15 mm.

Locality and Distribution: Auckland Harbour, and occurring in large shoals in open sea on the east and west coasts of the North Island. Hutton (1872, loc. cit.) states it is common in Wellington Harbour about the end of November, and that he noted a few on the west coast as far south as Martin Bay. Waite (1907) recorded it from the Bay of Plenty to Palliser Bay, in depths ranging from 13 to 94 fathoms. It is also found in Australian seas. It is regarded as an oceanic species, which sometimes enters inlets in shoals.

Affinities: This species is often mistaken for *T. declivis*, but a glance at the illustrations accompanying this paper will show the differences, which, though slight, are constant. *T. novaezelandiae* is a much more robust fish and grows to a greater length, also the scutes of the lateral line are broader and more numerous than any I have seen in *T. declivis*. The latter is also lighter in colour, with the dorsal and ventral profiles more evenly convex. Specimens in the Auckland Museum.

Trachurus declivis (Jenyns).

Herring Scad. (Plate 19.)

1841. *Caranx declivis* Jenyns, Zool. Beagle, iii., p. 68, pl. xiv.

1915. *Trachurus declivis*, McCulloch, Biol. Res. "Endeavour," vol. iii., pt. 3, p. 125, pl. xxxiv., fig. 2.

Br. 7; D. ii/VIII/I/XXX; A. ii/I/XXVII; V. i/V; P. i/XXI; C. XVIII.

Height of body 4.04, head 3.75 in the length to the hypural joint. Eye 4.06 in the head, and subequal with interorbital width, or nearly 1.41 in the snout. Caudal peduncle .75 in the width of the eye. Maxillary sub-equal with the caudal peduncle.

Body oblong, somewhat compressed, the dorsal and ventral profiles almost evenly arched, covered with small deciduous scales. Similar scales are also present on the preorbital, maxillary, cheeks, operculum, and lower jaw, but the top of the snout is scaleless.

Lateral line continuous, formed of numerous scutes, about 70 in the entire length. It follows a gradual curve from the upper angle of the operculum as far as the vertical of the anterior portion of the second dorsal, it then bends acutely downwards, after which it becomes a little larger at the bend, largest below the middle of the second dorsal, thence getting gradually smaller again to the end of the peduncle. Head with the interorbital convex; there is a small mesial ridge anteriorly. Two nostrils high up on the profile, slightly higher than the upper edge of the orbit, and situated rather nearer the eye than the tip of snout. Maxillary reaches the anterior margin of the orbit. A narrow band of minute teeth in both jaws; teeth are also present on the vomer and palatine bones, while the tongue is provided with a broad mesial ridge of granular teeth. Gills, 4; gill-rakers long, about 38 on the lower half of the anterior limb.

Fins: In front of the first dorsal there are two very minute detached spines directed forward, difficult to find, as they are almost wholly embedded in the skin; these are followed by eight high spines, the third of which is highest, nearly equal to two of the eye; the first ray is longest, subequal with the fifth spine, thence the rays get rapidly shorter backwards. Anal similar to the second dorsal. There is a moderate notch in the membrane separating the last rays in both fins. Pectoral falcate, reaching the vertical of the second ray of the dorsal. Caudal deeply forked, the two lobes equal.

Colour: Pale yellowish-green silver above lateral line, shot with cobalt; scutes, yellowish-green; below lateral line, silver white reflecting pale blue. Head the same as body, but there is a diffused black spot on the posterior upper angle of the operculum; maxillary pale greenish-white; eye gold and silver with the pupil blue-black. First dorsal with clear very pale greenish spines, the membrane between transparent; second dorsal clear transparent at base, bright yellowish-green on margin. Anal, uniform greenish-white. Pectoral, same as anal. Ventral, transparent light horn colour, the base of the rays tinged with dull red. Caudal similar to the second dorsal.

Described and figured from a specimen which is 25 mm. long from the symphysis of the lower jaw to the hypural joint. The greatest height is 63 mm., length of head 69 mm., eye 17 mm.

Locality and Distribution: Auckland Harbour. The species is very common in waters of the Auckland Provincial District; large hauls are frequently obtained by trawlers operating out of Auckland at all seasons of the year.

It is also reported to be abundant in Port Jackson, and it occurs all round the coasts of the southern half of Australia, from South-western Australia to Southern Queensland.

Genus Decapterus Bleeker.

Decapterus koheru (Hector). *Koheru.* (Plate 20.)

1874. *Caranx koheru* Hector, Trans. N.Z. Inst., vol. 7, p. 24, pl. XI., fig. 24a.

1921. *Decapterus koheru,* Phillipps, N.Z. Journ. Sci. Tech. vol. 4, p. 117.

Br. 6. D. vi/I/XXIX/I; A. ii/I/XXVIII/I; P. i/XXII; V. i/V; C.viii/3-3.

Depth before second dorsal 3.90 in the length from premaxillary symphysis to posterior margin of middle caudal rays. Head 3.81 in same. Eye 4.14 in head or 1.45 in snout, and 2 in second dorsal spine. Adipose eyelid 2 in the eye. Body elongate, robust, the dorsal and ventral profiles subequal. Snout long, pointed, lower jaw longest. Two nostrils in very close proximity to each other, situated about midway between premaxillary symphysis and anterior border of eye. Maxillary reaches the vertical from anterior margin of orbit. Adipose eyelid moderately developed. Scales present on cheeks, operculum, and on top of head as far as anterior border of eye. Snout, maxillary, lower jaw and the interoperculum are naked.

Teeth very minute, in a single series in both jaws, also present on vomer, but I do not find any on the palatine bones. The tongue is roughened. Gills, 4; gill-rakers long, slender, 34 on the lower half of anterior limb. Body covered with very small scales which completely cover the breast. Lateral line commencing at upper angle of operculum is moderately straight as far as the vertical from the second dorsal ray, it then dips steeply downward for a short distance to below the fifteenth ray, from thence it is straight to caudal. There are 26 keeled scales on the posterior portion, none of which is very large, broadest about the middle of the peduncle, about 4 in the eye.

Above the orbit, there is a long hardened ridge with a very much shorter one immediately behind. These appear to be a long, followed by a short procumbent spine, firmly embedded in the skin. There is also a much shorter and very thin one just before the first dorsal. Second spine of dorsal longest. Anterior rays of both dorsal and anal longest, those near the middle of the fins shortest. Both fins are concave near the centre, broadening out again gradually towards the posterior rays, which are almost as long as the anterior. Both fins protected by a very low scaly sheath. Pectoral subfalcate reaching backward nearly as far as hinder margin of first dorsal. Caudal moderately forked. Ventral origin below middle of base of pectoral and at a great distance from vent.

Colour: Above lateral line dark bluish-green silver, below lighter with a golden hue, ventral surface somewhat paler. All fins uniform yellowish-green, the tips rather darker, excepting the ventrals, which are pinkish white. Upper part of head same as dorsal; cheeks and opercles same as body below lateral line. A small round black spot on hinder margin of operculum. Eye golden and blue-black.

Described and figured from a specimen which is 350 mm. long from premaxillary symphysis to posterior of middle caudal rays. The depth of the body before the second dorsal is 89 mm., head 90 mm., eye 23 mm., caudal peduncle 13 mm.

Locality and Distribution: Auckland Harbour, and common in all waters of the Auckland Provincial District, from Cape Maria to East Cape. Fishermen inform me it is abundant about the entrance to Whangarei Harbour and the Hauraki Gulf, where large shoals are often observed. Although a fine table fish, it is seldom seen in any large quantities in our local fish markets. Specimen in the Auckland Museum.

The New South Wales species, *D. leptosomus,* is said by Ogilby (Proc. Linn. Soc. N.S. Wales, 1898, p. 760) to differ greatly from *D. koheru.*

The former appears to be a very much smaller species, rarely exceeding 170 mm. in length. There is also a greater number of spines in the first dorsal, 8 as against 6 in *D. koheru,* while the upper jaw in *D. leptosomus* is toothless.

Before proceeding with the descriptions of the trevallys, it is important to note the change in the generic name of the New Zealand and Australian species proposed by Whitley, who does not advise the retention of *Caranx,* that genus now being restricted to the genotype, *Caranx carangus* (= *hippos)* Linne, an American species with the breast naked, except for a central patch of scales. The New Zealand and Australian forms have the breast wholly scaly.

Whitley proposed the name *Usacaranx* (1931), for *Caranx nobilis* Macleay, and for all species of the group with scaly breasts.

The generic and specific synonymy is as follows:—

Genus USACARANX Whitley, 1931.

Longirostrum. Jordan, 1923, Classif. Fishes, p. 185, ex Wakiya MS., orthotype *Caranx platessa* C. et V. (Not *Longirostrum* Wakiya 1924), Ann. Carnegie Mus. XV., pp. 164 and 202, in strict sense, i.e., for Selenia, preocc. = *Usa* Whitley 1927, Rec. Austr. Mus. XV., p. 299, orthotype *Caranx (Usa) cordylaoides* (Meuschen). Both preoccupied by *Longirostra* C. T. Wood 1835, Orn. Guide, p. 203, and *Longirostris* S. D. Wood 1836, Analyst iv., April, 1836, p. 119, genera of birds, *fide* Sherborn, Ind. Anim.

Usacaranx. Whitley 1931, Austr. Zoologist, VI., Feb., 1931, p. 316, orthotype *Caranx nobilis* Macleay.

Key to the N.Z. species of *Usacaranx.*

Pectoral elongate, falcate, caudal deeply forked, body without vertical bars ..	1. *lutescens*
Pectoral much shorter, sub-falcate, body with eight broad vertical bars ..	2. *archeyi* n. sp.

Usacaranx lutescens (Richardson).

School Trevally; *Araara.* (Plate 21.)

1843. *Scomber lutescens* Richardson, Jan., 1843. Ann. Mag. Nat. Hist. XI., p. 26, ex Solander MS. New Zealand. Mar. 30, 1770.

1843. *Scomber micans* Richardson, Jan., 1843, Ann. Mag. Nat. Hist., XI., p. 27, ex Solander MS. "prope Motuaro," Queen Charlotte Sound, New Zealand.

1843. *Scomber platinoides* Richardson, Jan., 1843, Ann. Mag. Nat. Hist., XI., p. 28, ex Solander MS. Tolaga, New Zealand.

1843. *Caranx lutescens* and *platinoides* Richardson, 1843, "Travels in New Zealand" (Dieffenbach) ii., p. 210, ex Solander MS. New Zealand.

1848. *Caranx georgianus* Richardson, Zool. Voy. Erebus and Terror, Fish, p. 135. (Not *C. georgianus* Cuv. and Val., 1833, from West Australia.)

1911. *Caranx platessa* Waite, Rec. Cant. Mus. i., p. 233. (Not of Cuv. and Val.), 1833, from "La mer des Indes" (Peron).

1927. *Longirostrum platessa* Phillipps, Bib. N.Z. Fishes, i., p. 33, (Not *Longirostrum* of Wakiya, nor *platessa* of Cuv. and Val.).

Mr. Gilbert Whitley in a letter points out "that the earliest specific name that can with certainty be applied to our School Trevally is *Scomber micans* Richardson (ex Solander MS.), described from a specimen secured by Capt. Cook's expedition, but a brief Latin description having page priority is named *Scomber lutescens* in Richardson's paper, and as no other Neo-zelanic Carangid appears to fit in with this description, the specific name *lutescens* must be given priority over all others."

"It is probable that *Caranx platessa* and *Caranx georgianus* are synonymous, or closely allied, but they cannot be regarded as New Zealand species, as Peron (who was never in New Zealand) collected the type, probably from South Australia, but no definite locality was assigned to it."

A well graduated series of 26 fresh specimens in fine condition, ranging from 298—700 mm. long, has been critically examined.

In this series the following variations were recorded:—

Head, from 3.4 to 3.68 in the length of the fish; depth of body, 2.9 to 3.27; pectoral, 2.67 to 3.18 in the same. Eye in head, 4.9 to 6.83. Eye in snout, 1.7 to 1.85. Scutes of the lateral line number from 25-29, counting those only plainly visible to the eye.

The dorsal fin, in two cases, I count 8/24, three cases 8/25, seventeen of 8/26, and four of 8/27. The anal fin in all cases was 2/1/23.

The position of the ventrals is subject to considerable variation; in five cases the tips of the rays touch the vent; in sixteen cases it is near the vent, while in five specimens it is rather far from the vent.

The variations recorded have no relation to size, neither do the fish fall into groups; all were taken in the Auckland Provincial waters, and I cannot but regard them as all of one species.

The size of these trevallys, when schooling, ranges from 200-400 mm. long, and they are usually found in deep water a little distance from the coast, many acres being covered at a time by fish of this size. I have never seen very large trevallys among the school fish, and experienced fishermen have informed me they are not found among them. The large fish are more frequently met with in deep water bays and around rocky headlands, where I have observed them living in moderately large communities. These large fish are generally in fine condition, with the top of the head much more elevated than in the smaller and younger specimens, although their form cannot be considered gibbous; beyond this character, they are in every other way like the smaller school fish.

Locality and Distribution: From the Three Kings Islands to the Hauraki Gulf and all intermediate outlying islands in from 16 to 28 fathoms. Waite (1907) records it from the Bay of Plenty to Cape Palliser, in 16 to 68 fathoms, while Thomson, Trans. N.Z. Inst., XXIV., p. 208, gives Puysegur Point as its southern limit, but I have no other record of its being taken so far south, and question whether it extends much beyond Cook Strait.

Solander (1843) gives Queen Charlotte Sound as the locality for his specimen, and I have just received reliable information from Mr. D. H. Graham, late of the Portobello Marine Biological Station at Port Chalmers, that the Trevally is not found in Otago waters. This seems to confirm my own opinion that Cook Strait and Queen Charlotte Sound may be regarded as its southern limit in New Zealand. According to Phillipps (N.Z. Journ. Sci. and Tech., Vol. 1, No. 5, 1918, p. 271), the spawning season for the species is in January and February.

Specimens in the Auckland Museum.

The New South Wales Trevally *Usacaranx nobilis* (Macleay) differs from *Usacaranx lutescens* principally by its possession of very minute teeth, greater number of scutes on the lateral line, the gibbous form of the head, and, according to Macleay, the absence of the opercular spot.

Usacaranx archeyi n. sp. (Plate 22.)

Br. 8; D. viii/I/XXVII; A. ii/I/XXII; P. i/XIX; V. i/V; C. xix/6-6 = xxxi.

Height before second dorsal 3 in the length from the premaxillary symphysis to posterior margin of middle caudal rays.

Head 3.18, pectoral 7 in same. Eye 4.71 in head, and 2 in snout. Interorbital width rather greater than the eye, and subequal with snout. Body moderately elongate-ovate, compressed, dorsal and ventral profiles evenly curved. Snout of moderate length, the upper jaw slightly the longer. Maxillary reaching to vertical of midway between nostrils and eye. Adipose eyelid undeveloped.

Whole of head covered with very small scales. Minute villiform teeth, widely separated in both jaws. Teeth are also present on the vomer and palatine bones, the latter almost microscopic. Tongue covered in minute granular teeth. Gills, 4; gill-rakers, 23, very long and slender, on lower half of anterior limb.

Body entirely covered with small scales. Lateral line evenly arched to the vertical from the seventh-eighth dorsal rays, thence straight to caudal. There are about 37 finely keeled scales on the straight portion of lateral line, broadest below the posterior half of second dorsal, the broadest scales being about three-quarters the width of eye.

A procumbent spine deeply embedded in skin at base of first dorsal spine. The third and fourth spines are longest, reaching the second dorsal when adpressed.

Anterior dorsal rays much longer than those following, provided with broad lobes. Pectoral reaches backward to the vertical from the second ray of dorsal. Ventrals reach as far as the first anal spine. Anal fin subequal with the dorsal. Caudal moderately forked.

Colour: Silvery, with thin greenish shade over all, darker along dorsal. Eight slightly darker vertical bars nearly as wide as eye reach from top of back to ventral surface, but do not extend on to fins. A black spot on upper posterior margin of operculum.

All fin rays and spines same colour as the back, the membrane between thin, clear, colourless, but having a number of microscopic dots near the outer margin.

Variation and Dimensions: I have examined six examples of this fish, the largest being 103 mm. long from the premaxillary symphysis to the base of middle caudal rays. Greatest depth is 36 mm.; head, 34 mm.; eye, 8 mm. The smallest specimen is 73 mm. long; depth, 25 mm.; head, 24½ mm.; eye, 6 mm.

In every other way the large and small specimens do not differ from the type specimen.

Locality: Several specimens taken in beach trawl on the northern side of Motuihi Island, Hauraki Gulf, in May, 1928, by Mr. Gilbert Archey, Director of the Auckland Museum, after whom I have named the species.

These are the first of their kind brought to my notice, and as it has not been recognised since, I am inclined to think it is not common.

Holotype and *paratypes* in the Auckland Museum.

SERIOLIDAE.

Genus NAUCRATES Rafinesque, 1810.

Naucrates angeli Whitley (Plate 23). Pilot Fish.

1872. *Naucrates ductor* Linn., Hutton, Cat. Fish. N.Z., p. 18.

1927. *Naucrates indicus* Linn., Phillipps, N.Z. Marine Dept. Fish. Bull., No. 1, p. 34.

1931. *Naucrates angeli* Whitley, Austr. Zoologist, vol. 6, pt. 4, p. 316.

Hitherto, our Pilot Fish has been considered identical with the Atlantic species, but Whitley points out that the young forms figured by McCulloch (Rec. Austr. Mus., XV., 1926, 34) differ markedly from Atlantic juveniles of *Naucrates ductor* recently figured by Roule and Angel (Res. Camp. Sci. Monaco fasc: lxxix., 1930, 86, pl. V., figs. 111-114). Whitley therefore considers our Southern Pilot Fish to be a new species.

Br. 7; D. iv/I/XXX; A. ii/I/XVII; V. i/V; P. i/XX; C. xv/3/3.

Height of body equal to the length of head, or 3.87 in the length to the hypural joint. Eye 4.86 in the head, and 1.57 in the snout. Pectoral subequal with ventral, and about $1\frac{3}{4}$ in the head. Maxillary $1\frac{3}{4}$ in the eye.

Body oblong, subcylindrical, the dorsal and ventral profiles equally curved. Whole of body covered with small cycloid scales. A band of similar scales present on the cheeks, reaching as far as the upper posterior border of the orbit and at the top of the operculum, while the top of the head, maxillary, lower jaw and preoperculum are naked. Lateral line continuous, arched above the centre of pectoral, thence gradually sloping to the vertical of middle of dorsal, it then becomes straight to the caudal. Caudal peduncle with a moderate keel, the latter naked on its outer margin. There is a small scaly sheath at the anterior portion of the second dorsal, which ends below the eighth ray. A similar sheath at the anterior part of the anal, ending above the base of the sixth ray. Head, with the inter-orbital and nape strongly convex. Two nostrils close together, nearer the tip of snout than the eye, the posterior a small slit-like aperture pressed close to the anterior, which is oval, surrounded with a low cutaneous rim. Operculum strongly striated and notched on its upper posterior border. Preoperculum also striated, strongly denticulated on its posterior margin, but the denticulations become finer on its lower border. Maxillary does not nearly reach to the anterior margin of the orbit. Villiform teeth in a band in both jaws, those in the lower being in a broader band than in the upper jaw; there are also a few longer hooked teeth, mostly found in the lower jaw. Teeth on the vomer, palatine bones and tongue. Mouth oblique, the jaws equal when closed. Gills 4, gill-rakers long. Seventeen on the lower half of the anterior limb, the points of each furnished with minute spines on their inner margins. First dorsal with four small spines, with a very low membrane attached to each; the rays are highest anteriorly, but decrease rapidly in height backwards. Two very minute spines are situated close in front of the anal, the rays being similar to those of the dorsal, but much lower. Origin of anal at the vertical from the 13th dorsal ray. Ventral reaches backwards almost to the vertical from the second dorsal ray. There is a depression on the abdomen into which the ventral fits when laid back.

Colour: Above lateral line, deep bluish-silver, below, bright bluish-silver, the bands being deep prussian blue. Top of head same colour as the bands. Cheeks and opercles pale bluish-silver. Dorsal fin uniform dark bluish-black, the tips of the anterior rays being faintly margined white. Anal similar to the dorsal, but with rather more white at the tips of the first three or four rays. Caudal somewhat paler than the dorsal, and with a broad blackish band crossing both lobes near the margin, the tips white. Pectoral dull white, with a dusky patch. Ventrals dusky silver white.

Described and figured from a specimen which is 26 mm. long from the tip of snout to the hypural joint. The greatest height is 69 mm., head 64 mm., eye 11 mm.

Variation: In the specimen here described and figured, a male, it will be noticed that the upper caudal lobe is much greater than the lower. In all other specimens I have seen, also figures and descriptions, I have found the caudal lobes to be equal. I am not able to say whether the unequal lobes in my specimen may be due to a deformity, or perhaps a sexual difference. A fine female specimen received shortly after this one was captured has both the lobes equal, and, on further comparison, I find there is no other variation except in the colour, the female being somewhat brighter, and with much more white showing in the dorsal and anal fins.

Locality and Distribution: Red Mercury Island, Auckland, Nov., 1925. This fish was gaffed while the fishermen were engaged in landing a big mako shark. Two other specimens (one of which was brought to the Museum) were captured in shallow water in the Hauraki Gulf in October, 1926. It is also known from New South Wales.

Specimens in the Auckland Museum.

Genus Regificola Whitley, 1931.

Regificola grandis (Castelnau, Plate 24). King Fish. *Haku.*

1872. *Seriola grandis* Castelnau, Pro. Zool. Acclim. Soc. Victoria i, July, 1872, p. 115.

1872. *Seriola lalandi,* Hutton, Cat. Fishes N.Z., p. 17 (not *Seriola lalandi* Cuv. and Val.).

1907. *Seriola lalandi,* Waite, Rec. Cant. Mus. Vol. 1, No. 1, p. 23 (not *Seriola lalandi* Cuv. and Val.).

1915. *Seriola grandis,* McCulloch, Biol. Res. Endeavour, Vol. 3, p. 121, pl. 35, fig. 1.

1927. *Seriola lalandi,* Phillipps, N.Z. Marine Dept. Fish. Bull. No. 1, p. 34 (not *Seriola lalandi* Cuv. and Val.).
Seriola grandis, Phillipps, Trans. N.Z. Inst. 58, p. 128, p. 4.

1931. *Regificola grandis,* Whitley, Austr. Zoologist. Vol. 6, pt. 4, p. 316. Orthotype *Seriola grandis* Castelnau.

The New Zealand King-fish is now regarded as identical with the Australian species, for which Whitley (1931, p. 316) has founded a new genus.

For a number of years our King-fish has been confused with the Atlantic species *Seriola lalandi* of Cuvier and Valenciennes, but recent examinations of the two show that our King-fish differs from the Atlantic form principally in its being a much more slender species, with the upper profile of the head less convex. Another character which appears to be constant is the maxillary, which, in the Atlantic species, reaches fully to the middle of the eye, while in the New Zealand and Australian forms it extends to, or a trifle beyond, the anterior margin of the eye.

In three examples before me, two of which are of the average size of 1,040 mm., and a small specimen of 350 mm. long, I get exactly the same fin formula, viz.:

D. vii/I/XXXIII; A. ii/I/XXI; P. i/XX; V. i/V; C. XVII.

In the largest specimen the head is 3.62 in the length from the pre-maxillary symphysis to the base of the middle caudal rays, while the depth below the first dorsal is 4.48 in the same.

In the small specimen of 350 mm. long, the head is 4.07 in the length and the depth 4.38 in the same. These measurements agree very well with Australian examples, where the head ranges from 4.37 to 4.71, and the depth 4.6 to 5.17, according to the size of the fish.

According to Phillipps (1927, p. 129), the head ranged from 4.24 to 4.66, and the depth 4.3 to 4.79. It will be readily observed that the dimensions vary considerably according to the age and condition of the fish.

Distribution: Very common and growing to a large size in all waters of the Auckland Provincial District, from the Three Kings Islands to the Bay of Plenty. Said to be less plentiful in Cook Strait, and rare about Otago. Also well known in Australian seas.

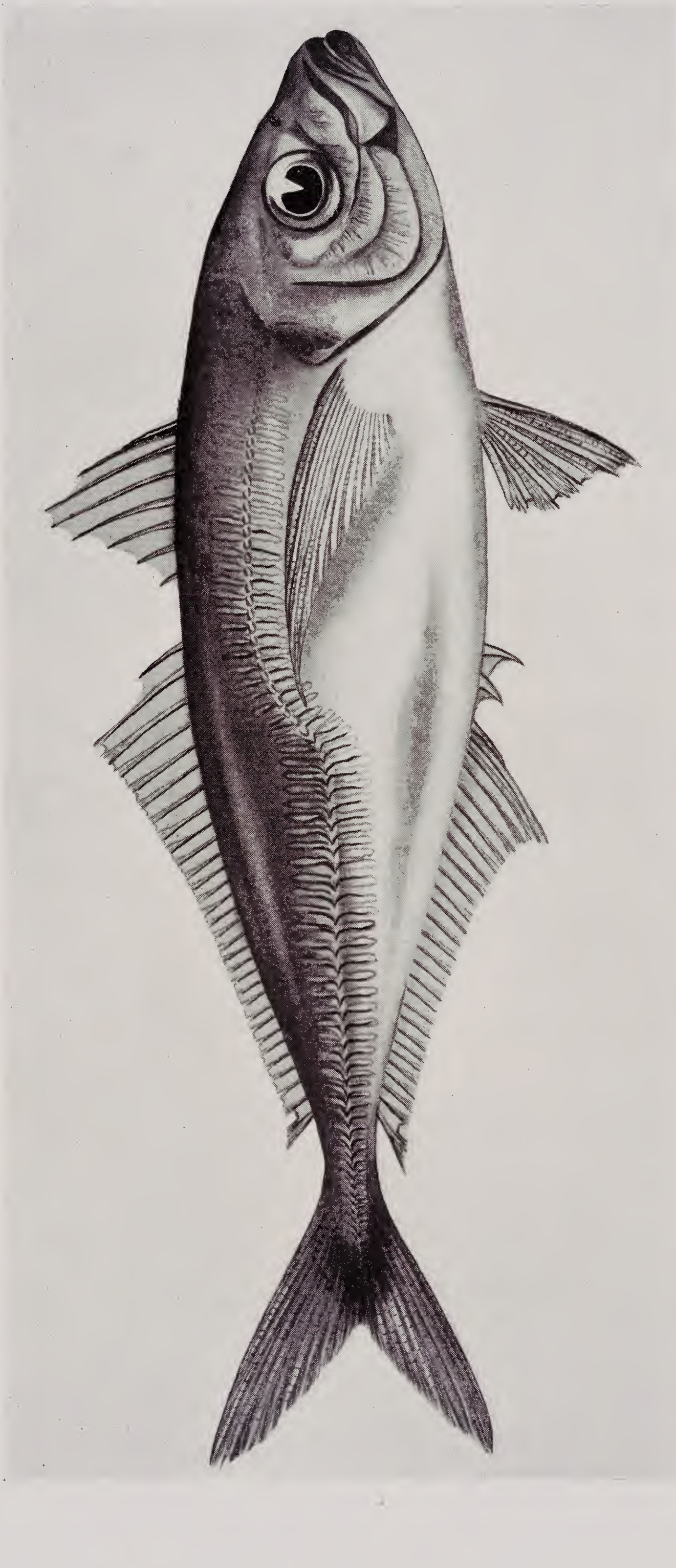
Specimens in the Auckland Museum.

PLATE 18.

L. T. Griffin, del.]

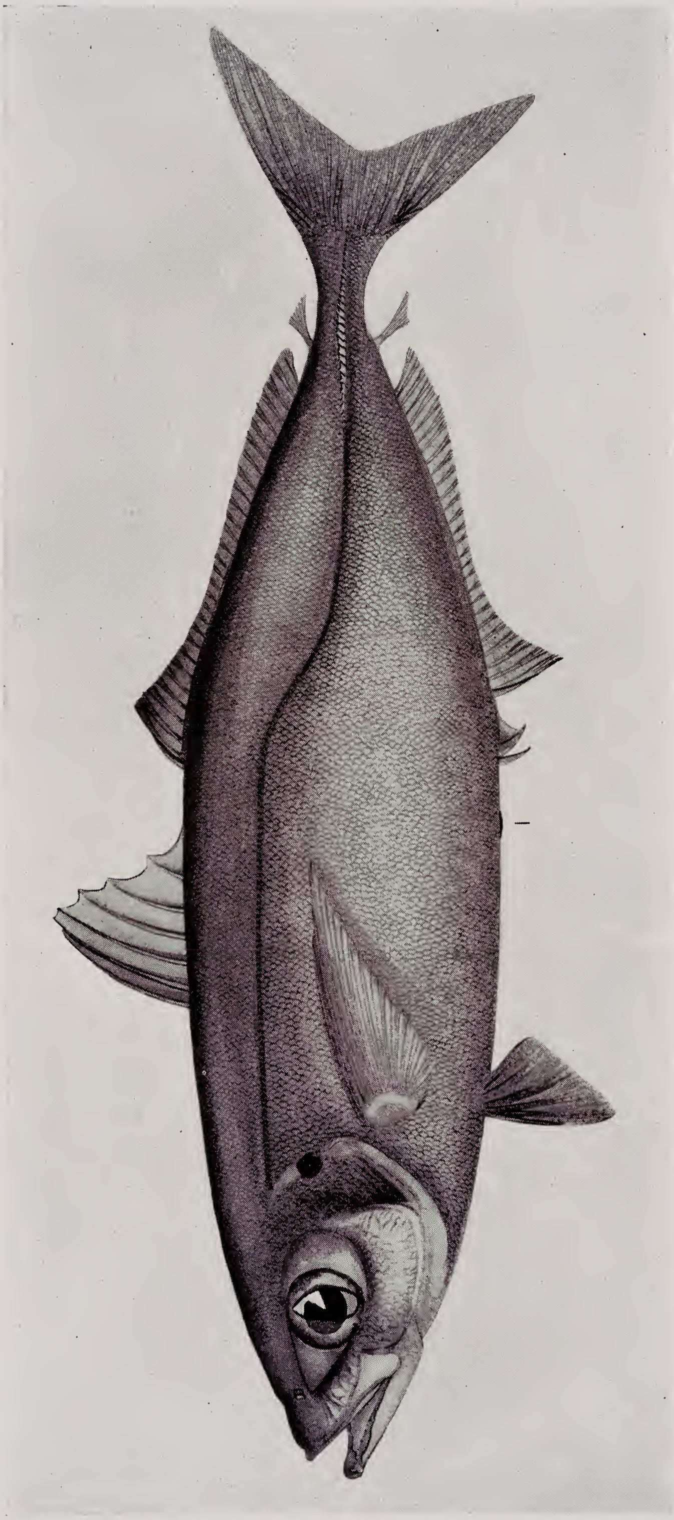
Trachurus novae-zelandiae Richardson.

Horse Mackerel; Hature.



Trachurus declivis (Jenyns).
Herring Scad.

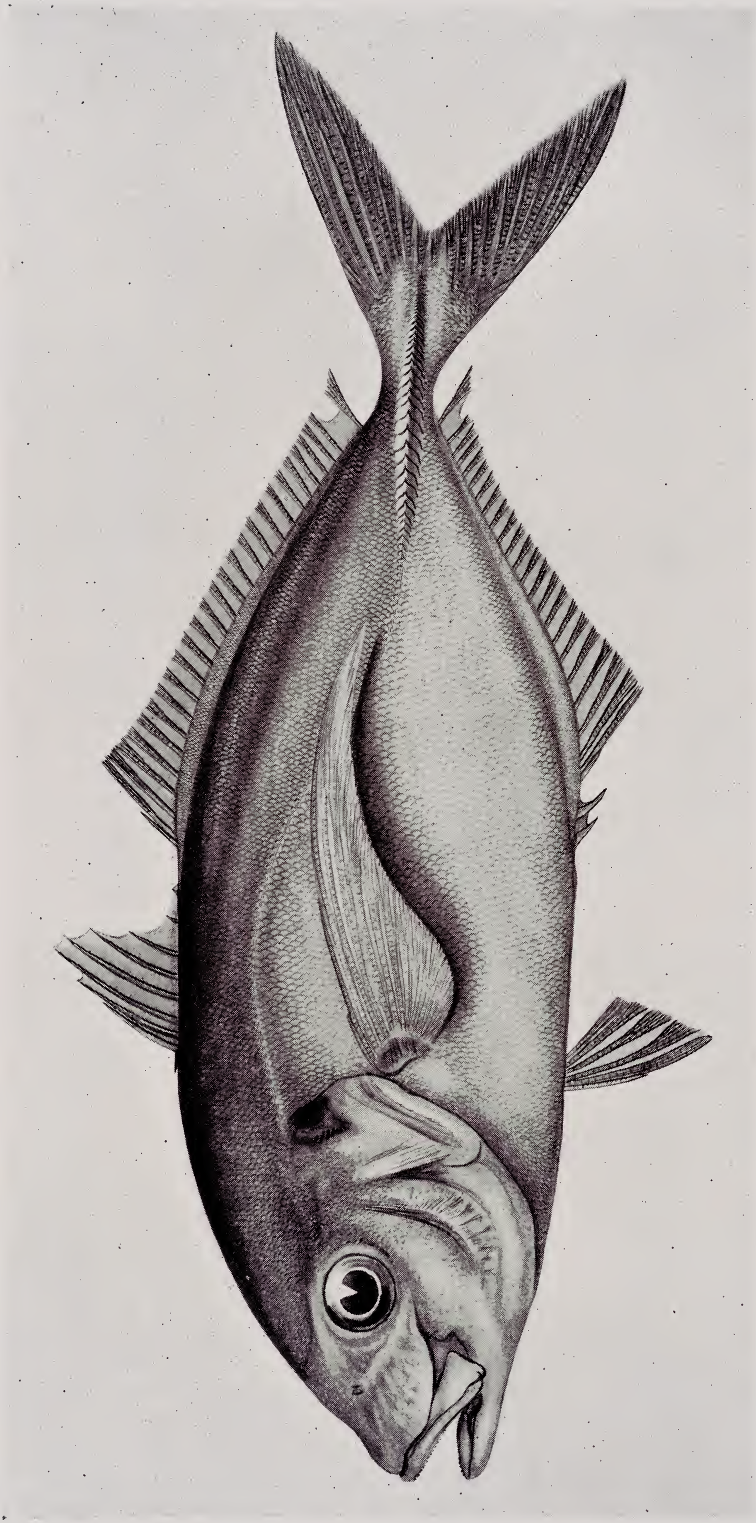
L. T. Griffin, del.]



L. T. Griffin, del.]

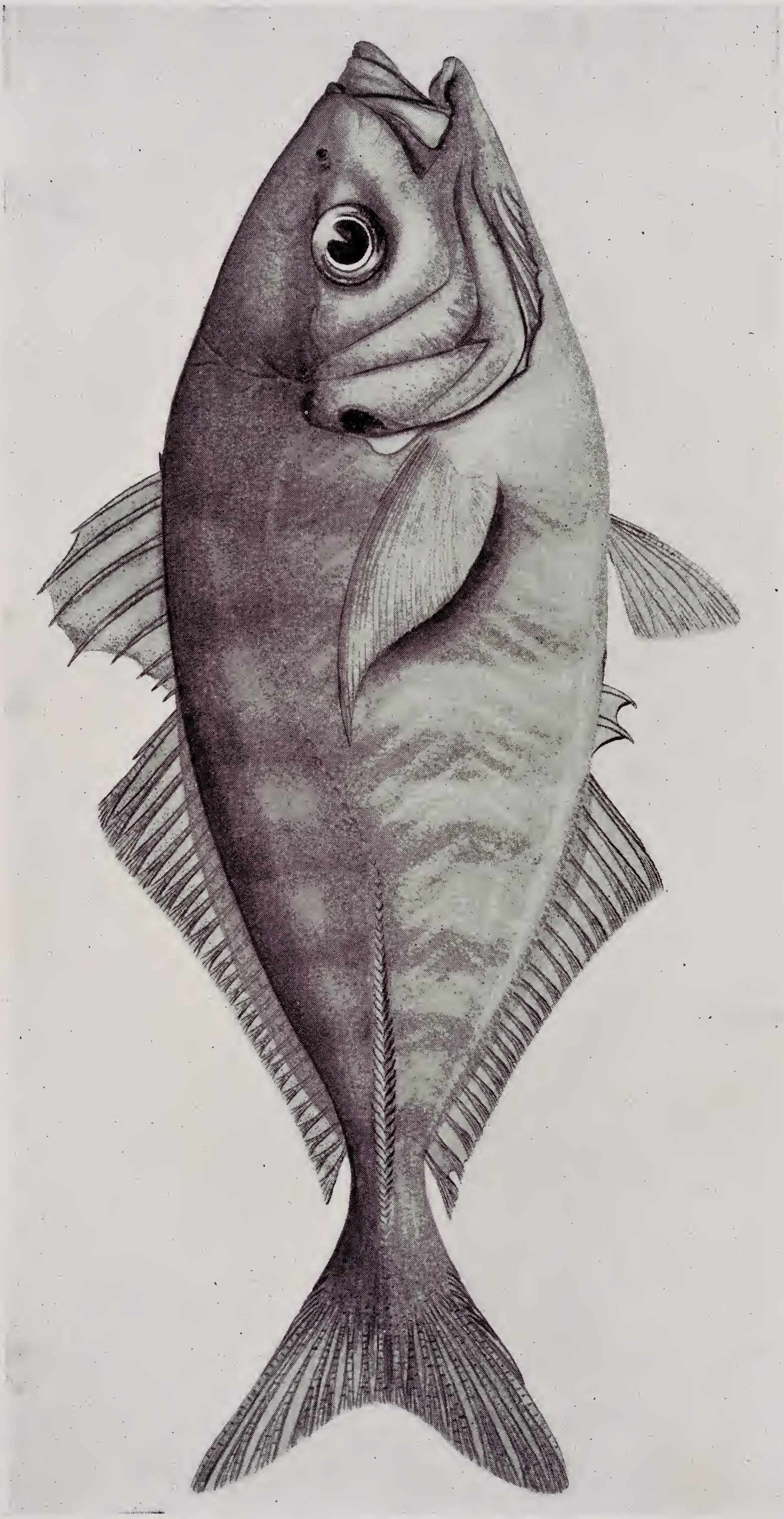
Decapterus koheru (Hector).

Koheru.



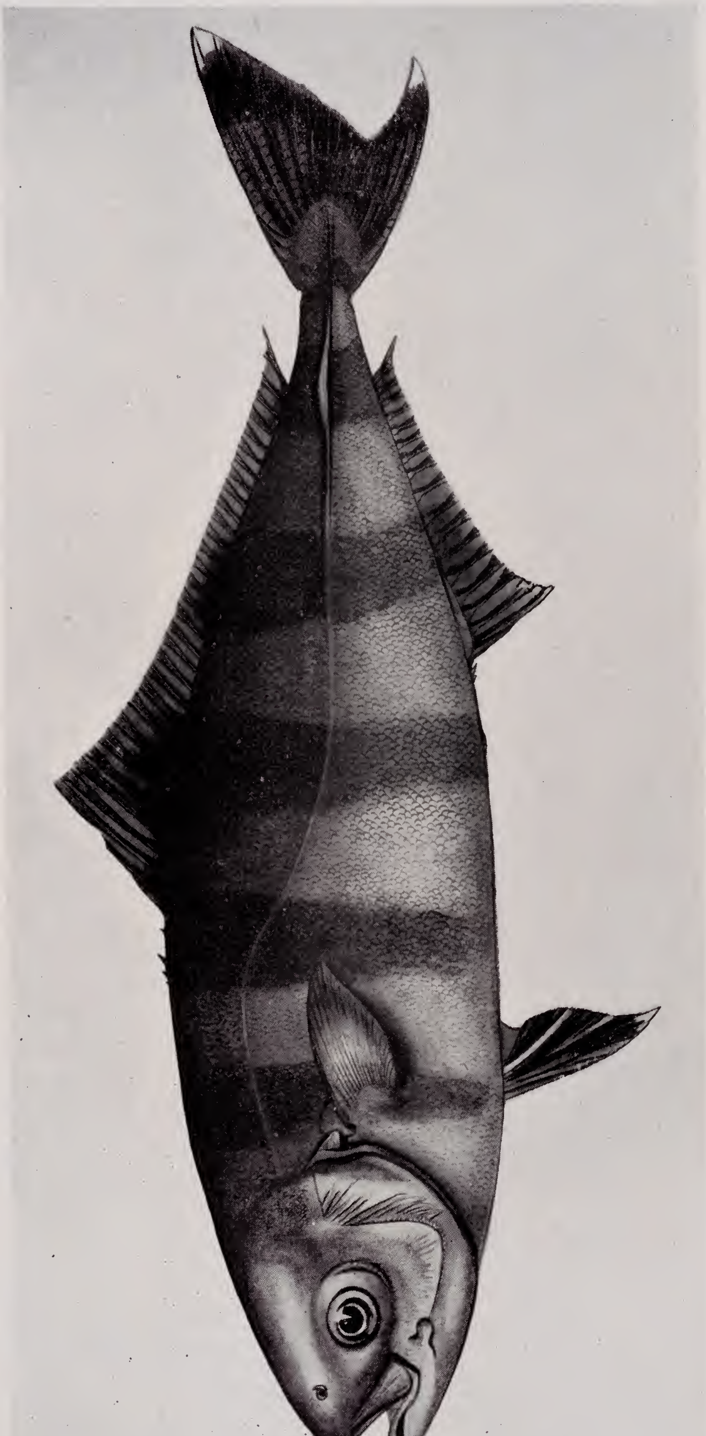
L. T. Griffin, del.]

Usacaranx lutescens (Richardson).
School Trevally; Araara.



Usacaranx archeyi n. sp.

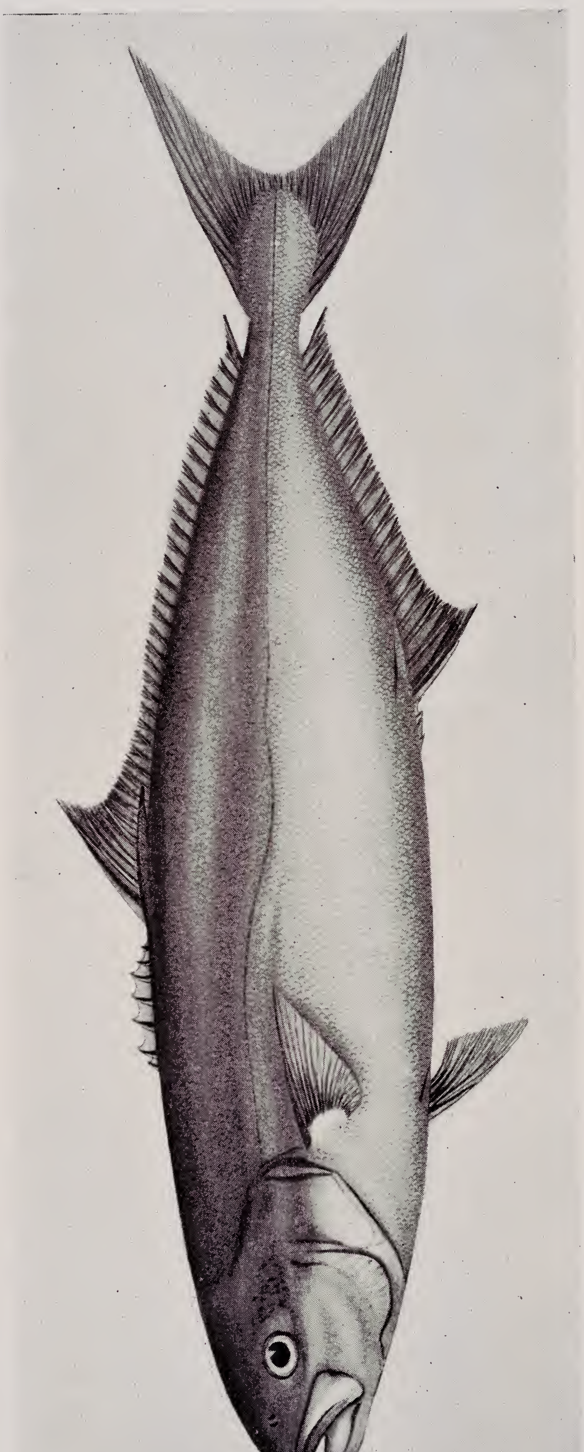
L. T. Griffin, *del.*]



Naucrates angeli Whitley.
Pilot Fish.

L. T. *Griffin, del.*]

PLATE 24.



Regificola grandis Castelnau.

King Fish.

L. T. Griffin, del.]

Notes on a New Collembola from New Zealand.

By E. D. PRITCHARD.

Sub-order	ARTHROPLEONA
Family	ENTOMOBRYIDÆ
Sub-family	ENTOMOBRYINÆ
Genus	ENTOMOBRYA (Rond.)

Entomobrya cuniculicola n. sp.

Length, 1.2 mm. Colour, white with rust-red spotting chiefly on third and fourth segments of abdomen. Fourth abdominal segment 2½ times as long as third. Abdomen with a ventral cavity corresponding with position of spring at rest (Fig. 2). Ciliated bristles, with longitudinal furrow (Fig. 3) occur on all tergites, but especially in transverse rows at occipital region of head and on anterior part of meso-notum.

Antennae (Fig. 4) twice as long as head, and covered with finely-ciliated bristles (Fig. 5). Ratio of antennal segments, 1: 2½: 2: 4.

Ommata and post-antennal organ not apparent in any specimens examined. Head sparsely pigmented. Simple setae at mouth form a conspicuous tuft.

Foot (Figs. 6, 7), with two somewhat similar claws, one very slightly larger than the other. Each with large, lamellate, empodial appendage. Larger claw with a small internal tooth. (Seen in some ventral aspects this claw shows similarity to upper mandible of parrot's beak, and then the internal tooth appears as a separated pair.) A prominent dorsal spur occurs at base of foot claw. Tenant hairs in form of curved pointed bristles without end plates, occur dorsally on each foot. Hind foot with an additional shorter one on ventral surface. Bristles on legs similar to those on antennae, but of stouter form.

Saltatory organ elongated. Dens 1¼ times as long as manubrium, and bearing 40 rough-surfaced corrugations on its dorsal surface (Fig. 8). Mucro consisting of an elongated shank ending in a strong apical claw and a dorsal tooth (Fig. 9). Attendant bristles long and much ciliated. Stout bristles like those of legs occur on manubrium and dens.

Locality. Niger Bay, Onehunga, Auckland, N.Z.

Specimens found in burrows of the larvae of *Melampsalta cingulata,* in uncultivated, scrub-covered land. The first specimens were discovered during August, 1928, and although several other species of collembola have been collected from this locality, the present species seems to be confined to the burrows of this larval cicada.

Owing to the absence of adequate literature, I am unable to discuss profitably the distribution or affinities of this insect. For assistance in securing the available literature I am indebted to Messrs. G. Archey, R. A. Falla, A. W. B. Powell, of the Auckland Museum, and to Mr. W. K. Hounsell, of Auckland.

Type and paratypes in the Auckland War Memorial Museum.

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Folsom. Proc. U.S. Nat. Mus.: 72. Art. 6.

Tillyard, 1925. "Primitive Wingless Insects." *N.Z. Journal of Science and Technology,* vol. 7, No. 5.

Shoebotham, J. W., 1917. "Notes on Collembola—Part 4." *Ann. Mag. Nat. Hist.,* 8th series, vol. 19, p. 425.

Fig. 1. *Entomobrya cuniculicola* n. sp. × 60.
Fig. 2. Ventral surface of abdomen, showing cavity and pigmented areas.
Fig. 3. Bristles from thorax. × 375. (a) Side view. (b) Edge.
Fig. 4. Antennae. × 100.
Fig. 5. Bristle from antenna. × 2,000.
Fig. 6. Fore foot. × 650.
Fig. 7. Hind foot. × 650.
Fig. 8. End of dens, and mucro, showing ventral corrugations.
Fig. 9. End of dens and mucro, side view. × 735.

New Zealand Cormorants in the collection of the Auckland Museum, with notes on field observations.

By R. A. FALLA, M.A., Ornithologist.

(Plates 25-27.)

Lack of sufficiently large and complete series and of reliable field data have hampered all reviewers of the New Zealand *Phalacrocoracidae.* Two recent works, those of Alexander (1928) and Oliver (1930), discuss briefly the relationships of the forms and reach differing conclusions regarding the status of the sub-antarctic forms particularly.

The present paper is mainly descriptive and is based on 81 New Zealand specimens in the collection of the Auckland Museum. Lack of reliable data with many of the older specimens, especially from the sub-antarctic region, and absence of juvenile series in some species, render it inadvisable to discuss relationships at any length, but the records of distribution and variation obtained should make a further contribution to the exact data so necessary for an adequate review of New Zealand cormorants.

For this reason tables of measurements in millimetres have been included under each species discussed. The measurement of the bill has been made in each case with dividers, and represents the chord of the exposed culmen. Other dimensions are also the shortest distance between extreme points, except in the measurement of the wing, where the primaries have been flattened along the rule.

Field observations have been recorded here only where necessary to supplement the existing literature.

Genus Phalacrocorax Brisson.

Phalacrocorax carbo (Linne).

Pelecanus carbo Linne, Syst. Nat., 10th Ed., 133, 1758. Type locality: Sweden.

Carbo carbo steadi, Mathews and Iredale, Ibis 10th series, vol. 1, 1913, p. 411: New Zealand.

Material examined in the collection of Auckland Museum.

No.	Sex.	Locality.	Date.	Wing.	Tail.	Tarsus.	Outer Toe.	Bill.
105.1	immat. ♀	Otago	—	370	167	60	98	66
105.2	ad. ♀	Waikato	—	341	152	54	89	61
105.3	ad. ♂	Motutara	1922	346	155	60	99	61
105.4	immat. ♂	Motutara	—	.357	154	63	101	65
105.5	ad. ♂	Motutara	—	355	157	62	101	63
105.8	ad. ♂	Bay of Islands	—	340	150	58	95	60
105.9	ad. ♂	Waikato	2/11/31	357	150	64	103	68
105.11	ad. ♀	Bay of Islands	25/8/30	340	165	52	100	61
105.13	ad. ♂	Waikato	2/11/31	357	154	60	102	67
105.14	ad. ♂	Tamaki River	5/16	340	150	55	91	59

In describing the New Zealand black shag as *Carbo carbo steadi*, Mathews and Iredale state (1913, p. 411) that it "is easily separable from the typical *C. c. carbo* by the scant white neck feathers of the summer plumage as well as by size; compared with *C. c. novae-hollandiae*, the nearest breeding subspecies of *C. c. carbo*, it is smaller in every dimension. Average measurements *C. c. novae-hollandiae:* culmen 66 mm., wing 345; average measurements *C. c. steadi:* culmen 59 mm., wing 325."

The series tabulated above gives a higher average for both dimensions, viz., culmen 63 mm., wing 350. Nuptial ornamentation is admittedly of short duration, but when fully developed hardly justifies the description "scant." As a contribution to future comparative studies of the forms of *P. carbo* a photograph is here given (Pl. 25, fig. 1) of the head of No. 105.14.

Breeding observations:—Black Shags breed twice a year, laying in May and September. Nuptial plumes would appear to be assumed before both the spring and autumn breeding seasons, for they occur in both August and May birds in the above series. However, among a colony of 35 pairs with fresh eggs in May, observed in 1930 in the Wellington district, not one showed nuptial ornamentation, and only one bird had white thigh patches, showing that either the extra plumes are shed very rapidly or under some circumstances are not assumed at all.

Sub-genus MESOCARBO Mathews and Iredale.

Phalacrocorax (Mesocarbo) ater (Lesson).

Carbo ater Lesson, Traite d'Orn., 8, 604, 1831.

Type locality: Shark Bay, West Australia.

Material in Auckland Museum Collection:—

No.	Sex.	Locality.	Date.	Wing.	Tail.	Tarsus.	Outer Toe.	Bill.
162.1	ad. ♂	Bay of Islands	—	239	118	45	73	47
162.2	ad. ♂	Bay of Islands	—	260	122	45	80	49
162.3	ad. ♂	Bay of Islands	—	257	136	44	76	49.5
162.4	ad.	Bay of Islands	—	237	125	38	74	44
162.5*	juv.	Lake Waikare	2/11/31	198	92	43	82	47

*Pl. 25, fig. 2.

The most interesting specimen in the above series is No. 162.5, a bird not quite fully fledged. Not only is this the first recorded young specimen of the little black shag in New Zealand, but its discovery extends the known breeding range of the species southward by some two hundred miles. It is appropriate that the credit for collecting the bird should belong to Mr. A. T. Pycroft, to whose researches at the Bay of Islands we owe practically all that is recorded of the habits of this shag in New Zealand, and all the specimens in Museum collection. Lake Waikare, in the lower Waikato, is a large fresh water lake surrounded by swamp. The large colonies of shags (mainly *P. carbo)* that nest in the kahikatea trees growing in the swamp are visited annually by shooting parties, who endeavour to destroy the birds in the supposed interests of trout fisheries. In order to obtain specimens, Mr. Pycroft accompanied one such party in November, 1931. Although many birds were shot, he was able to retrieve only three, one of them being the young of *P. ater.* This bird was evidently shot on the nest, for neither wings nor tail are fully grown. Short sooty black down covers the entire body except the face and crown, which are naked, and the wings and scapulars, which are well developed and of the same colour as the adult plumage. The irides were brown, bill and facial skin purple grey, and feet black.

Sub-genus MICROCARBO Bonaparte.

Phalacrocorax (Microcarbo) brevirostris Gould.

Phalacrocorax brevirostris Gould P.Z.S., 1837, p. 26.

Type locality: New Zealand.

Material examined in collection of Auckland Museum:—

No. and Sex.		Locality.	Date.	Wing.	Tail.	Tarsus.	Outer Toe.	Bill.
92.1	♀	Lake Waitakerei	—	235	155	36	66	30
92.2	♂	Dunedin	—	233	156	36	68	32
92.4	♀	Lake Waitakerei	—	234	150	35.5	64	30
92.5	♀	Lake Waitakerei	—	223	162	35	64	30
92.6	♀	Whangaparaoa	27/8/96	225	155	36	66	29.5
92.21	♀	Pokeno	5/07	230	158	36	65	29
92.24	immat.	Bay of Islands	—	230	140	34	63	30.5
92.25	♂	Mercer	2/11/31	228	150	37	67	29.5
92.26		Kereu River	16/11/31	212	153	35	64	30
98.1	♂	Lake Waitakerei	—	240	166	36	66	30.5
98.2	♀	Whangarei	17/8/78	223	143	35	62	30.5
98.3	♀	Lake Waitakerei	11/80	230	152	35	68	29.5

Noticeable features of the above series are the remarkable uniformity in the size of all the birds and the colours of soft parts, and the still more remarkable variation in the disposition of black and white in the plumage. No. 92.23, a nestling not listed above, is half-fledged. Apart from the half grown wings and tail and the bare face, the body is clothed in dark fuscous down. The small tufts of white down along the anterior margin of the wings, mentioned by Buller (1888, p. 172) are also noticeable.

No. 92.24 is an all-dark yearling bird. Head, neck and breast are strongly tinged brown, and the throat feathers are brownish grey.

No. 92.21 has a white throat extending up to the level of the gape. There are plentiful white filoplumes in the neck and a brown tinge throughout the plumage suggesting immaturity.

Nos. 92.1, 92.2 and 92.4 exhibit the facial pattern shown in Plate 26, fig. 1, right, with black ear coverts.

Nos. 92.5, 92.6, 92.25, 92.26 have the head identical with the "little pied" form (Plate 26, fig. 1, left). The white extends irregularly down to the upper part of breast in 92.5 and 92.6.

No. 98.1 agrees with descriptions of the plumage of *P. melanoleucus* (Vieillot) except for scattered black feathers in the thighs.

No. 98.3 just fails to reach the "little pied" condition by having black thighs and a few black feathers on chest and abdomen.

No. 98.2 (Plate 26, figs. 2, 3) is remarkable for the extreme development of white plumage. That it belongs to *P. brevirostris* stock, at least in part, is evident from the thin line of black across the breast. Whatever subsequent investigation discloses with regard to the status of short-billed shags there is no doubt that a strong tendency to whiteness must always be reckoned a factor.

As none of the above can be exactly referred to *P. melanoleucus* (Vieillot) they are here all included under *P. brevirostris* Gould. As the writer has not had an opportunity to examine good series of the supposed *P. melanoleucus* he prefers to make no comment on its status in New Zealand.

Opinion has oscillated as to the status of the small shags of this sub-genus found in New Zealand. Buller (1888, p. 169, and later 1905, p. 43) inclines to the opinion that *P. brevirostris* exhibits a strong tendency to albinism, and that its colours may approximate to the condition of the Australian species *P. melanoleucus* (Vieillot). He admits *P. melanoleucus* as a separate species on specimens exhibiting the frilled condition, due to frontal crest and elongated white feathers on the side of the head. As this condition also occurs in birds of the "white-throated" form (Plate 26, fig. 1, left) this distinction is not tenable. Until recently the published data indicated, although rather imperfectly, that all New Zealand birds were separable from *P. melanoleucus* (Vieillot), as a subspecies with a strong tendency to albinism, and the series here discussed confirms that view.

Oliver (1930, p. 184) has made a good case for the recognition of two species of short-billed shags, *P. melanoleucus* and *P. brevirostris*, and holds that they sometimes cross, producing hybrids of intermediate plumage. In support of this he refers to immature specimens which he examined in Canterbury, in which the undersurface is mottled brown and white. There would seem on the present specimens available no alternative to the conclusion that two or more forms of short-billed shags are recognisable and that they interbreed, but this appears to be the interbreeding merely of phases of a dimorphic or polymorphic species, a condition paralleled in some species of Tubinares, for example, *Puffinus pacificus.* Unfortunately no description exists of the nestling down, and *first* juvenile plumage of the supposed *P. melanoleucus* in New Zealand. The writer has had under observation during the last few years in two localities nests that were destroyed by shooting parties before the eggs hatched.

Habits:—Some observations made by the writer at Slipper Island, Bay of Plenty, on 31st January, 1926, relate to the segregation of the two extreme phases. Associated with a large nesting colony of *Phalacrocorax varius* in pohutukawa trees *(Metrosideros tomentosa)* were four smaller nests containing well grown nestlings with naked heads and uniform dark fuscous down. These were attended and fed by four pairs of "white-throated" birds. In the next tree were three nests of similar size on which "little pied" birds were sitting, mates in similar plumage perching nearby. The nests contained fresh eggs (three in each). These adult "little pied" birds were crested and "frilled," and all six had odd black feathers scattered on lower abdomen and thighs.

Food:—Interesting information as to the food of this species is published by the Marine Department of New Zealand in the report of the Chief Inspector of Fisheries (Hefford, 1931, pp. 27-28). Ten specimens, including both forms, were collected from the tidal estuaries of the Kaipara Harbour on 14th September, 1929. Their stomach contents are listed and include crustacea and fish in equal proportion, with indications that the birds favour fresh water. The stomach of No. 92.25, in the Museum series, shot on the Waikato River at Mercer, contained about ten fresh-water crayfish.

Sub-genus Hypoleucus Reichenbach.

Phalacrocorax (Hypoleucus) varius (Gmelin).

Pelecanus varius Gmelin, Syst. Nat., 1, 576, 1789.

Type locality: Queen Charlotte Sound.

Material examined:—

Collection and Number.	Sex.	Locality.	Date.	Wing.	Tail.	Tarsus.	Outer Toe.	Bill.
Auck. Mus. 100.1	ad.	Whangarei	—	295	140	59	91	66
Auck. Mus. 100.2	juv. ♀	Whangaparaoa	27/8/96	278	140	57	90	61
Auck. Mus. 100.4	ad. ♂	Whangarei	21/8/78	295	133	60	102	69
Auck. Mus. 100.5	juv. ♂	Orakei	1/10/78	280	130	57	88	59.5
Auck. Mus. 100.6	juv. ♂	Whangaparaoa	6/9/96	309	160	65	99	72
Auck. Mus. 100.7	juv. ♂	Whangaparaoa	6/9/96	305	143	62	97	70
Auck. Mus. 100.8	juv.	Hauraki Gulf	—	305	150	62	96	70
Auck. Mus. 100.9	ad. ♂	Hen Island	26/1/32	275	125*	50	85	59
Auck. Mus. 100.10	juv. ♂	T. Bowling Bay	15/2/32	300	135	56	93	71
R.A.F. 54	ad. ♀	Auck. Harbour	21/4/24	278	147	56	82	57
R.A.F. 17	ad. ♀	Hauraki Gulf	15/5/22	274	127	56	92	58
R.A.F. 32	ad. ♀	Auck. Harbour	21/6/24	280	126	58	94	60

*Tail much worn.

The dimensions tabled above indicate a characteristic of this species that is evident in field observations, namely, the variation in size. This has nothing to do with age, nor, apparently, with locality. A size variation in the sexes is, however, suggested by the fact that the average bill measurement of 5 males in the above is 68.3 mm., and of 4 females 59 mm. No. 100.9 is an albino specimen, pure white except for light brown flanks and thighs and a faint stain of brown on hind neck, scapulars and rump. The irides were dull hazel, facial skin flesh colour except for yellow patch in front of the eye; feet brown.

Colours of the soft parts of a normal specimen, an adult female shot on May 30th, 1932, were—smooth loral patch primuline yellow; irides sea green; fleshy ring surrounding the eye viridine green changing to blue near the gape; gape tinged yellow; gular pouch fleshy mauve; bill pale horn, brown on ridge; feet black.

Sub-genus LEUCOCARBO Bonaparte.

The cormorants inhabiting high southern latitudes and grouped in three areas, namely, South America and its sub-antarctic quadrant, the South Indian Ocean, and the sub-antarctic coasts and islands of New Zealand, are generally regarded as distinguishable from other cormorants by well-marked external characters shared by most of them. These characters are the fleshy ring of blue skin surrounding the eye, the frequent presence of dorsal and alar patches of white feathers, the brightly metallic plumage of the upper parts and flesh-coloured feet. This last point, the colouration of the feet, has been a source of much confusion in descriptions, and most published coloured plates are unreliable in this respect. It would now appear that the feet of blue-eyed shags are all some shade of pink in life. It has recently been accurately reproduced by L. H. Matthews (1929, pl. XLVII.) in the case of *P. georgianus*. In dried skins the feet of all the species I have examined dry to a rich orange brown, which is perhaps responsible for the frequent occurrence of "feet orange" in descriptions. Literature of this group by various writers during the nineteenth century is not always reliable, on account of inaccurate determination and lack of comparative material, a disadvantage that still persists to some extent. Hutton (1905) reviewed the New Zealand forms and discussed relationships. Mathews and Iredale (1913) summarise their conclusions in a reference list. Murphy (1916) has discussed the American sub-antarctic forms, giving much valuable field data which can be applied comparatively in a study of other areas, and lately Oliver (1930) has summarised the available information to that date on all New Zealand cormorants. In the following comment is made on all New Zealand forms with the exception of *P. colensoi* and *P. ranfurlyi*, of which there are no specimens in the Auckland Museum collection.

Phalacrocorax carunculatus (Gmelin).

Pelecanus carunculatus Gmelin, Syst. Nat., 576, 1789.

Type locality: Queen Charlotte Sound.

Six specimens from a breeding station at the entrance to Queen Charlotte Sound, collected on 2nd December, 1931, by Mr. D. Perano, have been examined and the following measurements taken in the flesh:—

Number and Sex.			Wing.	Tail.	Tarsus.	Outer Toe and Claw.	Culmen.
106.2	adult	♀	297	120	65	110	62
106.3	adult	♂	313	140	70	120	68
106.4	sub-adult	♂	310	140	70	120	71
106.5	sub-adult	♂	310	130	70	118	72
106.6	sub-adult	♀	300	120	68	118	69
106.7	immature	♂	300	138	62	110	63

Notes on age, plumage and colours of soft parts were made as follows:—

No.	Age.	Condition of Caruncles.	Naked Skin of Face.	Feet.
106.7	Immature	No caruncles	Dull fleshy pink, including eyelids	Fleshy white with tinge of pink
106.6	Sub-adult	No caruncles	Eyelid slate blue, face dull red brown, chin dary slate grey	As above
106.5	Sub-adult	No caruncles	As last. A tinge of yellow at gape	As above
106.4	Sub-adult	Very small	Skin of face red-brown. Eyelids slate blue. Gular pouch dark slate grey	As above
106.2	Adult	Well developed crimson and orange	As in last, but colours deeper.	As above, slightly stained with brown on webs and joints
106.3	Adult	As last, but carunclated patch smaller	As last	As above

The specimens having been frozen, flesh colours given may not be quite accurate. The series illustrates the successive changes of plumage with age. No. 106.7 is a bird of the year and shows no sign of moult, which is in progress in all the others.

The abrasion and fading to which a first plumage is quickly liable is much in evidence. The general disposition of coloured and white plumage is similar to the adult (Pl. 27), but the upper parts are dull brown tinged faintly with green on wings and rump, and faded almost white on lesser wing coverts, scapulars, mid-dorsal region and tail. With the exception of the tail these are areas that subsequently carry pure white feathers in the adult plumage.

In No. 106.6, undergoing a renewal of plumage, bronze green feathers are replacing the brown. The faded brown primaries and lesser coverts of the first plumage are still present, but amongst the latter some pure white feathers of the alar bar are beginning to show. A few white feathers have also appeared mid-dorsally. The colours of the naked skin of the face, described in the table above, are rather duller than those of fully adult birds.

No. 106.2, an adult female, has the brightest plumage and the largest patch of caruncles in the series. The bronze green of the upper parts is strongly metallic, with a tinge of purple in the feathers of cheek shoulders and scapulars. The white dorsal patch is broken, and does not show when the wings are folded.

No. 106.3, the specimen figured in Plate 27, is an adult male similar in plumage to the last. His smaller caruncles and some non-metallic brown feathers in the forehead indicate that he is a younger bird than 106.2.

A feature of the plumage of all the adult and sub-adult birds, traceable even in the youngest, is the presence of irregular patches of white feathers among the outer scapulars, clearly seen in the specimen figured. This character is mentioned by Buller (1876), but appears to have been overlooked by later writers in their descriptions of specific characters. It is, however, the only constant character separating *P. carunculatus* from the series of *P. huttoni* in the museum collection. The large size development of nasal caruncle and colour of upper parts mentioned by Oliver as distinctive can all be matched by some specimens of *P. huttoni* now before me.

Breeding Season: Mr. D. Perano, who collected the birds on 2nd December, informs me that at that time none of the nests were occupied, and that specimen No. 106.7 was the youngest bird he could see. All the adult birds were in moult and not in breeding condition. Captain Fairchild is quoted by Buller (1905, p. 27) as having collected fledglings in the middle of July from the same nesting place, so that a winter breeding season is evidently here the rule, with occasional later laying.

It should be noted that the White Rocks, one of the last known nesting places of this rare and distinctive bird, are situated not in the sheltered waters of Queen Charlotte Sound, but in an exposed situation at the entrance. The birds are poor flyers, and, according to Mr. Perano, when they fly off the rock almost invariably strike the water before getting properly under way.

Food: Examination of the stomach contents of the series described above disclosed portions of crayfish, large crabs, and remains of a small red rock fish. At this season of the year, therefore, food is evidently obtained by diving in the close neighbourhood of the home rocks.

The old sealers' name, "King Shag," still used in the Sounds, should be in more general popular use for this magnificent bird.

Phalacrocorax huttoni Buller.

Phalacrocorax huttoni Buller, Birds N.Z., 2nd Ed., 2, p. 174, 1888.

Type locality: Dunedin.

Particulars and dimensions of specimens in the Auckland Museum collection as follows:—

No. and Sex.		Locality and Date.	Wing.	Tail.	Tarsus.	Outer Toe.	Culmen.
1165.1	♂	Seal Rks., Foveaux Strait, 21/9/30	275	125	56	105	56
1165.2	♀	Seal Rks., Foveaux Strait, 21/9/30	283	110	57	103	51
1165.3	♀	Seal Rks., Foveaux Strait, 21/9/30	285	109	58	105	54
1165.4	♀	Seal Rks., Foveaux Strait, 21/9/30	286	117	57	103	55
1165.5	♀	Stewart Island	301	121	55	110	61
1165.6	♀	"Otago," July, 1896	277	122	59	101	51
1165.7	♂	"Otago," July, 1896	260	116	57	106	53
1165.8	♂	Cape Saunders, Otago	330	140	68	120	63

The flesh colours have not been noted, but in dried skins they appear similar to *P. carunculatus*. All are adult birds and show alar bars of white. In the matter of dorsal patches, crests and caruncles, they show some variation, indicated in the following table: —

No. and Sex.	Carunculation.	Dorsal Patch.	Crest.
1165.1	Small red papillae	Irregular and broken	Small
1165.2	Small orange papillae	Absent	Medium
1165.3	Small red papillae	Absent	Small
1165.4	None visible	Absent	Small
1165.5	Cluster of red papillae	35mm. wide	Small
1165.6	None visible	One white feather	Medium
1165.7	None visible	Irregular	Medium
1165.8	Large cluster orange red	Narrow	Conspicuous. 55mm. long

Number 1165.8 is a remarkable bird, reaching the average size of *P. carunculatus* in all dimensions, and differing in appearance from that species only in his conspicuous crest and absence of white scapulars. His cluster of caruncles does not equal the strong development found in some specimens of *P. carunculatus*, but it is a difference of degree only, and not sufficient to justify the artificial separation of these two species into sections arbitrarily designated "caranculated" and "non-carunculated," as suggested by Hutton (1905, p. 276) and Oliver (1930, p. 191). The series representing these two species show indications of close affinity, and a subsequent reviewer with enough material to group all sub-antarctic shags in a classification indicating relationships may well find it possible to relate these two subspecifically.

In general it may be said that *P. huttoni* differs from *P. carunculatus* in its average smaller size, tendency to bluish purple on thighs instead of bluish green (this is not uniform), development of a crest, weaker caranculation, and absence of white scapular patches, but that in all or any of these characters except the last, odd specimens may approximate to the condition of *P. carunculatus*. It is noteworthy that the bird number 1165.8 described as resembling *P. carunculatus* was collected at the point (Cape Saunders) where the range of *P. huttoni* approaches nearest to the range of *P. carunculatus* (Marlborough Sounds).

Breeding season: A young bird in the collection (No. 1165.9) was taken at Cape Saunders in November, 1885. It is fully fledged except on neck and throat, where the down is thick, and wisps of down on breast and flanks.

Fledgling plumage: The thick secondary down covering the neck and throat of the specimen (No. 1165.9) just mentioned is smoky brown in colour, with tufts and filoplumes of white interspersed both back and front. The wisps of down still adhering to the underparts are mainly brown; a few are white. This is almost exactly the condition of a fledging, *P. georgicus*, seven weeks old, described and figured by Murphy (1916, pp. 38-39). It also agrees with Buller's description of a fledgling *P. carunculatus* (1888, II., p. 155). Moreover, a fledgling of *P. onslowi*, described later in this paper, is of apparently the same age, and is exactly similar except in size. Oliver's description of the nestling of *P. huttoni* (1930, p. 191), "covered with black down, sometimes white on the underparts," could not be accurately applied to the condition here described. The fresh feathers of the first teleoptile plumage are brown tinged with dull green on mantle, secondaries, rump and thighs.

Phalacrocorax chalconotus (Gray).

Graculus chalconotus Gray, Zool. Erebus and Terror, Birds, 20, 1845.

Type locality: Otago.

Dimensions of specimens in the Auckland Museum are as follows:—

No. and Sex.	Locality and Date.	Wing.	Tail.	Tarsus.	Outer Toe.	Culmen.
99.1 immature	Otago	300	145	56	106	57
99.2 ad. ♀	Otago Heads, June, 1886	311	132	64	118	69
99.4 ad. ♀	Green Island, Otago	306	142	60	117	65
99.5 ad. ♂	Otago, 31/7/96	275	125	62	102	58
99.6 ad.	Otago Heads, June, 1886	300	132	62	103	65
99.7 ad. ♀	Dunedin, July, 1896	285	120	60	104	58
99.8 ad. ♂	Seal Rks., Foveaux Strait, 21/9/30	295	115*	58	111	58
99.9 ad. ♀	Seal Rks., Foveaux Strait, 21/9/30	295	110*	57	106	57
99.10 ad. ♂	Seal Rks., Foveaux Strait, 21/9/30	285	113*	56	98	53
99.11 ad.	Seal Rks., Foveaux Strait, 21/9/30	280	105*	54	104	54

*The birds from Seal Rocks, taken when the breeding season was already well advanced, have tails much shortened through abrasion.

Condition of crests and extent of carunculation is as follows:—

No. 99.2	Crest long (45 mm.)	Conspicuous cluster of small red caruncles.
99.4	No crest	Cluster of small red papillae.
99.5	Medium crest	No papillae visible.
99.6	Crest long	A few yellow caruncles.
99.7	Small crest	No papillae visible.
99.8	Small crest	No papillae visible.
99.9	Medium crest	A few small yellow papillae.
99.10	Small crest	A few small yellow papillae.
99.11	No crest	A few small red papillae.

The whole series is remarkably uniform in plumage and shows no variation from the conditions already well described in the literature of the species. Colours of soft parts as far as can be judged by comparing dried specimens are exactly as in *P. huttoni.* A further correspondence between these two species is to be noted in the fact that in both the largest birds and birds showing distinct carunculation, are from Otago Peninsula, the most northerly point in their co-extensive range. It is to be remarked also that the two birds in the most perfect plumage, with long crests, and visible though small clusters of caruncles, were collected at Otago Heads in the mid-winter month of June.

Phalacrocorax onslowi Forbes.

Phalacrocorax onslowi Forbes, Ibis 1893, p. 533.

Phalacrocorax rothschildi Forbes, Ibis, 1893, p. 537.

Type locality: Chatham Islands.

There is only one specimen in the Auckland Museum collection, but I have been able, by courtesy of Professor Speight, to examine four more from Canterbury Museum, including two fledglings. The older birds give the following dimensions:—

Number and Sex.			Date.	Wing.	Tail.	Tarsus.	Outer Toe.	Culmen.
Auck. Mus.	163.1	adult	—	285	118	55	109	52
Cant. Mus.	01172.13	ad. ♀	22/12/23	278	115	56	112	56
Cant. Mus.	01172.12	immat.	22/12/23	274	133	60	118	54

All are from Chatham Islands. No. 01172.12 is fully fledged except for wisps of down still adhering to throat and fore-neck. Two other fledglings (Nos. 01172.9 and 01172.10) are younger and still densely clothed on throat and pileum with thick smoky brown down, in which are mixed soft filoplumes of white. In all three young birds the first plumage visible is coloured as follows: Upper parts dull brown tinged with green except on the lesser wing coverts, which are pale brown. Rump and thighs a mixture of dark brown and blackish green. Underparts white, as in adult. Colours of the soft parts at all stages have been given by Archey and Lindsay (1924, p. 192).

It should be noted that the green tinge in the fresh juvenile plumage of all sub-antarctic shags is subject to such rapid fading that a bird may appear entirely brown above, without a trace of green, just before its first moult.

That the white dorsal patch may be post-nuptial in adults is suggested by the fact that it is absent in the glossy crested adult (No. 163.1, Auckland Museum), but fairly well developed in the December adult (No. 01172.13, Canterbury Museum), which has lost its crest. An unpublished photograph of a group taken in March shows a number of birds with the dorsal patch. An immature bird in the collection of Mr. A. C. O'Connor has the brown on both sides of the neck, almost meeting on the fore-neck. The continuity of white from chin to tail is, however, not actually broken.

Since writing the above I have received on loan from the Dominion Museum, Wellington, by courtesy of Mr. W. R. B. Oliver, the bird that is the basis of his remark (Oliver 1930, p. 189), under heading "Immature," that "the dark colour may extend across the neck even in birds in which the head is steel blue." This bird is labelled "Chatham Islands," without further data. It does not show any signs of immaturity, having, indeed, glossy adult plumage and the well-developed crest that is pre-nuptial in all blue-eyed shags that have a crest at all. The steel blue colour extends in a narrow (15 mm.) band across the fore-neck as in *P. campbelli*, with scattered white feathers down the mid-line. It has a broad white alar bar, no dorsal patch and no sign of caranculation; the loral space being thinly feathered. Its dimensions are—wing 267, tail 105, tarsus 55, outer toe 101, bill 47 mm.

This specimen introduces a disturbing element into discussions of the status of *P. onslowi.* If the locality given on the label is correct, we have to consider alternative explanations.

(1) That two species of blue-eyed shags inhabit the Chatham Islands, as Forbes evidently thought (1893, p. 539), but failed to make clear. This bird exhibits some of the characters of both *P. campbelli* and *P. colensoi,* and is nearest to the former.

(2) That the species inhabiting Chatham Islands is so variable in size and plumage that the specific distinction between *P. onslowi* and other shags in the adjacent area breaks down.

In the absence of supporting data it is safer to assume that a mistake has been made in labelling this specimen "Chatham Islands."*

Phalacrocorax campbelli (Filhol).

Urile campbelli Filhol, Bull. Soc. Philom, 2, 132, 1878.

Type locality: Campbell Island.

There is only one labelled skin in the collection, that of a male bird collected by A. Reischek at Campbell Island on 30th January, 1888. The plumage is dull and does not appear to be fully adult. The glossy dark plumage of head, neck all round, rump and thighs, is dull indigo, greenish on the side of the head, oil green on shoulders and scapulars. The only sign of white on the lesser wing coverts is a solitary feather on the right wing. Of the feathers on the gular pouch, the first few, from the apex of the strip for a distance of 6 millimetres are dark; the rest, extending over the throat, are white. A solitary dark feather also shows in the breast an inch or so below the dark patch of the foreneck. Colours of soft parts are not determinable. Dimensions—wing 272, tail 114, tarsus 57, outer toe 96, bill 50 millimetres.

Another bird undoubtedly of this species is unfortunately without any data whatsoever. It is remarkable for the brilliant lustre of its dark plumage and bushy crest, of which the longest feathers are 60 mm. The white alar bar is narrow, and there is no sign of dorsal patch. Dimensions—wing 270, tail 120, tarsus 52, outer toe 94, bill 48.

Genus Stictocarbo Bonaparte.

Stictocarbo punctatus (Sparrman).

Pelecanus punctatus Sparrman, Mus. Carls., fasc. 1, No. X., 1786.

Type locality: Queen Charlotte Sound.

*Since the above went to press Mr. Oliver has informed me that the specimen has almost certainly been wrongly labelled.

Material in collection of Auckland Museum:—

No.	Sex.	Locality.	Wing.	Tail.	Tarsus.	Outer Toe.	Bill.
96.1	ad.	Rakino Island	235	83	51	91	63.5
96.3	ad. ♀	Whangaparaoa	230	80	50	83	60
96.4	ad.	Rakino Island	242	93	53	88	62
96.5	juv.	Bay of Islands	234	85	54	84	64
96.70	juv. ♀	Kohimarama	239	82	55	87	63.5
96.71	juv. ♀	Thames	230	73	55	82	62
96.72	ad.	Waiheke	242	87	52	88	62

With one exception (No. 96.5) the specimens listed above are all from the Hauraki Gulf and indicate a uniformity of size and plumage sequences in birds from this area. In the first plumage succeeding the down the upper parts and thighs are ashy brown and the underparts ashy white, the shades merging on the neck. At this stage small filoplumes may be present on neck and thighs, and the feathers of the mantle are dark-spotted at the tips. After the next moult more pronounced spots appear at the tips of upper wing coverts and scapulars, as well as on the mantle, greenish black feathers appear on crown, hind neck and throat, and across the lower ventral surface in line with the thighs, which by this time are oil green, as are also the rump and back. The stripe down the side of the neck remains mottled ashy brown and white until the assumption of the nuptial ornaments consisting of frontal and occipital crests, and extensive series of elongated white feathers of fine texture. These latter overlie the shorter feathers of the sides of the neck and meet on the nape like an erect mane. They also appear more sparsely on the dark foreneck and lower back and thighs. These sporadic white feathers appear to be too highly specialised in structure to come under the accepted definition of filoplumes, being fully equipped with barbs to the base of the shaft. True filoplumes are also present in this nuptial plumage, as in the first teleoptile plumage of the young bird.

The progressive extermination of this species in the Hauraki Gulf has been rapid during the last few years, and the legal protection now afforded by an Order-in-Council published in the N.Z. Gazette of 9th January, 1931, has come none too soon. In 1910 nesting colonies occupied permanent stations in suitable headlands of the islands Tiritiri, the Noises, Rakino, Waiheke, Shag Rock, and islets off Coromandel. More than half of these were deserted by 1920, and others have dwindled rapidly. One has been observed by the writer at intervals since 1923, in which year 100 birds were seen there. In 1925 only 40 remained, in 1928 only 25, and in 1931 none at all. The only colony left on the western side of the Gulf at the present time is in a narrow tunnel that pierces a small islet, and from which the birds rarely emerge. On the west coast of the North Island at Te Henga and Oaia islet are inaccessible colonies of Spotted Shags, but whether of *S. punctatus* or another form I am unable to state.

The similarity between this bird and *Phalacrocorax gaimardi* of Peru extends to the high pitched chirping note exactly like that of a young sparrow. This has been remarked on in the case of the Peruvian bird by Coker (1919, p. 481). Another point in common, a feature observable in the living bird, but disappearing after death, is the beaded surface of the fleshy ring surrounding the eye. Coker notes "16 blue beads surrounding the eye" in *P. gaimardi.* My notes mention a double row of beads of opal blue in a living specimen of *S. punctatus.* Beyond this ring the facial and gular skin is viridine green, paler on the throat. Bill horny white with a dull brown stain on the ridge, irides opal brown, feet Caryta yellow. These colour notes were taken from a second year bird, sexually mature, but not in nuptial plumage.

Breeding habits: Oliver (1930, p. 199) remarks on the evidence of nuptial plumage in Canterbury in August, and his own finding of eggs at Waiheke in January. To this may be added the fact that the cavern-dwelling colony that alone now represents the species on the western side of Hauraki Gulf has for some years past been breeding in mid-winter. Full nuptial plumage is present in most of the birds in May, by the end of which month in 1932 about twenty new nests of green *Mesembryanthemum australe* had been built up, but no eggs laid.

Food: My only records of stomach contents refer to two examples containing respectively reddish crustacean remains (W. Coast, January) and adult anchovies, *Engraulis australis,* (Hauraki Gulf, May).

Stictocarbo featherstoni (Buller).

Phalacrocorax featherstoni Buller, Ibis, 1873, p. 90.

Type locality: Chatham Islands.

Material examined:—

Collection and Number.	Sex.	Locality.	Date.	Wing.	Tail.	Tarsus.	Outer Toe.	Bill.
Auck. Mus. 97.1	♂	Chatham Is.	—	236	95	51	77	52.5
Auck. Mus. 97.2	♀	Chatham Is.	—	230	98	44	78	47
Auck. Mus. 97.3	♂	Chatham Is.	—	242	96.5	48	88	55
Auck. Mus. 97.4		Chatham Is.	—	227	90	50	81	49

The specimens here listed are all adult and in full crest. A longer bill in the male is indicated by the measurements.

Stictocarbo steadi Oliver.

Stictocarbo steadi Oliver, Trans. N.Z. Inst., 61, 138, 1930.

Type locality: Otago.

The only specimen in the collection of the Auckland Museum is a female collected at Stewart Island in December by Mr. E. F. Stead. It is not in breeding plumage, and possibly not fully mature, as the dark throat is flecked with pale grey, and the white neck stripe is also broken with darker feathers. It has no crests. The neutral grey of the under-parts corresponds to the shade found in *S. featherstoni*, that is, the light neutral grey of Ridgway's Standards, rather than to the pale neutral grey found in *S. punctatus*. The shoulders, mantle, and upper surface of the wings are greyish brown glossed with green, identical in this respect also with *S. featherstoni*.

In a living or freshly killed specimen the opal blue skin surrounding the eye is beaded, sixteen such "beads" being counted in the bird described above. Its dimensions are: Wing 234 mm., tail 85, tarsus 51, outer toe 84, bill 55.

Except for the narrow white neck stripe which links it to *S. punctatus*, the plumage of this single specimen shows closer affinities with *S. featherstoni* than with the northern series of *S. punctatus* available for comparison.

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2

Fig. 1. Head of *Phalacrocorax carbo*.
Fig. 2. Fledgling *Phalacrocorax ater*.

PLATE 26.

1

2

3

Fig. 1. Left: Adult *P. brevirostris*. Centre: Immature *P. brevirostris*. Right: Adult *P. brevirostris*.
Fig. 2. Dorsal view of abnormal *P. brevirostris*.
Fig. 3. Ventral view of abnormal *P. brevirostris*.

PLATE 27.

1

Phalacrocorax carunculatus, showing usual white patches.

2

Phalacrocorax carunculatus.

The Paryphantidae of New Zealand.

Descriptions of Further New Species.

By A. W. B. POWELL, Conchologist and Palaeontologist.

(Plate 28.)

In the first issue of these "Records" the writer published a review of the New Zealand members of the *Paryphantidae*, a family of large carnivorous land snails. In that paper it was shown that the localisation of the rather numerous species and subspecies was directly due to isolation, brought about by past and present topographic features. It was pointed out that many of these snails restrict themselves to high altitudes, and, in consequence, colonies on one mountain system are often effectively isolated from those inhabiting other systems, and so divergence takes place.

Since the publication of the first paper, two more new species of *Paryphanta* have been discovered, and these considerably extend the known range of the genus. One, from East Dome, Southland, extends the southern range by over two hundred miles, while the finding, on the Ruahine Range, in the North Island, of a new species of the *hochstetteri* series is also of considerable importance. The allied genus, *Rhytida*, has had one addition, with the discovery of a new species on the Poor Knights Islands.

Descriptions of these new species of *Paryphanta* and *Rhytida* are given herein, together with some further locality records of previously described species.

ACKNOWLEDGMENTS.

The writer is deeply indebted to Professor W. B. Benham for granting permission to describe the Southland species, to Messrs. E. A. Marchant, James Grant and W. R. B. Oliver, in connection with the Ruahine species, and to Mr. A. T. Pycroft for the Poor Knights Island *Rhytida*. For carrying out valuable field investigations on the Whakamarama Range, West Nelson, the writer's thanks are due to Mr. E. B. Langford, of Bainham, and for specimens and important locality records to Messrs. R. E. Clouston and L. J. Dumbleton.

Rhytida duplicata Suter.

1904. *Rhytida duplicata* Suter. Proc. Malac. Soc. vol. 6, p. 155, figs. 1-3.

Although the bleached shells of this species are common along the Far Northern Coast, in most of the subrecent consolidated dunes, it was not until recently that living specimens were found. Apparently *duplicata* is peculiar to the "Far Northern Block," for it has not been found south of Parengarenga Harbour, either living or subrecent.

Living specimens of this species were collected by the writer last February, on a forested ridge near Unuwhao (1063′), which is situated between Spirits Bay and Tom Bowling Bay. Other living specimens were found at the same time, by Mr. R. A. Falla; these came from further east, in a precipitous ravine near North Cape.

The colour of the fresh shells is a uniform ochreous-brown, and they were found living on the ground under masses of decaying leaves.

Dentition: (Text. Fig. 4). Formula, 15 + 1 + 15. Outermost lateral tooth small and rudimentary, next three increasing rapidly, followed by the fifth tooth, which is the largest and most massive, after which the remaining teeth gradually diminish in size towards the middle. Central tooth about two-thirds the size of the adjacent laterals.

Rhytida pycrofti n. sp. Pl. 28, fig. 7, and text figs. 1 and 2.

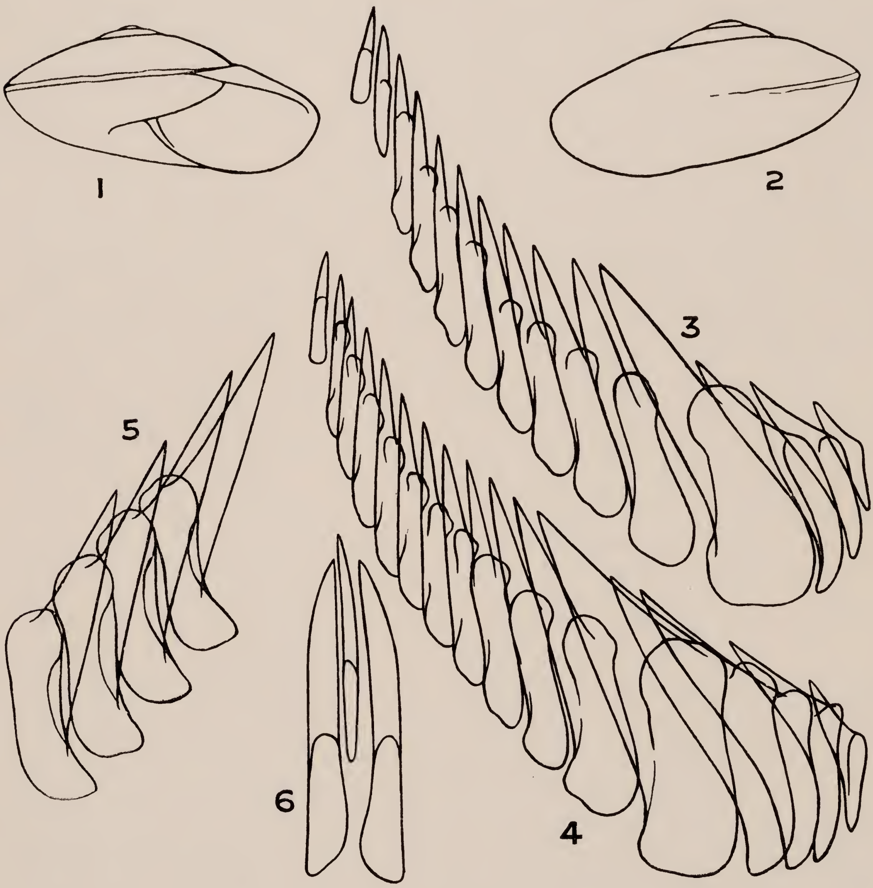
This species occurs at the Poor Knights Islands, off the eastern coast of the North Auckland Peninsula, and it belongs to the *dunniae* series, which includes also the species *tarangaensis* Powell 1930, Hen Island; *duplicata* Suter 1904, northernmost New Zealand; and *dunniae* (Gray, 1840), from Kaitaia, North Auckland to Thames.

The Hen Island species, *tarangaensis,* and the new species, *pycrofti,* are very good examples of new forms which have originated through long isolation from the mainland stock.

The same may be said of the Far Northern *duplicata,* which is just as characteristic of the block to the north of the sandy waste stretching from near Parengarenga to Awanui, as *dunniae* is to the lower portion of the Peninsula, from Kaitaia, southward. In this latter instance, although the respective areas occupied by *duplicata* and *dunniae* are connected as dry land, isolation obtains owing to the sterility of the connecting country, which is not forested and is for the most part a waste of drifting sand. These conditions must have existed for a considerable time, for *duplicata* is a common fossil, and the only *Rhytida* present in the Far Northern consolidated dunes, and, similarly, at Doubtless Bay, *dunniae* is the only *Rhytida* found there in the sub-recent dunes. In both areas "moa" remains are found associated with the fossil snails.

Description of new species:—

Shell superficially very similar to that of *dunniae,* except that the peripheral keel almost fades out on the last half of the body-whorl. The most striking difference, however, is in the dorsal sculpture of the two species. That of *dunniae* (Pl. 28, fig. 6) consists of radiate obliquely-retractive wrinkles, which are so broken and irregular that they give a malleated appearance to the surface, whereas in *pycrofti* (Pl. 28, fig. 7) the radials are mostly entire and evenly arcuate, with only a slight tendency to anastomose. Size, number of whorls, colour, and other shell features, unless otherwise stated above, are identical in the two species. The sculpture in *pycrofti* is nearest to that of the Hen Island, *tarangaensis*, but that species differs considerably in shape, height of spire, size of the umbilicus, and in the dentition.



Figs. 1 and 2. *Rhytida pycrofti* n. sp. (holotype). × 1½.
Fig. 3. *Rhytida pycrofti* n. sp. Dentition. × 100.
Fig. 4. *Rhytida duplicata* Suter. Dentition (Unuwhao specimen). × 100.
Fig. 5. *Paryphanta marchanti* n. sp. Dentition, laterals. × 100.
Fig. 6. *Paryphanta marchanti* n. sp. Dentition, central and adjacent laterals. × 100.

Dentition: (Text fig. 3.) Formula, 13 + 1 + 13. Outermost lateral tooth small, rudimentary, next two increasing in size, followed by the fourth, which is the largest and most massive, after which the teeth gradually diminish towards the middle. Central tooth very little smaller than adjacent laterals.

Dimensions of shell:—

Major Diameter.	Minimum Diameter.	Height.	
24.5 mm.	20 mm.	12 mm.	(holotype)
25.0 mm.	20.5 mm.	12.25 mm.	(paratype)
24.75 mm.	20.4 mm.	13 mm.	(paratype)
25.0 mm.	20 mm.	12 mm.	(*dunniae*, Whangarei)
24.5 mm.	20 mm.	12 mm.	(*dunniae*, Whangarei)
31.0 mm.	24.5 mm.	19.5 mm.	(*tarangaensis*)

Holotype in Auckland Museum.

Habitat: Poor Knights Islands, N.Z. Collected by Mr. A. T. Pycroft, 1932.

Genus PARYPHANTA Albers 1850.

Type: *Nanina busbyi* Gray.

Paryphanta marchanti n. sp. Pl. 28, figs. 1 and 2.

Shell of about the same size as *hochstetteri bicolor,* to which it is nearest allied, but differing from that species in having the base entirely without colour bands or zones, and in the parietal callus being pale grey. In *hochstetteri, hochstetteri obscura, hochstetteri bicolor* and in *traversi* the parietal callus is dark purplish-brown. Whorls 5¼, rather slowly increasing. Dorsal surface to periphery finely striated, ventral surface smooth and polished. Protoconch of two moderately broad flattened whorls, which are irregularly sculptured with faint axial folds and a few microscopic spiral striations. On the first post-nuclear whorl, spiral striae separate the dorsal sculpture into six spiral series of roughly chevron-shaped axial striations. On the remaining whorls this dorsal sculpture becomes a mass of irregularly anastomosing striations. Umbilicus about one seventh major diameter of base. Colour of shell yellowish-brown; protoconch pale yellowish, parietal callus pale grey, interior of aperture dark grey. Dorsal surface of shell faintly spirally banded and lined with darker brown. The holotype has two narrow bands at the periphery, four lines immediately below it and about six faint lines between the peripheral bands and the upper suture. The paratypes are variously marked, but all have a few distinct colour bands at the periphery and indistinct colour lines above. Ventral surface of shell uniformly yellowish-brown, except for a slightly darker gradation of colour towards and within the umbilicus.

The shell proportions are as in typical *hochstetteri,* i.e., "Type A." (Powell, 1930, p. 34.). The only other *Paryphanta,* allied to the *hochstetteri* series, at present known from the North Island, is *traversi.* This species is found in the low country around Levin, but it has the shell proportions of "Type B," so, obviously, it has no close relationship with *marchanti.*

Major diameter, 52 mm.; minimum diameter, 43 mm.; height, 28 mm. (holotype).

Holotype presented to Auckland Museum by Mr. E. A. Marchant, of Wanganui. Paratypes in Wanganui and Dominion Museums.

Habitat: Mokai-Patea trig station, 3,600 ft., near junction of Mangatera Stream with Rangitikei River, Ruahine Range, North Island. Collected by Mr. E. A. Marchant, February, 1932.

Dentition: (Text figs. 5 and 6.) Formula, 57 + 1 + 57. Central tooth considerably smaller and more slender than innermost laterals. Lateral teeth very similar to those of *hochstetteri.* The specimen from which the radula was extracted was only about half grown, hence the formula of an adult specimen may be found to have slightly more teeth.

The finding of a *Paryphanta* of the *hochstetteri* type, on the Ruahine Range, comes as a surprise, particularly as species of that genus appear to be absent from the Tararua and Rimutaka mountain systems. As mentioned above, *P. hochstetteri bicolor* is the nearest relative to the Ruahine species, and it is restricted to the mountainous country of the Eastern Marlborough Sounds.

The species is named after the late Mr. J. W. A. Marchant, father of Mr. E. A. Marchant.

Paryphanta spedeni n. sp. Pl. 28, figs. 3, 4, 5.

Shell sub-globose, moderately large, narrowly umbilicate; smooth and polished below periphery and faintly striated above. Colour mostly dark greenish-brown, irregularly axially streaked with darker greenish-brown bands, which are co-incident with the rest periods in the shell. The protoconch is pale yellowish, and the dorsal surface of the body-whorl has a slightly reddish-brown tone, predominant over the normal greenish-brown of the rest of the shell. Shell substance thin, composed almost entirely of conchin. Whorls rapidly increasing, $4\frac{1}{2}$, including protoconch of $1\frac{1}{2}$ flattened, almost smooth whorls. At a magnification of X 12, the protoconch is seen to be sculptured with exceedingly fine axial striations, which are crossed by irregular and equally fine spiral striations. On the succeeding whorl and a-half, the sculpture consists of definite closely spaced axial striations, which are broken up by smooth spiral interspaces, into about ten narrow spiral series.

On the remaining whorls the axials link up in a complex pattern of chevron-shaped striations. This dorsal sculpture terminates at about the periphery, the lower surface being smooth and polished. Spire slightly raised, rounded, about one third height of aperture. Umbilicus small, deep, about one-eleventh major diameter of base. Peristome discontinuous, thin, advanced above and overhanging the basal portion. Parietal wall with a very thin veneer of callus, bearing scattered, exceedingly fine granules, which are not nearly so prominent as those in *gilliesi.*

Major diameter (estimated), 36 mm.; minimum diameter, 30 mm.; height, 25 mm. (holotype).

Holotype: Presented to Auckland Museum by Professor W. B. Benham.

Habitat: On East Dome, at 3,000 ft., Garvie Mountains, between Wakaia and Kingston, Southland. Collected by Mr. J. Speden.

In coloration and size this species most closely resembles *P. rossiana* Powell, from Mt. Greenland, Ross, but on shell features, particularly in the shape and the striated dorsal surface, it stands nearest to the West Coast *unicolorata* Powell. The darker coloration, the axial banding, and the more globular shape serve to separate *spedeni* from *unicolorata.*

The finding of this interesting species increases the southern range of the genus by over two hundred miles.

Paryphanta hochstetteri (Pfeiffer).

1862. *Helix hochstetteri* Pfeiffer, *Mal. Bl.,* p. 146.

1930. *Paryphanta hochstetteri* (Pfeiffer), Powell, Rec. Auck. Inst. Mus., vol. I., No. 1, p. 37 (for full synonymy).

The following specimens from localities on the Haupiri Range are no different from the typical species of the adjoining Pikikiruna system:—

(1) Between Snows River and Anatoki River, Haupiri Range, Nelson. Collected by Mr. E. B. Langford.

(2) Headwaters of Anatoki River, Nelson. Collected by Mr. R. E. Clouston.

Paryphanta superba Powell.

1930. *Paryphanta superba* Powell. Rec. Auck. Inst. Mus., vol. I., No. 1, p. 41.

The known range of this species is extended by the following new locality records.

(1) Between Mt. Higgins, 2,972 ft., and Mt. Stevens, 3,800 ft., Whakamarama Range, West Nelson. Collected by Mr. E. B. Langford, 28/3/1932.

(2) On "Karamea Track," at headwaters of Tony Creek, Gouland Downs, at about 2,000 ft. Collected by Mr. L. J. Dumbleton, 26/12/1930.

(3) On "Karamea Track," Weka Creek, Gouland Downs, at about 2,000 ft. Collected by Mr. L. J. Dumbleton, 26/12/1930.

The finding of this species on the Gouland Downs end of the Whakamarama Range is interesting, but not surprising, as one end of this System joins up with the high country of the Downs.

Paryphanta hochstetteri bicolor Powell.

1930. *Paryphanta hochstetteri bicolor* Powell, Rec. Auck. Inst. Mus., vol. 1, No. 1, p. 40.

Further field work during August of this year has furnished additional particulars concerning the distribution of the subspecies *bicolor.* A remarkable fact is that on one small island, Blumine Island (also known as Pig Island and Oruawairau Island), *bicolor,* hitherto not observed living from below 2,000 feet, was found right down to sea level. Blumine Island, which is situated in Queen Charlotte Sound, has a maximum elevation of only 1,023 feet, but it is well watered and the south-eastern portion is covered with a dense coastal vegetation, the dominant plants of which are *mahoe, Melicytus ramiflorus, kohekohe, Dysoxylum spectabile,* sedge, *Uncinia australis,* supple-jack, *Rhipogonum scandens, ponga, Cyathea dealbata, nikau, Rhopalostylis sapida,* and the ferns *Asplenium bulbiferum* and *Blechnum filiforme.**

The Paryphantas were so abundant on this island that the dead shells were to be found everywhere on the ground, and little searching was necessary to locate the live ones, which occurred in great numbers under dead leaves and around the roots of ferns. Even the high-tidal drift-line was strewn with the empty shells washed down by small streams and storm water.

The neighbouring island, Arapawa, has an elevation up to 2,190 feet and there these snails are found also, but local residents report that there are none below 2,000 feet.

Evidently Blumine Island has become detached from Arapawa during a comparatively recent subsidence, and apparently the snails in this case have been required to alter their normal habits owing to lack of the required elevation.

The fact that the island is well watered and also that the coastal forest does not get so dry as in the case of the beech areas has made it a simple matter for these snails to adapt themselves to the new conditions that have been forced upon them.

Mr. D. Perano, of Picton, who informed the writer of the Blumine Island snails, has not seen them living below 2,000 feet at any other locality, nor had the other residents of the district.

Dead shells of *bicolor* were found at a low elevation near Para, on the eastern side of the Tuamarina Valley, Marlborough, but these proved to have been washed down by storm water from higher country at the back.

Paryphanta gilliesi E. A. Smith.

1880. *Paryphanta gilliesi* Smith. Ann. Mag. Nat. Hist., ser. 5, vol. 6, p. 159.

1930. *Paryphanta gilliesi* Smith. Powell, Rec. Auck. Inst. Mus., vol. I., No. 1, p. 44.

Two further locality records of typical *gilliesi* are given below. These indicate that the species is distributed along the entire length of the Whakamarama Range and also over at least part of the Gouland Downs.

As the Gouland Downs are at a moderate elevation, 2,000 to 3,000 feet, they afford intercommunication for several species which have spread from neighbouring mountain systems converging at about this locality.

(1) On saddle between Saxon Creek and headwaters of Bluffy Creek, Gouland Downs, West Nelson. Collected by Mr. L. J. Dumbleton, 25/12/1930.

*Identified by Miss L. M. Cranwell, M.A., Botanist.

(2) Mt. Stevens, Whakamarama Range, at about 3,800 ft., around roots of "tussock." Collected by Mr. E. B. Langford, 28/3/1932.

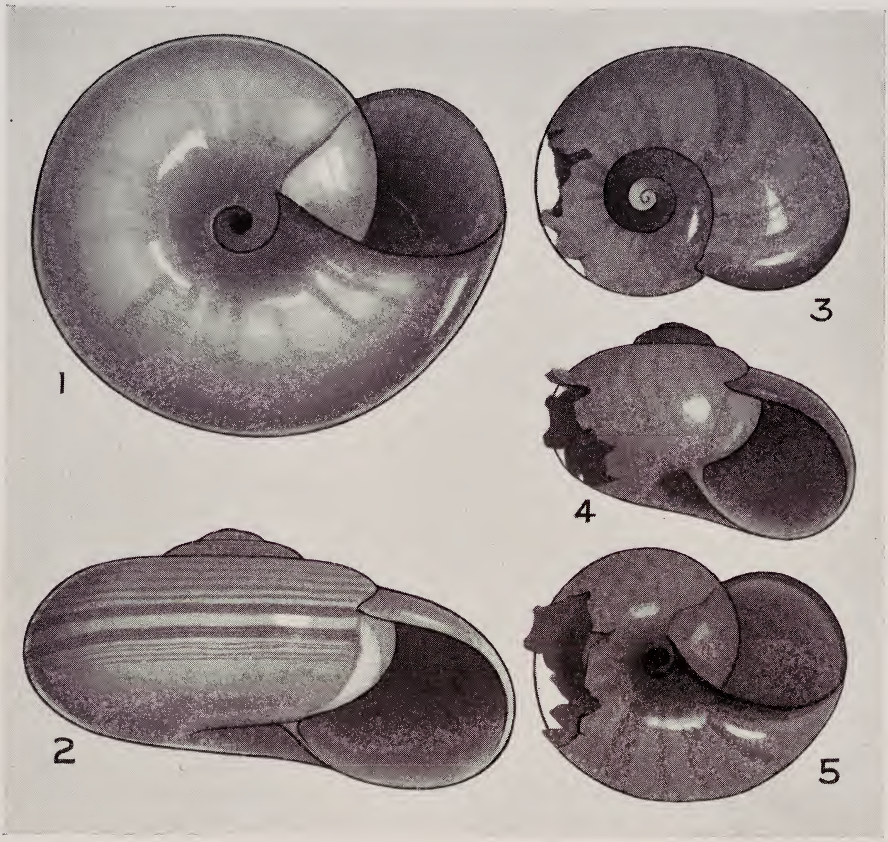
Paryphanta gilliesi (variety A).

1930. *Paryphanta gilliesi* (variety A) Powell, Rec. Auck. Inst. Mus., vol. I., No. 1, p. 46.

At the time this form was described and figured there was some doubt concerning a lot of shells that were stated to have been collected on the Whakamarama Range, West of Bainham. The donor of the West of Bainham specimens, Mr. F. V. Knapp, did not collect the shells himself, and he is unable now to find out if the locality, as originally stated, was correct for all the specimens, but thinks that most likely they were gathered from several localities in the district.

Mr. E. B. Langford, of Bainham, kindly undertook to search the Whakamarama Range, west of his township, and at an altitude of 3,800 ft., on Mt. Stevens, he found a living specimen and some dead shells of *P. gilliesi,* typical, but no specimens of the "variety A."

PLATE 28.



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Figs. 1 and 2. *Paryphanta marchanti* n. sp. (holotype).
Figs. 3, 4, 5. *Paryphanta spedeni* n. sp. (holotype).
Fig. 6. *Rhytida dunniae* (Gray) Whangarei. Photomicrograph of sculpture.
Fig. 7. *Rhytida pycrofti* n. sp. Photomicrograph of sculpture.

Maori Decorated Sinkers.

By V. F. FISHER, Assistant Ethnologist.

(Plates 29 and 30.)

Maori fishing weights or sinkers, whether of the "grooved," "knobbed" or "perforated" types, usually have but little decoration: indeed, those of the two first groups are almost invariably undecorated, while in the perforated sinkers the decoration is usually confined to a few grooves similar to those on the butt of a *patu onewa* or a flax beater *tuki muka.*

A few decorated sinkers have, however, been recorded (Best, 1908, p. 52; 1929, p. 20) and it is the purpose of this paper to describe some of the ornamented fishing weights in the Museum collection, so that the details concerning them may be available for purposes of comparison.

The terminology used is based on that suggested by Linton (1923, p. 333).

Body: The main portion of the sinker, usually rounded in form.

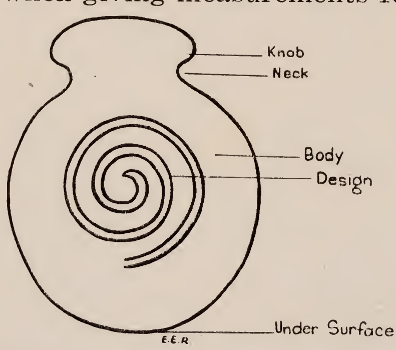
Knob: The top to which the line was attached. It is much smaller than the body, and is frequently perforated.

Neck: The narrow part, where the body meets the knob.

Under Surface: The underneath portion, or base.

Design: Refers to any attempt at decoration.

In using these terms, it will readily be seen that the boundaries between the neck and the knob cannot in many instances be clearly defined. The width at the narrowest part has therefore been chosen when giving measurements for the neck.



Names for Sinkers, or words connected therewith:—

Mahe, maihea, makihea, sinker for a fishing line.

Karihi, sinker attached to the lower end of a drag net.

Kohao or *Kowhao,* hole in the knob.

Whakairo refers to any carved design.

Of the above names, which are quoted from the Maori Dictionary (Williams, 1921) *mahe* is that commonly used in the northern part of the Auckland Peninsula. It has not been possible to obtain a special word for the hole in the knob, except *kohao* or *kowhao,* which are the common words for any sort of hole.

The forms used in decoration are those common to Maori carving generally, (a) human figures or their parts; (b) grooves; (c) spirals: in two sinkers the elements are used in combination.

DESCRIPTION OF SPECIMENS.

The first specimen to be described is No. 5,240 (Plate 29, figs. 1 and 2).

Dimensions: Height, 165 mm.; diameter of body, 135 mm.; diameter of neck, 72 mm.

This flattened sinker is made of sandstone; it was discovered some years ago in a swamp at Miranda, being placed in the Museum in 1909.

The knob is decorated with two human heads placed back to back, with a hole pierced just at the back of the heads. In each case the treatment of the face is the same. The rounded eyes may perhaps formerly have been lined with a small piece of *paua* shell, while the nose is very prominent. No attempt has been made to portray a protruding tongue, although the mouth is wide open. The rest of the face is quite plain, lacking any sign of tattooing. Certainly the design is a striking one and well suited to the sinker.

Nothing definite is known regarding the locality in which No. 9,849 (Plate 29, figs. 3 and 4) was found, except that it is a North Island specimen.

Dimensions: Height, 109 mm.; diameter of body, 91 mm.; diameter of neck, 75 mm.

This specimen has not been polished, although the material, sandstone, would be quite suitable for such treatment. It would appear that the owner had carved the design on the knob first and intended later to polish the body. Apparently something interfered with his plans, for the hole, which has been commenced from both sides, does not penetrate very far.

Two heads placed back to back form a bold decoration for the knob. Once again the eyes, nose and mouth are well carved, only this time the tongue is clearly indicated, as also a rather prominent chin. This feature is not very clearly illustrated in fig. 4.

The rather crudely shaped specimen, No. 485 (Plate 29, figs. 5 and 6), was dug up at Katikati and presented to the Museum by Captain H. Stewart, in 1883.

Dimensions: Height, 133 mm.; diameter of body, 101 mm.; diameter of neck, 63 mm.

The whole of the top of the knob has been carved to represent an upturned human face, with a short, squat nose, a large mouth with the tongue visible, but not protruding, and a pointed chin. The forehead, which is very prominent, is decorated with two carved grooves running from a point above the ridge of the nose towards the back of the head, apparently intended to represent a tattooed emphasis of the eyebrows.

The height of the knob from the neck to the top is only 19 mm., which, when compared with the length of the knob, 74 mm., appears quite out of proportion. Possibly formerly it was much higher and had a piece broken off, being afterwards re-carved with the face, as described. An attempt has been made to carve a spiral on the side, but it is only just recognisable.

The finest specimen known is perhaps No. 51 (Plate 30, figs. 1 and 2). It has been previously figured by Best (1908, p. 52, and 1929, p. 20), but as it has never been described in detail, it was thought advisable to do so here.

Dimensions: Height, 102 mm.; diameter of body, 97 mm.; diameter of neck, 53 mm.

This beautifully carved specimen, bearing the personal name Marutuahu, was formerly in the collection of the late Captain Gilbert Mair. According to him it originally belonged to Hotunui, of Tainui fame, the father of Marutuahu. Later it passed into the possession of a *hapu* of Ngati-Awa. After being lost for many generations, it was finally recovered in 1868 at Te Kaha, following a slip which occurred in the cliff at the *pa*. It was buried about fifteen feet from the surface.

An old man recognised it as the famous stone "Marutuahu." A quarrel arose as to the ownership of the relic, and was finally settled by the presentation of the disputed article to Captain Mair. Later it was acquired for the Auckland Museum.

Fashioned in marl, it has been elaborately decorated over almost the entire surface. The main design consists of two human figures, with their heads back to back on the knob, and their feet extending right beneath the undersurface or base. Great care has been shown in carving the two heads, which show much detail, their most prominent feature being the protruding tongue. The necks of the figures are clearly shown on the neck of the sinker.

A neatly executed double spiral decorates the shoulders in each case, and also the buttocks. The three fingers and toes so characteristic of Maori carving are here reproduced very faithfully. In fig. 2, the finger tips meet on the body, hence that portion is not otherwise decorated. On the corresponding figure, which is not illustrated, the fingers are placed on the thighs, consequently it has been possible to carve the body with a series of chevrons representing ribs. Archey (1926, p. 151) has already shown that the design decorating this specimen has certain points of resemblance to the design on a carved stone figure found at Northcote.

Between the two main figures, on each side, there is a small, conventionalised human figure represented.

Such an elaborately carved specimen was probably only used on special ceremonial occasions, when the *tohunga* would bring it from its resting place, to which it would be returned at the conclusion of the ceremonies.

The next specimen, No. 6,304 (Plate 30, fig. 3), is manufactured from rhyolite. It was discovered by Mr. Stevens near Mount Maunganui, Tauranga, and presented by him to the Museum. It is of a different shape from any specimens reviewed so far, as it does not possess either a knob or a neck. It is roughly circular in shape and perforated just above the centre with a large hole.

Dimensions: Height, 167 mm.; diameter, 148 mm.

Double spirals adorn the front and back, while the sides are partially covered with a representation of the human head. The eyes, nose and mouth are very boldly treated, owing to the fact that the coarse nature of the material rendered a more detailed treatment too difficult.

Practically the whole of this large sinker is covered with one or other of the two designs employed. The illustration shows the spiral carving very well, but no figure has been prepared showing the human head on the side.

Specimen No. 6,674 (Plate 30, fig. 4), fashioned from fine grained sandstone, was discovered in the North Cape district.

Dimensions: Height, 93 mm.; diameter of body, 71 mm.; diameter of neck, 47 mm.

As an example of a well finished sinker it would be hard to find a better specimen. It has been beautifully shaped and highly polished, and the carved grooves on the knob have been executed with great care. The carving on the knob is similar to that often seen on *patu onewa* and *tuki muka,* just below the hand grip. The distribution of this type is very limited, and reference will be made to this point at a later stage.

In No. 7,304 (Plate 30, figs. 5 and 6) we have a specimen roughly circular in shape. It was found on the celebrated Waihi Beach, and presented to the Museum by Mr. H. E. Vaile.

Dimensions: Height, 161 mm.; diameter, 136 mm.

The exact nature of the material from which it has been fashioned is not certain, but it is probably scoriaceous andesite. Evidently the decorator found it awkward to carve, so he utilised the design shown, in a very effective manner. It consists of two single spirals, one on each side, worked not in a continuous groove, as in other specimens, but with a series of knobs, or raised lumps. A large hole near the top perforates the sinker.

DESIGNS EMPLOYED.

From a consideration of the above specimens it will be seen that the variety of designs employed was not very extensive. A detailed examination of all the sinkers in the Museum collection indicated clearly that the most popular design was that with the grooves on the knob. The Museum possesses fifteen of this type, and, as mentioned previously, their distribution is very restricted.

It was found that, with two exceptions, they were all from localities north of Auckland. The list will probably prove of interest to students, so it is inserted here for reference, and is as follows:—Kapowairua (2); Batley, Kaipara; Marsden Point, Whangarei; North Kaipara Head; Lower Waihou, Hokianga; Kaipara; Paparoa (2); North Cape; Mangonui County; Waimate North; Kaitaia; Whanganui, and one for which no locality has been recorded. There seems little doubt, therefore, that the type is peculiar to North Auckland. With regard to the isolated specimen from Whanganui, it is possible it may have been carried there and was originally from the North. Skinner (1921, p. 76) has drawn attention to the fact that perforated line sinkers are characteristic of what he styles the "northern culture area."

The other designs, in order of their popularity, are as follows:—Human form, 8 (5 of which portray the human head only); spiral design, 7; combination of elements, 2 (includes human form and spiral design); miscellaneous, 4. The examination shows that of 520 sinkers in the Museum collection, only 36, or 7 per cent., are decorated specimens.

It seems probable that elaborately carved sinkers were used on ceremonial occasions, receiving in many instances a special name, as in the case of Marutuahu. Considering their comparative scarcity and the work expended on them, we may be sure they were highly prized by their owners.

Those described in this article illustrate the best specimens in the Museum collection, and each type is represented.

An interesting point is the fact that with an odd exception only perforated sinkers have been decorated.

Finally, I have to thank Miss E. Reekie for drawing the sketch illustrating the terminology, and Mr. C. W. Firth for kindly identifying the material from which the various sinkers described were fashioned.

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Fig. 1. Sinker No. 5,240, decoration, two carved heads.
Fig. 2. Sinker No. 5,240, side view.
Fig. 3. Sinker No. 9,849, decoration, two heads.
Fig. 4. Sinker No. 9,849, side view.
Fig. 5. Sinker No. 485, decoration, an upturned face.
Fig. 6. Sinker No. 485, decoration, an upturned face.

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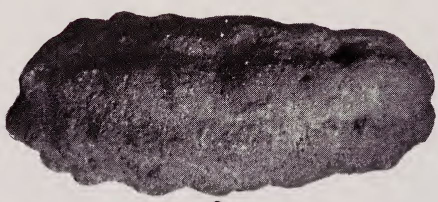

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Figs. 1 and 2. Sinker No. 51 ("Marutuahu"), front and side views.
Fig. 3. Sinker No. 6,304, decoration, double spiral.
Fig. 4. Sinker No. 6,674, decoration, grooves on knob.
Figs. 5 and 6. Sinker No. 7,304, front and side views, decoration double spiral outlined by small knobs.

Notes on New Zealand Petrels;

With Descriptions of New Forms and some New Records.

By R. A. FALLA, M.A., Ornithologist.

From a fuller review of New Zealand petrels now in preparation the following records of new forms, extra-limital records, and noteworthy occurrences, have been selected.

Oceanites oceanicus (Kuhl).

On 31st May, 1933, Mr. R. G. Gritton, of Gisborne, picked up and sent to the Auckland Museum an adult female bird of this species. Exceptionally heavy south-easterly weather had been experienced for some days previously. The bird was in a starved condition, but in good feather, with no sign of moult. Its measurements were: Wing 136, tail 65, tarsus 33, toe 28, culmen 12 mm.

Oceanodroma leucorhoa (Vieillot).

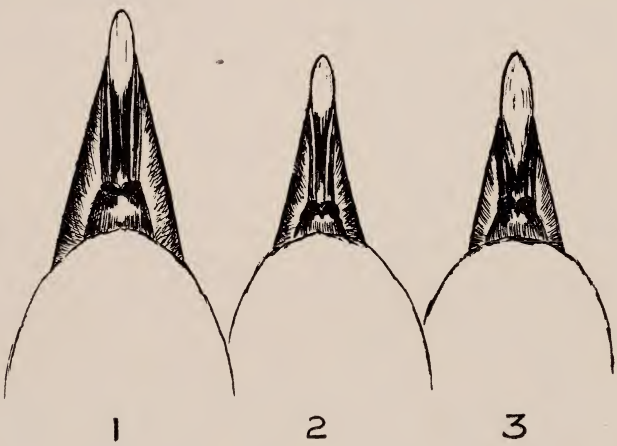
A specimen of this northern hemisphere bird was picked up by the writer on the Muriwai Beach, on the west coast, near Auckland, in August, 1922, and the skin, although damaged by sand lice, was preserved. The bird, a male, was emaciated and its plumage much weather-beaten, rendering it altogether a poor specimen for comparison. Its measurements, which are in millimetres, wing 160, tail 82, fork of tail 12, tarsus 23.5, middle toe and claw 25, exposed culmen 15, do not place it conclusively in any of the subspecific groups described by Oberholser (1919). Excluding the wing measurement, it agrees fairly well with his description of the characters of *O. leucorhoa kaedingi* Anthony, especially in the comparatively shallow tail fork (12 mm.).

Halobaena caerulea (Gmelin).

Of the two specimens in the Auckland Museum, Oliver (1930) has recorded the locality of one, viz., Tauranga. This bird, a male, was picked up there by the late Dr. C. E. R. Bucknill in November, 1924. Its measurements are: Wing 212, tail 90, tarsus 30, middle toe and claw 39, bill 26 mm. On 13th May, 1933, another male bird was picked up at Muriwai Beach, but so damaged by the attacks of gulls that only the head and wings have been preserved. The wing is 210 and the bill 26.5 mm. long. These two birds show no marked difference in size or colours of soft parts from a series from Kerguelen, with which I have been able to compare them. The bill of the second specimen, when fresh, was olive black, with a pale mauve blue patch along the lower edge of the lower mandible, at the base.

Pachyptila (Heteroprion) cf. belcheri Mathews.

Mathews (1912, p. 224) has cleared up a difficult problem in the classification of prions by distinguishing his *Heteroprion belcheri* from the related *H. desolatus,* but by making his specific distinction rest upon the ratio of length to width of the bill of one specimen he has created a taxonomic problem for later workers. These narrow billed birds of the sub-genus Heteroprion are undoubtedly of wide distribution and fall into several recognisable breeding races, but very few of them conform strictly to the formula "bill width less than a third of its length," except in immature birds. In a reference subsequent to his original description Mathews (Mathews and Iredale, 1921, p. 41) describes under *H. belcheri* adult birds from West Australia "with bills 25 mm. long by 10 mm. wide," and another adult from the Falkland Islands with the same measurements. None of these conform to the formula in the type description. The true relationship of these geographical forms is undoubtedly sub-specific, but it is impossible to attach them to a species which depends on such a strict bill ratio.



TEXT FIGURE.

Fig. 1. *Pachyptila desolata desolata* (Gmelin). Adult male (Kerguelen).
Fig. 2. *Pachyptila* cf. *belcheri* (Mathews). Adult male (Auck. Mus., 213-1).
Fig. 3. *Pachyptila turtur* (Kuhl). Adult male (Muriwai Beach, N.Z.).

Particulars are here given of three specimens in the collection of the Auckland Museum, all storm-driven birds from the Tasman Sea picked up on the west coast during the winter.

No.	Sex.	Locality.	Date.	Wing.	Tail.	Tarsus.	Mid-toe and Claw.	Length Bill.	Width Bill.	
213.1	♂	Muriwai Beach	1/8/32	176	80	28	36	24	10	mm.
213.2	♂ immat. albino	Kaipara Harb.	13/5/33	170	75	30	38	23.5	9.2	mm.
213.3	♂	Onehunga	1918	175	83	30	37	25	10	mm.

These birds are all smaller than the typical *P. belcheri,* but they agree in the form of the bill with its relatively weak nail. The actual measurements of bill length and width of No. 213.1 are the same as those of the specimen of *P. turtur* figured for comparison (Text figure 3), but the relatively stronger nail of *P. turtur* distinguish it in plan and profile. The larger skull in *P. belcheri* gives the head a different appearance in life, and its plumage colouration, with the darker crown, is that of the *P. desolatus* group.

No. 213.2 is a pure albino, with pink eyes and dull pink bill and feet.

Pachyptila turtur fallai Oliver.

Pachyptila turtur fallai Oliver, N.Z. Birds, p. 114, 1930.

Heteroprion belcheri fallai Mathews, Ibis, Jan., 1931, p. 44.

The type of this subspecies, in the Auckland Museum collection, is an immature bird, as shown by its bill characters and two shreds of nestling down still adhering to the flanks. However an adult referable to this form was collected by Mr. E. F. Stead at sea off Stewart Island in September, 1930. This bird is a female with the following measurements: Wing 173, tail 88, tarsus 29.5, mid-toe and claw 36.5, length of bill 21.5, width of bill 9 mm.

Mathews (1931, p. 44), without examining the type, has concluded that "this form corresponds exactly to *belcheri,*" except for a somewhat shorter bill. Both the immature type and the adult here described have the bill structure of the *P. turtur* group, and not the elongate, weak-nailed structure of *belcheri.*

Puffinus tenuirostris (Temminck).

To the scattered records of the occurrence of this species in New Zealand waters may be added the following: Two specimens were blown ashore at Cheltenham Beach, Auckland, during a north-easterly gale on 16th December, 1931. One bird, a male, was picked up by Major Allan Brooks, of British Columbia, who was on a visit to Auckland. The second specimen, also a male, now in the collection of the Auckland Museum, has the underparts distinctly paler than the upper parts, with an ashy grey chin and throat and under wing coverts washed with greyish white at their tips. Its measurements are: Wing 275, tail 82, tarsus 48, middle toe and claw 61, bill 34 mm. The testes of both were much reduced, a condition noted by Murphy (1930, p. 9) in two other males of this species taken in a neighbouring locality at the same time of year.

Another specimen was picked up by the writer in Spirits Bay, in the extreme north of New Zealand, in February, 1932, but was preserved only as a skeleton.

Pterodroma melanopus (Gmelin).

Among a number of petrel remains found by the writer on Muriwai Beach in January, 1921, was a bird of which measurements, sketch of head and colour notes were made before preserving it as a skeleton. It was regarded at the time as an abnormal specimen of *Pterodroma macroptera* (Smith) and overlooked. Further consideration, however, leads to the conclusion that the bird is a specimen of *P. melanopus*. The sketch of the head agrees with the specimen figured by Mathews (1912, Pl. 84) and the notes made at the time state that the plumage was blackish brown except for the mottled face and whitish underwing, feet black. Total length 420, wing 309, tarsus 38, toe 60, bill 42 mm.

Pterodroma neglecta (Schlegel).

A dead specimen, quite fresh, but much damaged by gulls, was picked up on Muriwai Beach by the writer on 29th November, 1932, and has been preserved in spirit. It agrees exactly in plumage and measurements with the bird described by Oliver (1930, p. 138) as a specimen of average intermediate colouration. There appear to be no previous records of the species from the New Zealand mainland.

Pterodroma pycrofti sp. nov. (Plate 31, figs. 1 and 3.)

Specific characters.—Similar to *Pterodroma cookii* (Gray), but with a much shorter bill, shorter wing, and darker colouration of the upper parts.

Description: Type, adult male, No. 200.2, Auckland Museum; Taranga (Hen Island), N.Z., 27th January 1932, collected by R. A. Falla. Upper parts generally from deep to dark neutral grey (Ridgway's Standards) according to wear; darkest patches on nape and rump, but neither of these conspicuous; edges of central forehead feathers white, but subject to wear; anterior part of lores and a line extending thence above and just past the eye, white; except for a thin white infraorbital stripe the feathers in front of the eye are darkly mottled, and those below are almost black; underparts, including flanks and axillaries, pure white; wings blackish brown, with faint grey bloom on secondaries; the inner vanes of the primaries are white basally on their inner half, the white area not sharply marked as in *P. cookii*, but merging more diffusely with the dark, as in *P. leucoptera;* wing lining, white, with anterior margin mottled; central rectrices dark neutral grey, darker terminally with wear, and white at extreme base; basal white is more extensive on each succeeding pair until the two outer pairs are largely white with grey patches on outer webs (four outer pairs are usually mainly white in *P. cookii);* under tail coverts, white, but shorter than in *P. cookii*, reaching only to within 22 mm. of tip of tail; bill, black; irides dark brown; tarsi and toes pale blue, webs flesh colour.

A male (the type specimen) and a female were found together in a new burrow on Taranga Island on the above date. Both were in breeding condition, with enlarged gonads and no food in the stomachs. On this date, on the neighbouring Little Barrier Island, *P. cookii* already had well-grown nestlings in the burrows, so that a considerable difference in nesting season is indicated if our Taranga Island pair are representative. Other new burrows on the same slope appeared to be unfinished and were empty. Mr. A. T. Pycroft revisited the spot in April, 1933, and unfortunately found the colony deserted.

There are probably in collections a number of specimens referable to this form. Several in the Dominion Museum, Wellington, appear to belong to it, but are without data. Another in the Auckland Museum, with data, "Cape Maria Van Diemen, 1896, Mr. Rayner," agrees with the Taranga birds, except in having a few faint flecks of grey on the axillaries and longer under tail coverts. The female bird collected with the type specimen is exactly similar in plumage and not appreciably different in size.

The species is distinguishable in size, more slender bill, colour of back and colour of feet from *P. leucoptera* (Gould), specimens of which have been examined by courtesy of the Trustees of the Australian Museum, Sydney. It more resembles *P. cookii,* and, according to the key by which Murphy (1929, p. 2) distinguishes forms of *P. leucoptera* from forms of *P. cookii,* could be regarded as a subspecies of the latter. This may prove on the examination of more material to indicate the facts of relationship more accurately, but it is in the meantime perhaps unwarranted to run counter to current notions of subspecies as geographic units by recognising two subspecies of the same species as nesting in one small group of islands.

The specific name is chosen in recognition of long service to ornithology of Mr. A. T. Pycroft, of Auckland, who also organised the expedition on which the birds were discovered.

Comparative measurements of the material examined:—

PTERODROMA COOKII.

No. and Sex.	Locality and Date.	Wing.	Tail.	Tarsus.	Middle Toe.	Culmen.
Auck. Mus. 148.1 ♀	"Hen & Chickens Is., 1880"	240	95	30	38	28.5
Auck. Mus. 148.3 immat.	Titirangi, 2/4/28.	235	95	30	36	27.5
Dom. Mus. 1813 ♂	Hauraki Gulf, 18/1/26	230	88	29.5	37	27
Dom. Mus. ♂	Hauraki Gulf, 4/2/32	232	90	27.5	39	25.5

PTERODROMA LEUCOPTERA.

No. and Sex.	Locality and Date.	Wing.	Tail.	Tarsus.	Middle Toe.	Culmen.
Aust. Mus. 016503 ♂	Cabbage Tree I., N.S.W.	221	92	28	37	25
Aust. Mus. 030240 ♀	Cabbage Tree I., N.S.W.	233	94	29	38	26.5

PTERODROMA PYCROFTI.

No. and Sex.	Locality and Date.	Wing.	Tail.	Tarsus.	Middle Toe.	Culmen.
Auck. Mus. 200.2 ♂	Hen Island, 27/1/32	215	88	28	33.5	23.5
Auck. Mus. 200.3 ♀	Hen Island, 27/1/32	217	86	27	34.5	23
Auck. Mus. 200.1	C. Maria van Diemen, 1896	218	94	25	35	24.5

Pterodroma cookii (Gray).

An immature specimen (Pl. 31, fig. 4) was picked up at Titirangi, near Auckland, by Master Neil Jones, on 2nd April, 1928, on which date it could hardly have been more than a month away from the nest. The first fresh plumage succeeding the down does not appear to have been described, and it is sufficiently distinct from the average adult condition to merit description.

The difference is due entirely to the fresh pale grey bloom of the upper plumage and the pronounced white edging to the feathers. This is so marked on the forehead that the dark bases of the feathers are only visible as scattered flecks. The scalation due to white edging is prominent on crown nape and sides of head, less noticeable on the hind neck, and prominent again on the mantle and the whole of the back down to the dark rump patch, where it is represented by very slight white tipping of the dark feathers. The upper surface of the wings is dark blackish brown, with conspicuous scalation of whitish on the secondaries and the greater and median coverts; lesser wing coverts are dark brown edged with grey. Measurements are: Wing 236, tail 94, tarsus 30, middle toe with claw 36, bill 27 mm. Colours of soft parts have not been noted when fresh; the dried feet are similar to those of adult *P. cookii.*

The distinctive characters of this first year's plumage are exactly those said to distinguish *Pterodroma cookii orientalis* Murphy (1929, p. 5) from *P. c. cookii.* While they are apparently larger, it still remains to be shown, therefore, that *breeding* specimens of the eastern Pacific form are distinguished by pronounced scalation of the dorsal plumage from the New Zealand form.

Thalassarche chrysostoma (Forster).

This species is apparently more plentiful in New Zealand seas than the available records would indicate. Specimens are washed ashore every year on the west coast near Auckland, and several complete and partial skeletons have been obtained in this way. From an adult male picked up at Muriwai Beach on 5th December, 1932, the following colour notes were taken in the flesh: Latericorn and upper half of mandibles, olive black; lower edge of mandibles and culminicorn to near tip yellow; tip orange; membrane from base of mandible to gape, orange; feet, fleshy white, bluish on the joints. The head plumage was all grey, lightest on forehead, crown, and throat; in front of the eye a dark patch; infra-orbital strip white. Wing 510, tail 200, tarsus 80, toe 125, bill 115 mm.

An immature bird (Pl. 32, fig. 1) found in the same locality on 12th May, 1933, had an olive black bill with a light horn-coloured strip along the lower edge of the mandibles. Forehead and chin white, the remainder of the head patchy with brown-grey and white. A renewal of plumage was in progress, and wing and tail measurements therefore not significant; bill 110 mm. long.

Thalassarche cauta steadi subsp. nov. (Plate 32, fig. 2.)

Subspecific characters: Differs from *T. cauta cauta* (Gould) in its bright and more uniformly coloured bill and average greater size. Its size, white throat and neck, and white on the inner web of the primaries distinguish it from both *T. cauta salvini* (Rothschild) and *T. cauta eremita* Murphy.

Description: Type, adult male, No. 153.3, Auckland Museum; Foveaux Strait, N.Z., December, 1931, collected by E. F. Stead. Upper back slate grey, with white bases to the feathers; scapulars and tail ash-brown, becoming brown with exposure and abrasion; wing coverts dark brown with white bases; primary quills dark brown with white shafts and inner web white except along shaft and at tip; the eyebrow and a patch in front of the eye form a continuous dark ash grey line reaching the bill at the apex of the latericorn, and separating the white of the forehead and crown from the pale ash grey cheek; a patch behind the eye, and ear coverts, washed with pale plumbeous grey; head and neck, all underparts, including axillaries and under-tail coverts, white; bill cream yellow, unguis and extremity of mandible bright yellow; a membranous belt of black behind the nostrils separates the latericorn from the culminicorn, and the latter from the frontal feathers; at the base of the mandible a belt of orange extends back towards the gape and is separated from the feathers by a narrow belt of black; feet bluish white; iris dark brown. Wing 610, tail 252, tarsus 90, middle toe and claw 142, bill 140 mm.

A female collected at the same locality in the following season has a much shorter bill (125 mm.) and less white on the inner web of the primaries.

This is the commonest mollymawk in the seas around Stewart Island during the summer months. Its distinctness from described forms was recognised by Mr. E. F. Stead, who collected the specimen on which the above description is based, and in recognition of whose valuable contribution to our knowledge of southern seabirds the subspecific name has been chosen.

Associated at sea with these yellow-billed birds are a number of others, averaging slightly smaller in size, having pale cream bills with a dark sub-terminal patch on the mandible. In these the whole neck all round is grey, very pale on the crown and throat, and the inner web of the primaries is dark. These characters agree with the adult condition of *T. cauta salvini* breeding on Bounty Island, except for the colour of the bill. The condition of the testes of several of these birds collected by Mr. Stead in Foveaux Strait indicate that they may, however, be immature examples of *T. cauta steadi.* The breeding place of this form is unknown, but it may be pointed out that breeding colonies of some form of *T. cauta* are known to exist on the Snares Islands and at Disappointment Island, in the Auckland Islands, but have not yet been correctly identified.

Thalassarche chlororhynchus (Gmelin).

A solitary New Zealand record of this species is given by Oliver (1930, p. 164) and recent observations by the writer indicate that it occurs in New Zealand seas, at any rate in the extreme north, at certain seasons. During August, 1932, the writer made observations during a trawling cruise in the R.R.S. Discovery II., and the following occurrences were noted:—

16th August, 1932, off North Cape, N.Z., two adult specimens accompanying the ship and seen at very close range.

17th August, off Three Kings Islands, five adults and one immature bird in the morning, increasing to eight birds in the afternoon.

T. melanophrys and an odd *T. cauta* were about at the same time. *T. chlororhynchus* was not again noticed as the ship proceeded south to Wellington, nor has the writer noted it when making observations from passenger steamers between Auckland and Sydney in April (two trips), or October (one trip).

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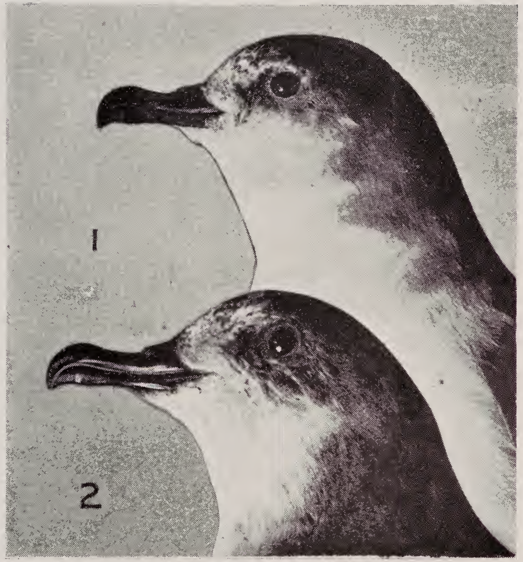
PLATE 31.



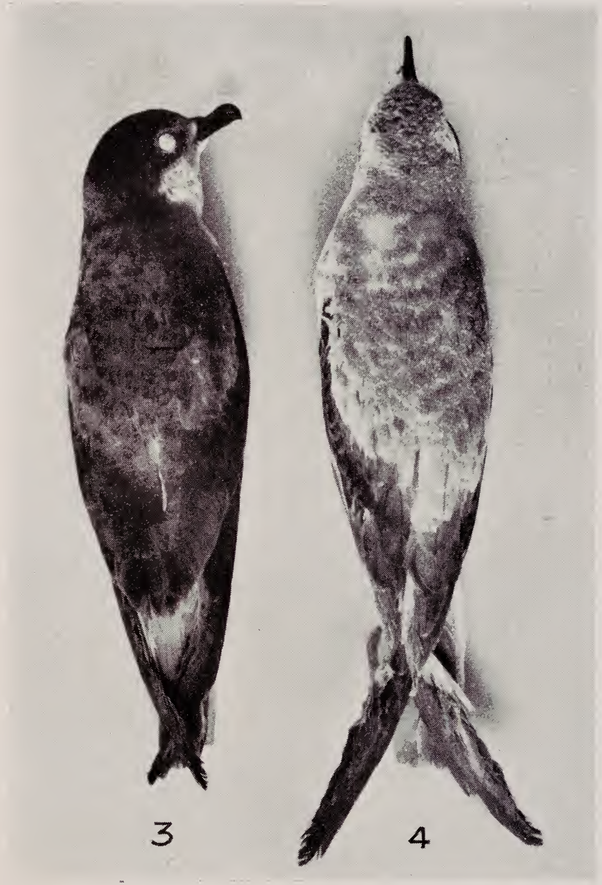


Fig. 1. *Pterodroma pycrofti* sp. nov. Adult male (type).

Fig. 2. *Pterodroma cookii* (Gray). Adult female (Auck. Mus., 148-1).

Fig. 3. *Pterodroma pycrofti* sp. nov. Adult female (paratype).

Fig. 4. *Pterodroma cookii* (Gray). Immature.

Fig. 1. *Thalassarche chrysostoma* (Forster). Immature.

Fig. 2. *Thalassarche cauta steadi* subsp. nov. Adult male (type).

The Marine Mollusca of the Chatham Islands.

By A. W. B. POWELL, Conchologist and Palaeontologist.

In this paper 19 new species and 5 new subspecies are described, and records are given of 78 species not previously known, from the Chathams.†

A summary of the Chatham Island Recent molluscan fauna, including descriptions of some new species, was published by Finlay in 1928. This was based upon the collections made by the Otago Institute party at the Chathams in the summer of 1924, but included also the Chatham Island references cited by Suter (1913) in his Manual of the New Zealand Mollusca.

The present paper is descriptive of material gathered personally by both shore collecting and shallow-water dredging during a stay of three weeks at Chatham Island during February of this year. Adverse weather prevented landing at any of the other islands of the group, and on only one occasion was it possible to use the dredge. Further dredging should add considerably to the off shore fauna, but I think that the littoral fauna is now fairly completely known. Certainly it has been explored sufficiently to now utilise negative evidence with tolerable safety; meaning that the absence of records of *Struthiolaria, Nerita, Amaurochiton, Turbo smaragdus* and other common mainland littoral species, can be given a definite significance, without fear that their apparent absence may be due to casual investigation.

Finlay recorded a total of 202 species (three of them non-marine) which included a number of Suter's records, the presence of which has not been confirmed by further field work. As most of these records appear in the "Manual" with but the bare locality reference "Chatham Islands," no collector or authority being cited, it seems desirable to suspend from the faunal list these at present unsubstantiated records, until more intensive collecting demonstrates the wisdom of either reinstating or permanently rejecting some, if not all, of them. The species I propose to place on this suspense list number 24, and they are listed following the revised faunal list given below.

In this revised list 256 species are recorded from the Chathams, and the number of endemic forms is now found to be 47. The approximate equality in numbers of the marine species that definitely show either Northern or Southern origin, as noted by

†These new records are indicated by blanks in the column of asterisks, preceding the names in the faunal list, which follows.

Finlay (1928, p. 285) remains about the same. Of the 80 species that either occupy restricted areas on the mainland or, in the case of endemics, are most closely allied to such mainland species, there are 43 showing southern influence and 38 northern influence. Two noteworthy additions are the second known Recent species of *Pachymelon* and a subspecies of a Tasmanian *Condylocardia.* A number of species of small land snails were collected, but these will be dealt with in another paper. In the faunal list, (E) indicates that the species is endemic, N. that it is of northern origin, and S. southern origin; an asterisk before a name that the species was collected by the Otago Institute party (recorded by Finlay, 1928), two asterisks that the species was listed by Finlay upon the authority cited after the name, and in most cases has been confirmed, and a cross that it was collected either by myself or by Mr. C. A. Fleming, who accompanied me for part of the trip.

The number following the cross refers to the list of stations given below.

1 = Waitangi, in shell-sand. 2 = Waitangi, living on or under stones, at low tide. 3 = Waitangi, living on seaweeds. 4 = Waitangi, cast up on beach. 5 = 10 fathoms off Owenga. 6 = On tidal rocks or cast up on beach at Owenga. 7 = Port Hutt, cast up on beach. 8 = Tioriori, cast up on beach. 9 = Wharekauri, living on or under stones. 10 = Wharekauri, in shell-sand. 11 = Kaingaroa, in stomachs of blue-cod. 12 = Maunganui, cast up on beach. 13 = Te Whanga lagoon. 14 = Waitangi West. 15 = Generally distributed.

Revised List of Chatham Island Recent Marine Mollusca.

PELECYPODA.

+	1	*	*Nucula nitidula* A. Adams 1856	
+	1		*Nucula hartvigiana* Pfeiffer 1864	
+	1	*	*Nucula dunedinensis* Finlay 1928	S
+	6	*	*Barbatia novaezelandiæ* Smith 1915	
+	1		*Acar sandersonæ* Powell 1933	N
+	6	*	*Glycymeris laticostata* (Q. & G. 1835)	
+	5		*Glycymeris modesta* (Angas 1879)	
+	5		*Austrosarepta* cf. *harrisonæ* (Powell 1927)	S
+	5		*Cosa filholi* (Bernard 1897)	
+	1		*Cosa costata* (Bernard 1896)	
		**	*Hochstetteria meleagrina* Bernard 1896 (Auth. Professor H. B. Kirk)	
+	6	*	*Ostrea sinuata* Lamarck 1819	
		*	*Lopha glomerata* (Gould 1850)	N
+	5		*Perrierina insulana* n. sp.	(E) S
+	6	*	*Notovola novaezelandiæ* (Reeve 1852)	
+	6	*	*Chlamys celator* Finlay 1928	S
+	6	*	*Chlamys suprasilis* Finlay 1928	S
+	6	*	*Chlamys radiatus* (Hutton 1873)	
+	11	*	*Chlamys dichrous* Suter 1909	S

+	11	*	*Pallium (Mesopeplum) convexum* (Q. & G. 1835)	
		*	*Limatula maoria* Finlay 1926	
+	12	*	*Monia zelandica* (Gray 1843)	
+	6	*	*Mytilus planulatus* Lamarck 1819	
+	2	*	*Mytilus (Aulacomya) maoriana* Iredale 1915	
+	4	*	*Volsella areolatus* (Gould 1850)	
+	13	*	*Volsella fluviatilis* (Hutton 1878)	(E)
+	1	*	*Trichomusculus barbatus* (Reeve 1858)	
+	4	*	*Modiolaria impacta* (Hermann 1782)	
+	8	*	*Gaimardia forsteriana* Finlay 1926	S
+	1	*	*Costokidderia costata* (Odhner 1924)	S
+	14	*	*Cardita aoteana* Finlay 1926	
+	6	*	*Venericardia purpurata* (Deshayes 1854)	
+	5		*Pleuromeris marshalli* (Marwick 1924)	S
+	1	*	*Condylocardia crassicosta* Bernard 1896	
+	1		*Condylocardia concentrica* Bernard 1897	
+	5		*Condylocardia torquata* Marwick 1928	(E)
+	1		*Condylocardia pectinata chathamensis* n. subsp.	(E) N
+	1		*Benthocardiella obliquata chathamensis* n. subsp.	(E) N
+	6	*	*Divaricella cumingi* (Ad. & Ang. 1863)	
+	6	*	*Diplodonta (Zemysia) zelandica* (Gray 1835)	
+	1	*	*Diplodonta (Zemysina) striatula* (Finlay 1926)	
+	1	*	*Melliteryx parva* (Deshayes 1856)	
+	1	*	*Myllitella pinguis* Marwick 1928	(E)
+	5	*	*Notolepton sanguineum* (Hutton 1883)	
+	5	*	*Notolepton* cf. *antipodum* (Filhol 1880)	
+	1	*	*Mysella unidentata* (Odhner 1924)	
+	2	*	*Rochefortula reniformis* (Suter 1908)	
+	1	*	*Chironia suborbicularis* (Montagu 1804)	
+	6	*	*Kellya hinemoa* Finlay 1928	
		*	*Kellya rossiana vexata* Finlay 1928	(E) S
+	5		*Arthritica bifurca* (Webster 1908)	
+	5		*Pachykellya concentrica* Powell 1927	S
+	5	*	*Cyamiomactra problematica* Bernard 1897	S
+	6	*	*Dosinia (Phacosoma) maoriana* Oliver 1923	
		*	*Tawera marionæ* Finlay 1928	S
+	7	*	*Tawera spissa* (Desh. 1835 = **mesodesma* Q. & G.)	
+	13	*	*Chione (Austrovenus) stutchburyi* (Gray 1828)	
+	6	*	*Protothaca (Tuangia) crassicosta* (Desh. 1835)	
+	6	*	*Paphirus largillierti* (Phil. 1847)	
+	4	*	*Notirus reflexus* (Gray 1843)	
+	4	**	*Macomona liliana* (Iredale 1915) (specimen in Otago University Museum)	
+	15	*	*Zearcopagia disculus* (Desh. 1855)	
+	6	*	*Gari lineolata* (Gray 1835)	
+	6		*Gari stangeri* (Gray 1843)	
+	5		*Ascitellina urinatoria* (Suter 1913)	S
+	6	*	*Soletellina* sp. cf. *siliqua* Reeve 1857	
+	13		*Mactra rudis* Hutton 1873	
+	6	*	*Longimactra elongata* (Q. & G. 1835)	
+	5	*	*Scalpomactra scalpellum* (Reeve 1854)	
+	12	*	*Amphidesma (Taria) subtriangulata* (Wood 1828)	
+	6	**	*Paphies australis* (Gmelin 1791) (recorded in Suter's Manual)	
		*	*Notocorbula haastiana* (Hutton 1878)	
+	6	*	*Notocorbula zelandica* (Q. & G. 1835)	
+	4	*	*Hiatella australis* (Lamarck 1818)	
+	6	*	*Panope zelandica* (Q. & G. 1835)	
+	4		*Anchomasa similis* (Gray 1835)	
+	7		*Offadesma angasi* (Cr. & Fisch. 1864)	
+	6	*	*Cleidothaerus maorianus* Finlay 1926	

GASTEROPODA.

+	5	*	*Scissurella prendrevillei* n. sp. (= *Scissurella* n. sp. Finlay 1928)	(E) S
+	5		*Schismope laqueus* Finlay 1926	S
+	1		*Scissurona rosea* (Hedley 1904)	N
+	5		*Sinezona brevis* (Hedley 1904)	
		*	*Sinezona* cf. *subantarctica* (Hedley 1916)	S
+	1		*Sinezona levigata* (Iredale 1908)	
+	5		*Sinezona pauperata* n. sp.	(E)
+	1	*	*Incisura lytteltonensis* (Smith 1894)	
+	1	*	*Tugali suteri* (Thiele 1916)	(E) N
		*	*Tugali* cf. *elegans* (Gray 1843)	
		*	*Montfortula chathamensis* Finlay 1928	(E) N
+	14	*	*Emarginula striatula valentior* Finlay 1928	S
+	6	*	*Monodilepas skinneri* Finlay 1928	(E) S
+	15	*	*Haliotis iris* Martyn 1784	
+	15	*	*Haliotis australis* Gmelin 1791	
+	15	*	*Haliotis virginea* Gmelin 1791	
		*	*Trochus (Coelotrochus) huttoni* Cossman 1918	
+	15	*	*Trochus (Thorista) viridis* (Gmelin 1791)	
+	15	*	*Thoristella chathamensis* (Hutton 1873)	S
+	2	*	*Melagraphia aethiops* (Gmelin 1791)	
+	2	*	*Zediloma arida* Finlay 1926	
+	2	**	*Zediloma digna* Finlay 1926 (recorded in Suter's Manual as *nigerrima* Gmel.)	
+	15	*	*Cantharidus opalus cannoni* n. subsp.	(E)
		*	*Micrelenchus sanguineus* (Gray 1843)	
+	5		*Micrelenchus sanguineus morioria* n. subsp.	(E) S
		*	*Micrelenchus tenebrosus* (A. Ad. 1853)	
		*	*Micrelenchus tenebrosus huttoni* (Smith 1876)	
+	15	*	*Micrelenchus dilatatus* (Sowerby 1870)	
+	15	*	*Maurea tigris* (Martyn 1784)	(N)
		*	*Maurea cunninghami pagoda* (Oliver 1926)	
+	6	*	*Maurea (Mucrinops) punctulata* (Martyn 1784)	(N)
+	2	*	*Herpetopoma bella* (Hutton 1873)	
+	15	*	*Margarella fulminata* (Hutton 1873)	(E) S
		*	*Zethalia zelandica* (A. Adams 1873)	
+	5	*	*Antisolarium egenum* (Gould 1849)	
+	1	*	*Liotella polypleura* (Hedley 1904)	
+	5		*Munditia owengaensis* n. sp.	(E) N
+	1		*Zalipais lissa* (Suter 1908)	
+	5		*Brookula (Aequispirella) finlayi* n. sp.	N
+	1		*Dolicrossea vesca* Finlay 1926	N
+	1		*Orbitestella hinemoa* Mestayer 1919	S
+	1		*Orbitestella toreuma* Powell 1930	N
+	15	*	*Modelia granosa* (Martyn 1784)	
+	1		*Argalista fluctuata* (Hutton 1883)	
+	6	*	*Astraea heliotropium* (Martyn 1784)	
+	15	*	*Cookia sulcata* (Martyn 1784)	
+	15	*	*Radiacmea inconspicua rubiginosa* (Hutton 1873)	(E)
+	4	**	*Notoacmea (Conacmea) parviconoidea* (Suter 1907) (recorded in Suter's Manual)	
+	15	*	*Cellana chathamensis* (Pilsbry 1891)	(E) S
+	15	*	*Melarhaphe oliveri* Finlay 1930	
+	15	*	*Melarhaphe cincta* (Q. & G. 1833)	
+	1		*Macquariella* n. sp.	S
+	1		*Zelaxitas micra* (Finlay 1924)	S
+	15	*	*Risellopsis varia* (Hutton 1873)	
+	15	*	*Risellopsis varia carinata* Kesteven 1902	

+	1	*	*Haurakia hamiltoni* (Suter 1898)		
+	1		*Notosetia neozelanica* (Suter 1898)	S	
+	1		*Notosetia infecta* (Suter 1908)	N	
+	1		*Notosetia verecunda* (Suter 1908)	S	
+	5		*Notosetia lampra* (Suter 1908)	N	
+	5		*Notosetia lubrica* (Suter 1898)	S	
+	1		*Notosetia atomaria* n. sp.	(E)	
+	5		*Notosetia exaltata* n. sp.	(E)	
+	2	*	*Estea minor* (Suter 1898)		
+	2	*	*Estea rekohuana* n. sp. (= E. n. sp. aff. *minor* Finlay 1928)	(E)	
+	1	*	*Estea guesti* n. sp. (= ?E. n. sp. aff. *zosterophila* Finlay 1928)	(E)	
+	1	*	*Estea porrecta* n. sp. (= ?E. sp. cf. *subfusca* Finlay 1928)	(E)	
+	5		*Estea morioria* n. sp.	(E)	
+	5		*Estea* cf. *insulana* Marwick 1928	(E)	
+	5		*Estea gracilispira* n. sp.	(E)	
+	5		*Estea impressa* (Hutton 1885)		
+	5		*Linemera maclurgi* n. sp.	S	
+	5		*Larochella alta* Powell 1927	N	
+	1	*	*Merelina plaga* Finlay 1926	S	
+	1		*Merelina waitangiensis* n. sp.	(E)	N
+	5		*Anabathron foliatum* (Suter 1908)	S	
+	2		*Scrobs hedleyi* (Suter 1908)		
+	2	*	*Austronoba martini* Finlay 1933	(E)	N
+	1		*Subonoba fumata* (Suter 1898)		
+	1	*	*Subonoba morioria* n. sp. (= ?S. cf. *fumata* Finlay 1928)	(E)	
+	1	*	*Subonoba* cf. *paucicostata* Powell 1931 (= ?S. n. sp. Finlay 1928)	S	
+	2		*Subonoba inornata* n. sp.	(E)	
+	2	*	*Dardanula olivacea* (Hutton 1882)		
+	1		*Dardanula limbata* (Hutton 1883)		
+	5		*Dardanula roseola* (Iredale 1915)		
+	3		*Skenella pfefferi* Suter 1909		
+	1	*	*Rissoina chathamensis* (Hutton 1873)		
		*	*Zegalerus crater* Finlay 1926		
+	15	*	*Sigapatella novaezelandiæ* (Lesson 1830)		
+	15	*	*Zeacumantus subcarinatus* (Sowerby 1855)		
+	1	*	*Lyroseila chathamensis* (Suter 1908)		
+	5		*Notosinister (Teretriphora) huttoni* (Suter 1908)	S	
+	15	*	*Maoricolpus roseus* (Q. & G. 1834)		
+	2		*Caecum digitulum* Hedley 1904		
+	4	*	*Vermicularia sipho* (Lamarck 1818)		
+	4	*	*Novastoa zelandica* (Q. & G. 1834)		
		*	*Magilina* sp.	(E)	
		*	*Siliquaria weldii* Ten-Woods 1876		
+	1	*	*Trichosirius inornatus chathamensis* Finlay 1928	(E)	
+	4	*	*Cabestana spengleri* (Perry 1811)	N	
+	6		*Cabestana waterhousei segregata* Powell 1933	N	
+	6	*	*Argobuccinum tumidum* (Dunker 1862)		
+	10	*	*Xenophalium (Xenogalea) powelli* (Finlay 1928)	N	
+	6	*	*Tanea zelandica* (Q. & G. 1832)		
+	1	*	*Uberella vitrea* (Hutton 1873)	S	
		*	*Triviella (Ellatrivia) memorata* Finlay 1926	N	
		*	*Janthina violacea* Bolten 1798		
+	1	*	*Janthina exigua* Lamarck 1822		
+	1		"*Odostomia*" *cryptodon* Suter 1908 } = ? 2 sp. *Odostomia* Finlay 1928		
+	1		*Evalea sabulosa* (Suter 1908) }		
+	5	*	*Gumina dolichostoma* (Suter 1908)	N	
+	1	*	*Pyrgulina rugata* (Hutton 1886)		
+	1		N. gen. and sp. aff. *Pyrgulina*	(E)	

+	2	*	*"Turbonilla" campbellica* Odhner 1924 (= ? *T. zelandica* Finlay 1928)	S	
+	1		N. gen. and sp. aff. *Turbonilla*		
+	5	*	*Chemnitzia* n. sp. (= ? *Turbonilla* n. sp. Finlay 1928)		
+	5		*Graphis blanda* (Finlay 1924)		
+	1	*	*Eulima archeyi* Finlay 1928	(E)	N
+	2	*	*Marginella (Serrata) aoteana* Powell 1932 (= *M. allporti* (?) Finlay 1928)	N	
+	2		*Marginella (Serrata) cairoma* Brookes 1924		
+	1		*Marginella (Glabella) pygmaea* Sowerby 1846†		
+	6		*Pachymelon (Palomelon) wilsonæ* n. sp.	(E)	
+	1	*	*Buccinulum waitangiensis* n. sp. (= *lineum* Finlay 1928)	(E)	N
		*	*Buccinulum pallidum* Finlay 1928		
+	15	*	*Buccinulum (Evarnula) characteristica* (Finlay 1928)	(E)	
+	15	*	*Buccinulum (Evarnula) marwicki* (Finlay 1928)	S	
+	15	*	*Buccinulum (Euthrena) bicinctum* (Hutton 1873‡)	(E)	
+	6	*	*Austrofusus chathamensis* Finlay 1928		
+	6	*	*Austrofusus glans agrestior* Finlay 1927	S	
+	15	*	*Cominella maculosa* (Martyn 1784)		
+	15	*	*Cominella (Acominia) adspersa nimia* Finlay 1928	(E)	N
+	6	*	*Cominella (Cominista) glandiformis* (Reeve 1847)		
+	6	*	*Cominella (Eucominia) iredalei* (Finlay 1928)	(E)	S
+	6		*Cominella (Eucominia) ellisoni consobrina* n. subsp.	(E)	
+	15	*	*Austromitra rubiginosa* (Hutton 1873)		
+	1	*	*Zemitrella finlayi* n. sp. (= ? *Z. chaova*, Finlay 1928)	(E)	
		*	*Paxula* n. sp. aff. *leptalea* (Suter 1908)	(S)	
+	15	*	*Paxula subantarctica* (Suter 1908)	S	
+	15	*	*Paxula allani* Finlay 1928	(E)	
+	1	*	*Macrozafra subabnormis saxatilis* (Murdoch 1905)	N	
+	6		*Poirieria zelandica* (Q. & G. 1833)		
+	6	*	*Zeatrophon ambiguus* (Philippi 1844)		
		*	*Xymene plebejus* (Hutton 1873)		
+	15	*	*Axymene traversi* (Hutton 1873)	(E)	
+	2	*	*Lepsia haustrum* (Martyn 1784)		
+	6	*	*Neothais scalaris* (Menke 1829)	N	
+	6	*	*Lepsithais youngi* Finlay 1928	(E)	S
+	6	*	*Lepsiella scobina* (Q. & G. 1833)		
+	1	*	*Guraleus* cf. *sinclairi* (Smith 1884)		
+	5	*	*Nepotilla (Zenepos) totolirata* (Suter 1908)		
		*	*Cavolina telemus* (Linn. 1758)		
+	1		*Retusa cookiana* (Suter 1909)		
+	1		*Cylichnina striata* (Hutton 1873)	S	
+	5		*Philine* cf. *constricta* Murd. and Suter 1906		
		*	*Tethys brunnea* (Hutton 1875)	N	
		*	*Tethys* n. sp. (?) aff. *tryoni* (Meinertzhagen 1880)	N	
		**	*Bouvieria aurantiacus* (Risso 1818) (Suter, fide Schauinsland)	N	
+	6		*Bouvieria ornatus* (Cheeseman 1878)	N	
+	2		*Ctenodoris flabellifera* (Cheeseman 1881)	N	
		**	*Fiona pinnata* (Eschscholtz 1831) (Suter, fide Schauinsland)		
+	1	*	*Marinula chathamensis* Finlay 1928	(E)	
+	2	*	*Leuconopsis obsoleta* (Hutton 1878)		
+	15	*	*Siphonaria zelandica* Q. & G. 1833		
+	15		*Siphonaria cookiana* Suter 1909	N	
+	2	*	*Gadinia nivea* Hutton 1878		
+	2	**	*Onchidella nigricans* (Q. & G. 1832) (recorded in Suter's Manual)		

†Recorded, Powell 1932, Trans. N.Z. Inst. vol. 62, p. 205.

‡Intergrades with the uniformly dull shells that were identified as *strebeli* by Finlay (1928, p. 253).

AMPHINEURA.

+ 2 ** *Plaxiphora (Maorichiton) schauinslandi* Thiele 1909 (recorded in Suter's Manual as *glauca)* .. .. .. (E)
+ 15 *Plaxiphora (Diaphoroplax) biramosa* (Q. & G. 1835) ..
+ 15 ** *Notoplax violacea* (Q. & G. 1835) (recorded in Suter's Manual) .. ..
+ 15 *Cryptoconchus porosus* (Burrow 1815) .. .. ..
+ 15 ** *Ischnochiton maorianus* Iredale 1914 (recorded in Suter's Manual) .. ..
+ 15 ** *Sypharochiton pelliserpentis* (Q. & G. 1835) (recorded in Suter's Manual) .. ..
+ 15 ** *Onithochiton neglectus* Rochebrune 1881 (recorded in Suter's Manual .. ..

SCAPHOPODA.

* *Fissidentalium zelandicum* (Sowerby 1860) .. .. ..

CEPHALOPODA.

+ 4 * *Spirula spirula* (Linn. 1758) .. .. N
* *Argonauta argo* Linn. 1758 .. .. N
+ 15 *Argonauta nodosa* Solander 1786 .. .. N
+ 4 *Polypus maorum* (Hutton 1880) .. ..

SUSPENSE LIST OF CHATHAM ISLAND MOLLUSCA.

Being unsubstantiated records that have not been confirmed by subsequent investigation.

Acmaea stella corticata Hutton 1880.
Acmaea fragilis (Chemnitz 1790).
Helcioniscus denticulatus (Martyn 1784).
Helcioniscus radians earlii (Reeve 1855)
Helcioniscus radians flavus (Hutton 1873)
Helcioniscus redimiculum (Reeve 1854).
Helcioniscus strigilis (Hombron & Jacquinot 1841).
Monodonta excavata Ad. & Ang. 1864.
Epitonium zelebori (Dunker 1866).
Septa rubicunda Perry 1811.
Lamellaria ophione Gray 1850 (specimen in Otago University Museum).
Ancilla australis (Sowerby 1830).
Architectonica lutea (Lamarck 1822).
Drillia novaezelandiæ (Reeve 1843).
Bathytoma cheesemani (Hutton 1878).
Mangilia dictyota (Hutton 1885).
Onchidella patelloides (Q. & G. 1832).
Onchidella flavescens Wissel 1904.
Chiton sinclairi Gray 1843.
Plaxiphora caelata (Reeve 1847).
Cytherea oblonga (Hanley 1828).
Dosinia greyi Zittel 1864.
Dosinia subrosea (Gray 1853).
Myadora boltoni Smith 1880.

(Records with one exception from Suter's Manual of the N.Z. Mollusca, 1913.)

CHATHAM ISLAND RECORDS PREVIOUSLY REJECTED.

By (1) Iredale 1915 and (2) Finlay 1928.

(1) *Acanthopleura granulata* (Gmelin 1790).
(1) *Onithochiton semisculptus* Pilsbry 1893.
(2) *Trochus oppressus* (Hutton 1878).
(2) *Cantharidus conicus* (Gray 1827).
(2) *Calliostoma spectabile* (A. Adams 1855).
(2) *Acmaea octoradiata* (Hutton 1873).
(1) *Helcioniscus antipodum* (Smith 1874).
(1) *Helcioniscus radians affinis* (Reeve 1855).
(2) *Trophon paivæ* Crosse 1864.
(2) *Trophon inferus* (Hutton 1873).
(2) *Dentalium opacum* Sowerby 1828.

ACKNOWLEDGMENTS.

I am greatly indebted to the residents of Chatham Island and to the captain and officers of the "s.s. Tees" for their kindness and hospitality and much useful information.

Also I record my indebtedness to the Wanganui Museum authorities for the loan of type specimens from the Suter collection.

SYSTEMATIC.

The types of all the new species and representatives of nearly all the new records that appear in this paper are preserved in the Auckland Museum.

PELECYPODA.

PERRIERINIDÆ.

Genus PERRIERINA Bernard 1897.

Perrierina insulana n. sp. Pl. 34, fig. 1.

Shell minute, thin and fragile, ovate, equivalve and inequilateral. Beaks fairly prominent, with a moderately large rounded prodissoconch which is marked off from the post-embryonic part of the shell by a slightly raised thin rim. Sculpture of exceedingly fine and closely spaced concentric growth striae. Under a low power lens the surface appears to be smooth and glossy. Hinge plate narrow and long, typical. Right valve with two divergent cardinals, which are situated in front of the narrow oblique resilium. In addition there are four anterior and five posterior lamellae set obliquely on the distal parts of the hinge-plate. Left valve with three anterior cardinals, and the corresponding lamellae. Central cardinal rectangular, outer two narrow and slightly divergent. Valve margins smooth except for a few weak crenulations on the posterior section of the ventral edge. Colour creamy buff tinged with light brown towards the beaks. The hinge plate and prodissoconch are stained reddish-brown, and there is a faint open pattern of a few zigzag lines, in light brown over the whole shell.

Length, 1.85 mm.; height, 1.55 mm.; thickness (one valve), 0.4 mm.

Habitat: Off Owenga Beach, in 10 fathoms, in clean shell-sand.

This species is the Recent descendant of Marwick's *P. ovata* from the Pliocene of Titirangi, Chatham Island. From the fossil species the Recent one differs constantly in outline, being more evenly ovate. In *ovata* the posterior end is broadly rounded and slightly subangled above and below.

Condylocardiidæ.

Genus Condylocardia Bernard 1896.

Condylocardia pectinata chathamensis n. subsp. Pl. 33, fig. 8.

Shell minute, ovate-trigonal, equivalve, and almost equilateral; radially sculptured with 14 low rounded ribs, having very narrow, almost linear interspaces. The concentric lines of growth cut into these radials, and being rather close together, produce upon them transversely ovate-granules which are most prominent towards the ventral margin. Prodissoconch small, smooth, slightly convex, not prominent but clearly marked off from the rest of the shell. Ligament short, external and situated immediately below the prodissoconch. Resilium broadly triangular and situated in a sunken pit beneath the umbo. There are two cardinals and two laterals in each valve, and they are arranged as follows: In the left valve there is first a socket, then the posterior lateral, followed by a socket and a well defined cardinal which borders the resilium. Following the resilium is a socket and another well defined cardinal and finally another socket and then a lateral. In the right valve there is a posterior lateral, then a socket, followed by an elongated, ill defined cardinal, a socket and then the resilium. Immediately following the resilium is a small, well defined cardinal, a socket, and finally the anterior lateral, followed by a socket. This may be expressed by the following formula:—

L. 01 . 01 r 01 . 01 = 2 laterals + 2 cardinals.

R. 10 . 10 r 10 . 10 = 2 laterals + 2 cardinals.

(r = resilium. 0 = a socket, and . divides the laterals from the cardinals.)

Muscle scars subcircular and about equal in size. Margins of valves strongly crenulate. Colour creamy white.

Length, 1.5 mm.; height, 1.35 mm.; thickness (two valves), 1.1 mm. (Holotype).

Habitat: Waitangi Beach, in shell-sand.

It is rather remarkable that the Chatham shells are so unlike the known New Zealand species, yet so near to the Tasmanian *pectinata* that at first sight the two seem to be identical. True *pectinata* differs from the Chatham shell only in having the anterior end a trifle more produced. There is much variation in shape in Tasmanian topotypes, and most of them are far more equilateral than is shown in Tate and May's figures. This difference, however, is so slight when series of topotypes are compared that one cannot consider the status of the Chatham shells as more than subspecific.

Condylocardia torquata Marwick 1928.

Habitat: Off Owenga Beach, in 10 fathoms.

Previously recorded from the Chathams, only as a Pliocene fossil.

None of the Recent specimens are quite the size of the solitary Pliocene holotype, but nevertheless the Recent examples are very close to the fossil species in all details, with the exception of the hinge. The anterior cardinal of the left valve of the holotype (described as the right valve by Marwick) is far more prominent and massive than in the Recent examples. However, as the holotype is a fully mature shell probably verging upon senility, this extra development of the cardinal in the holotype may not be of specific importance.

However, the range of Recent specimens, representing both valves of the species, furnishes more complete details of the hinge, which are as follows: Right valve with two cardinals, an obliquely-triangular one in front of the ligament-pit and a very narrow rudimentary one behind, almost on the shell margin. Left valve with two cardinals, a narrowly triangular one in front of the ligament-pit and a thin vertical one bordering the front edge of the ligament-pit. Laterals are represented by thickened anterior and posterior valve edges in the left valve, which fit into distinct grooves in the right valve.

The hinge characteristics are best explained by the following formula:—

L. 1 . 0 r 1 0 1 . 1 = 2 laterals + 2 cardinals.

R. 0 . 1 r 0 1 0 . 0 = 2 lateral sockets + 2 cardinals.

This Chatham Island species is nearest allied to the New South Wales *C. ovata* Hedley 1906 (P.L.S.N.S.W., vol. 30, p. 539).

Genus BENTHOCARDIELLA Powell 1930.

Benthocardiella obliquata chathamensis n. subsp. Pl. 34, fig. 2.

Shell very close to *B. obliquata* Powell 1930, but differing from that species in having a less conspicuous prodissoconch, the rim of which is evenly developed all round without a projecting posterior knob. The outline of the Chatham species is almost identical with that of the North Island *obliquata* except that in the former there is a tendency for full grown shells to be more regularly ovate, the beaks being set not quite so far behind, and the anterior dorsal slope is higher, more convexly arcuate and less rapidly descending. The hinge characters are the same as in *obliquata.*

Although the two forms seem very closely allied, the difference in the prodissoconchs is very pronounced and so constant that I have no hesitation in declaring the Chatham Island shells a distinct subspecies.

Length, 1.15 mm.; height, 0.90 mm. (Holotype).

Length, 1.11 mm.; height, 0.85 mm.; thickness (two valves), 0.57 mm. (Paratype).

Length, 0.98 mm.; height, 0.75 mm.; thickness (two valves), 0.5 mm. (Paratype).

Habitat: Waitangi Beach, in shell-sand; off Owenga in 10 fathoms in clean shell-sand. (Common.)

ERYCINIDÆ.

Genus NOTOLEPTON Finlay 1926.

Notolepton cf. antipodum (Filhol 1880).

Habitat: Off Owenga Beach, in 10 fathoms.

Finlay (1926, p. 463) considers that *K. sanguinea* (Hutton) is very possibly a synonym of *antipodum.* However, specimens referrable to both species occur at the Chathams. The *sanguinea* can be separated from the cf. *antipodum,* not only by the presence of the pink tinged umbo, but also on shell characters, the sculpture being coarser and the outline a trifle less circular. The type of *antipodum* is from Campbell Island, so I have not been able to compare the Chatham shells with actual topotypes. *Sanguinea* was recorded from the Chathams by Finlay (1928, p. 274), but not *antipodum.*

LIMOPSIDÆ.

Genus AUSTROSAREPTA Hedley 1899.

Austrosarepta cf. harrisonæ (Powell 1927).

Habitat: Off Owenga Beach, in 10 fathoms. (One valve.)

Iredale (1924, p. 186) has advocated the revival of Hedley's genus as distinct from the Antarctic and Subantarctic *Lissarca,* with which it had been synonymised. Apart from the New South Wales genotype, *Austrosarepta* may be used for the two New Zealand species, *Lissarca harrisonæ* Powell 1927 and *L. pileopsis* Powell 1927.

The main difference between the two genera lies in the form of the resilium, that of *Lissarca* being narrow and oblique, while that of *Austrosarepta* is broadly triangular. Also there is in *Austrosarepta,* on each side of the resilium, a long vertically striated ligamental area, and this was not seen in any of the Subantarctic *Lissarcas* that I have examined.

VENERIDAE.

Genus CHIONE Megerle 1811.

Subgenus AUSTROVENUS Finlay 1926.

Chione (Austrovenus) stutchburyi (Gray 1828).

This species is very abundant in the Te Whanga Lagoon, Chatham Island, but normal, large, heavy shells occur only near the outlet at Te Awapatiki. In the areas remote from the entrance, where the salinity is low and the tidal influence practically nil, only small, thin-shelled specimens occur. Finlay 1928 (p. 278) has remarked upon these stunted thin shells, but had not seen specimens of them nor of the normal form.

In another paper (1932, p. 67) I have remarked that in specimens of *stutchburyi* from northern parts of the North Island there is a slight tendency towards greater inflation and less elongation posteriorly than in Southern specimens. By Southern I mean from localities around Wellington and southward to Stewart Island.

It is of interest in tracing the origin of the Chatham Island fauna to note that the type from the Chathams is of the elongated Southern form.

MACTRIDÆ.

Genus MACTRA Linn. 1767.

Mactra rudis Hutton 1873.

Habitat: Muriwhenua, Te Whanga Lagoon. Broken specimens were seen on the shores, but no whole specimens were collected.

Previously recorded from the Chathams, only as a Pliocene fossil.

SANGUINOLARIIDÆ.

Genus GARI Schumacher 1817.

Gari stangeri (Gray 1843).

Habitat: Owenga Beach (dead shells).

Previously recorded from the Chathams, only as a Pliocene fossil.

PHOLADIDÆ.

Genus ANCHOMASA Leach 1852.

Anchomasa similis (Gray 1835).

Habitat: Waitangi. Boring into soft rock below low tide.

Previously recorded from the Chathams, only as a Pliocene fossil.

GASTEROPODA.

SCISSURELLIDÆ.

Genus SCISSURELLA D'Orbigny 1823.

Scissurella prendrevillei n. sp. Pl. 33, fig. 6.

Shell small, depressed turbinate, umbilicate, white, moderately solid. Whorls 3½, including a delicately radially ribbed protoconch of 1½ whorls, which is marked off from the adult whorls by a prominent varix. Spire low, early whorls not showing above the level of the shoulder of the body-whorl. Fasciole girdle sunken, with sharp raised edges, and it is well defined for fully two-thirds of a whorl behind the apertural slit, which is 2.5 mm. in length in the holotype. The body-whorl is evenly convex, and the fasciole is situated not at the widest part, but between the periphery and the suture. The fasciole also defines the outer limit of a broad and almost flat shoulder. The sculpture is of numerous thin axials, persistent over the whorls from suture to umbilicus, and these are crossed by numerous fine spiral threads. The axials number about 17 on the penultimate whorl and 20 on the body-whorl, the spirals, three on the shoulder and fourteen on the body-whorl and base. Umbilicus deep, about one tenth major diameter and bordered by one of a series of four spirals, which are considerably stronger than the rest. Aperture subquadrate. Peristome simple, continuous except for the slit. Columella oblique, rather straight.

Height, 0.8 mm.; diameter, 1.07 mm. (Holotype).

Habitat: Off Owenga Beach, in 10 fathoms.

No doubt this is the *Scissurella* n. sp. of Finlay (1928, p. 234), which was not then described, as there was only a single specimen available.

Genus SINEZONA Finlay 1926.

Sinezona pauperata n. sp. Pl. 33, figs. 4 and 5.

Shell minute, turbinate, rather thin. There is a moderately large umbilical depression, partially filled with callus, but no true umbilicus. Whorls 3, including a delicately radially ribbed protoconch of one flattened whorl. Post-nuclear sculpture of numerous closely-spaced axial riblets, which are crossed on the periphery by four equispaced spiral threads. There is a moderately large oval foramen with its edges slightly raised, but no fasciole. Aperture obliquely-ovate. Peristome continuous. Spire very little raised, less than half height of aperture. Colour white.

Height, 0.4 mm.; diameter, 0.5 mm. (holotype).

Habitat: Owenga Beach, in 10 fathoms.

This species is well characterised by its minute size, faint peripheral spirals, compact whorling and absence of a fasciole.

TROCHIDÆ.

Genus CANTHARIDUS Montfort 1810.

Cantharidus opalus cannoni n. subsp. Pl. 36, figs. 15 and 16.

Habitat: Abundant all round the Chathams on D'Urvillea.

The subspecies differs from the typical species in being proportionately much broader and in the spire being concave and the body-whorl inflated.

Finlay (1928, p. 238) noted the distinctive characters of his Chatham specimens, but owing to an insufficient range of specimens he hesitated to give them a name.

After examining a large series of specimens from the Chathams, North Auckland, Bay of Plenty, Cook Strait, West Nelson and Stewart Island, I find that the Chatham specimens are constantly the wide form, and all the others are invariably the narrow form.

Suter's *C. opalus biangulatus* Suter 1908 from Cook Strait is not comparable with the Chatham Island broad form, the disproportionate body-whorl being abnormal, as is clearly shown by the straight and narrowly conical spire whorls, which are identical with those of the typical species.

Height, 42 mm.; diameter, 33.5 mm. (holotype from Kaingaroa).

Height, 43.5 mm.; diameter, 28 mm. (typical *opalus,* Whangarei Heads).

Genus MICRELENCHUS Finlay 1926.

Micrelenchus sanguineus morioria n. subsp. Pl. 36, figs. 10 and 11.

Spire bluntly conical, same height as aperture, sides convex. Body-whorl large, rounded but broadly subangled at periphery. Sculpture consisting of flattened spiral cinguli with interspaces about equal to the width of the cinguli. These spirals number five on the early whorls, six on the penultimate and fourteen on the body-whorl and base. There is no umbilical chink. The ground colour is pale pink and the cinguli are picked out in scarlet.

Height, 7 mm.; diameter, 6 mm. (holotype).

Habitat: Off Owenga Beach, in 10 fathoms. Also common in the Pliocene at Titirangi, Chatham Island.

This species belongs to the *sanguinea* series, but has the coloration of *rufozona.* From typical *sanguinea* it is distinguished by its more rounded body-whorl and different coloration. It is nearest to the Auckland Island *M. sanguinea mortenseni* (Odhner 1924), which is of similar shape and coloration, but has all the cinguli distinctly granulate.

LIOTIIDÆ.

Genus LIOTELLA Iredale 1915.

Liotella polypleura (Hedley 1904).

Habitat: Off Owenga Beach, in 10 fathoms; Waitangi, in shell-sand.

A Chatham Island shell was recorded by Finlay (1928, p. 239) as n. sp. aff. *polypleura*, but after examining a series of specimens I am unable to separate Chatham examples from topotypes. Hedley described his species as having 16 riblets on the last whorl, but the majority of topotypes have from 17 to 19 riblets.

Genus MUNDITIA Finlay 1926.

Munditia owengaensis n. sp. Pl. 33, figs. 9 and 10.

Shell small, white, shining, discoidal, almost flat above and widely umbilicate below. Whorls $2\frac{1}{2}$, very rapidly increasing. Protoconch of one and a-quarter smooth flattened whorls. Sculpture consisting of numerous, prominently raised radial ribs, which are continuous over the whorls right from the upper suture to within the umbilicus. These radials number fourteen on the body-whorl, and they are bluntly rounded above and below, but quite thin and sharp over the peripheral area, which has four distinct widely and evenly spaced linear, raised cords. The uppermost and lowest of these form subangles with the dorsal surface and base respectively. Aperture large, circular. Peristome smooth, continuous, strengthened on the outside by one of the radials. Umbilicus wide and deep, about one fourth the major diameter of the base.

Height, 0.6 mm.; diameter, 1.1 mm. (Holotype).

Habitat: Off Owenga Beach, in 10 fathoms, in clean shell-sand.

The previously known New Zealand species of *Munditia* are *tryphenensis* (Powell 1926), *serrata* (Suter 1908) and *suteri* (Mestayer 1919), but the Chatham Island species is not closely allied to any of them.

Genus BROOKULA Iredale 1912.

Subgenus AEQUISPIRELLA Finlay 1924.

Brookula (Aequispirella) finlayi n. sp. Pl. 33, fig. 1.

Shell minute, elevated-turbinate, thin, narrowly perforate, white, translucent, shining. Whorls $4\frac{1}{2}$, including a bluntly rounded but moderately elevated smooth globose protoconch of $1\frac{1}{4}$ whorls. Spire tall, $1\frac{1}{2}$ times height of aperture. Sculpture consisting of numerous narrow but prominent axial ribs with the interspaces four to six times the width of the ribs. These interspaces are crossed by less conspicuous sculpture of fine spiral threads. There are 21 axials on the penultimate and 27 on the body-whorl. The number of axials in *corulum*, averaged from four topotypes, is 28 for the penultimate and 32.5 for the body-whorl. The spirals number six on the early spire whorls and about ten on the penultimate. On the base the axials become weaker, finishing abruptly before reaching the umbilicus, and the spirals are more numerous and closely spaced, they, likewise, terminating just before reaching the umbilical cavity. Umbilicus narrow but deep. Aperture circular, peristome continuous, thin and sharp.

Height, 1.3 mm.; diameter, 0.95 mm. (Holotype).

Habitat: Off Owenga Beach, in 10 fathoms, in clean shell-sand (type); Waitangi, in shell-sand.

This species is closely allied to the Pliocene-Recent *corulum*, but differs in having more narrowly conical apical whorls and fewer axial ribs. *Finlayi* is not restricted to the Chathams, for it is rather common in shell-sand from Tom Bowling Bay, northernmost New Zealand. However, *corulum* also occurs Recent, for I have it from 10-12 fathoms off Wanganui, but not from further north, where it seems to be represented by an obtuse-spired closely allied new species which I have from 20 fathoms, off the Little Barrier Island.

PATELLIDÆ.

Genus CELLANA H. Adams 1869.

Cellana chathamensis (Pilsbry 1891). Pl. 36, figs. 1-4.

1891. *Acmaea chathamensis* Pilsbry. Manual of Conchology, Vol. 13, p. 56.

I found only one species of the *Patellidæ* at the Chathams, and it must bear the above name. Pilsbry's species was described as an *Acmaea*, but it is undoubtedly the young of the shells which have been recorded as *strigilis* and *redimiculum* (Suter 1913). The figure of Pilsbry's species does not coincide with the dimensions he cites, being proportionately wider, but actual specimens agree with these measurements exactly. The species is given to extreme variation in colour pattern, those from light coloured tuffaceous rocks having a pale whitish or yellowish ground, with a sparse and irregular dark-brown radiate pattern, while those from lava flows have the radiate pattern as such a dense network that the light coloured ground shows only when the shell is held up to the light, the general effect being uniformly dark. Every conceivable intermediate form occurs, but no shell that I have seen can be ascribed to *radians*.

The Chatham shells are undoubtedly a distinct species, being nearest allied to the South Island *redimiculum*, but differing in having weaker radials, the young shells being almost smooth, and in the colour pattern being most frequently of simple radials, seldom blotched or anastomosing. A series covering growth stages and colour variants is given. The largest figured specimen measures 55 mm. x 45 mm., and the smallest 21 mm. x 15.75 mm.

Finlay (1926, p. 338) is undoubtedly wrong in ascribing *redimiculum* to the genus *Nacella.* Actual live specimens of this species and of *chathamensis* that I have examined, have the unmistakable *Cellana* features of the gill cordon interrupted by the head and no epipodial processes on the sides of the foot. *Nacella* undoubtedly occurs in the Subantarctic of New Zealand, but should be restricted at present to *N. macquariensis* Finlay 1926 (= *delesserti* of Hedley 1916) and *N. kerguelenensis* Smith. Shells of this genus can be readily distinguished by the peculiar bronze irridescence.

LITORINIDÆ.

Genus MACQUARIELLA Finlay 1926.

Macquariella n. sp. Pl. 33, fig. 7.

Habitat: Waitangi, Chatham Islands, in shell-sand.

This species I am describing from Auckland Island specimens in a paper on Subantarctic Mollusca which should appear in part 5, vol. 20, of the Proceedings of the Malacological Society, London.

The Auckland Island specimens are rather worn and are described as being uniformly reddish-brown. However, the better preserved Chatham material shows that there is a zone of paler colour over the lower part of the base. The Chatham shells vary slightly, some having higher spires than in the few available Auckland Island specimens, so I figure one of the Chatham Island extreme forms, for comparison with the figure of the holotype, when it appears.

Genus ZELAXITAS Finlay 1926.

Zelaxitas micra (Finlay 1924).

Habitat: Waitangi, Chatham Islands, in shell-sand.

I have not been able to compare the Chatham shells with topotypes, but they match the description and figure in all respects. Not previously recorded from the Chatham Islands.

RISSOIDÆ.

Genus NOTOSETIA Iredale 1915.

Notosetia neozelanica (Suter 1898). Pl. 34, fig. 10.

Habitat: Waitangi, in shell-sand (one specimen). Not previously recorded from the Chathams.

A lectotype of Suter's species has been selected from the syntypes, 23 in number, and is here figured. The dimensions of the figured lectotype are: Height, 2.15 mm.; diameter, 1.5 mm. Profile of outer-lip inclined forwards above.

Notosetia infecta (Suter 1908). Pl. 34, fig. 5.

Habitat: Waitangi, in shell-sand. Not previously recorded from the Chathams.

A lectotype of Suter's species has been selected from his 29 syntypes, and is here figured. The dimensions of the figured lectotype are: Height, 1.75 mm.; diameter, 1.1 mm. Profile of outer lip straight with axis of whorls.

Notosetia verecunda (Suter 1908). Pl. 34, fig. 11.

Habitat: Waitangi, in shell-sand. Not previously recorded from the Chathams.

A lectotype of this species has been selected from Suter's 14 syntypes, and it is here figured. Its dimensions are: Height, 1.90 mm.; diameter, 1.25 mm.

Notosetia lampra (Suter 1908). Pl. 34, fig. 7.

Habitat: Off Owenga Beach, in 10 fathoms. Not previously recorded from the Chathams.

A Chatham Island specimen is figured and its dimensions are: Height, 1.10 mm.; diameter, 0.65 mm. The holotype is a larger shell, but it is slightly abnormal in coiling. Paratypes are more the size of Chatham specimens and cannot be separated from them.

This species was referred to *Estea* by Iredale (1915, p. 454), but it does not belong there, for the shell is very thin in build and the peristome is neither thickened within nor expanded.

Notosetia lubrica (Suter 1898).

Habitat: Off Owenga Beach, in 10 fathoms. Not previously recorded from the Chathams.

A new figure of the holotype is given (Pl. 34, fig. 3), as Suter's figure shows the spire tapered too much. Also the correct dimensions are: Height, 1.75 mm.; diameter, 0.85 mm., not diameter 0.6 mm., as described by Suter.

Notosetia atomaria n. sp. Pl. 34, fig. 9.

Shell minute, globular, thin, translucent, smooth and polished. Coloured uniformly light brown. Whorls four, including small depressed protoconch of one smooth whorl. Apart from a few faint axial growth lines there is no true sculpture. Spire broadly conical, a little less than height of aperture. Aperture circular. Peristome oblique in profile, inclined forwards above, discontinuous, but connected across parietal wall by a thin callus. There is a small crescentic umbilical chink. Outer lip thin and sharp.

Height, 1.20 mm.; diameter, 1.05 mm. (holotype).

Habitat: Waitangi, in shell-sand.

This species is allied to *subflavescens* Iredale (= *atomus* Suter) from 50 fathoms, off the Bounty Islands. However, *subflavescens* differs from *atomaria* in being more ovate in outline, and in having the umbilical chink almost obsolete.

A lectotype of *Rissoa atomus* has been selected from Suter's five syntypes, and is here figured (Pl. 34, fig. 8). The dimensions of the figured lectotype are: Height, 1.25 mm.; diameter, 0.95 mm.

Notosetia exaltata n. sp. Pl. 34, fig. 6.

Shell minute, elongate-conic, moderately solid. Coloured uniformly light-brown. Whorls 5, including low dome-shaped protoconch. Protoconch and the whole of the post-nuclear whorls smooth and polished. Spire elevated, conic, $1\frac{1}{2}$ times height of aperture. Suture false-margined, due to the base of the previous whorl showing through, giving the appearance of a narrow subsutural band of darker brown. Aperture ovate-pyriform, comparatively small. Peristome discontinuous but united by an almost straight and upright columella, and a thin parietal callus, oblique in profile and inclined forwards above. There is a small crescentic umbilical chink. Outer lip thin and sharp, slightly adpressed at the suture.

Height, 1.55 mm.; diameter, 0.9 mm. (holotype).

Habitat: Off Owenga Beach, in 10 fathoms, in clean shell-sand.

This species belongs to the *micans* group.

Genus Estea Iredale 1915.

Estea rekohuana n. sp. Pl. 35, fig. 9.

Shell small, ovate, solid. Whorls $4\frac{3}{4}$, including low dome-shaped protoconch of $1\frac{3}{4}$ whorls, which is faintly sculptured with closely spaced spiral striae. The surface of the post-nuclear whorls is smooth, but not polished, and apart from faint, slightly oblique axial growth lines, there is no true sculpture. Spire elevated, bluntly conical, one and a-half times height of aperture. Colour reddish-brown, except for a narrow whitish band immediately below the suture, and the peristome and interior of the aperture, which is more yellowish than reddish-brown. Aperture very large, almost circular. Peristome continuous, much thickened within and clearly marked off from the base by a heavy callus. There is no umbilical chink.

Height, 2.2 mm.; diameter, 1.2 mm. (holotype).

Habitat: Waitangi (holotype) and Waitangi West, on under sides of stones.

This species is intermediate in size between *Estea minor* (Suter) and *Estea subfusca* (Hutton). Also, it has a relatively larger aperture than in either species, and a distinctive outline, the whorls being less convex than in *minor* and the body-whorl more obese than in *subfusca.* A figure of a lectotype of Suter's *Rissoa annulata* var. *minor* is given (Pl. 35, fig. 4).

Estea guesti n. sp. Pl. 35, fig. 5.

Shell small, but large for the genus, elongate-conic, solid. Whorls 6, including a low dome-shaped protoconch, of 1½ whorls, which is faintly sculptured with closely spaced spiral striae. Surface of post-nuclear whorls smooth and polished. Spire tall, almost twice height of aperture. Outline of body-whorl bulging and subangled at the periphery, outline of spire whorls almost straight. Aperture comparatively small, almost circular. Peristome continuous, much thickened within and clearly marked off from the base by a heavy callus. There is no umbilical chink. Ground colour pinkish buff to light brown, protoconch reddish-brown, upper spire whorls tinged by a very faint greyish zone spread over the lower part of the whorls and faintly persistent on the body whorl at the periphery, in front of the aperture, where the middle of this zone is more distintcly marked by a narrow line of darker grey, which proceeds from the suture. All the available specimens are dead shells, so the colour pattern should be more definite in fresh specimens. Aperture, with a narrow diffused ring of chocolate, just within.

Height, 2.8 mm.; diameter, 1.5 mm. (holotype).

Habitat: Waitangi, in shell-sand.

Compared with *zosterophila,* the Chatham species is much larger, has a subangulate body-whorl and a proportionately smaller aperture. It also resembles *subfusca,* so a figure of that species (Pl. 35, fig. 7) is given for comparison with the above new species, as well as with *rekohuana* and *porrecta,* also described herein.

Estea morioria n. sp. Pl. 35, fig. 6.

Shell minute, elongate-cylindrical, rather thin. Protoconch and spire whorls light-brown, fading to white on the body-whorl and within the aperture. Surface of post-nuclear whorls sculptured with fine, indistinct, closely spaced spiral striations, which are crossed by equally fine and closely spaced retractively-arcuate axial striations. Whorls 5, including a bluntly rounded protoconch of 1½ microscopically finely striated whorls. Spire tall, twice the height of aperture, cylindrical, sides almost straight. Aperture almost circular. Peristome continuous, much thickened inside and slightly expanded. Profile of outer lip parallel with axis of whorls. There is no umbilical chink.

Height, 2.5 mm. (estimated), 1.9 mm. (actual); diameter, 0.85 mm. (estimated), 0.8 mm. (actual). (Holotype.)

No perfect examples were found; the holotype has the outer lip missing, but the details of this are supplied by a paratype which has the body-whorl and aperture perfect, but no spire.

Habitat: Off Owenga Beach, in 10 fathoms, in clean shell-sand.

This species is a miniature of the Foveaux Strait *micronema* Suter, but it differs further in being much more cylindrical in outline.

Estea cf. **insulana** Marwick 1928.

Habitat: Off Owenga Beach, in 10 fathoms. One specimen of 4½ whorls, without the adult lip.

Previously recorded from the Chathams, only as a Pliocene fossil.

Estea porrecta n. sp. Pl. 35, fig. 8.

Shell small but moderately large for the genus, elongate, subcylindrical, solid and smooth. Whorls 6, including a low dome-shaped protoconch of 1½ whorls (surface worn). Spire tall, two and a-half times height of aperture. Outline of whorls lightly convex, spire very gradually tapered. Aperture oblique-oval, very small. Peristome continuous, much thickened within the aperture and clearly marked off from the base by a heavy callus. There is no umbilical chink. Colour uniformly yellowish-brown, probably darker in fresh specimens.

Height, 2.7 mm.; diameter, 1.0 mm. (holotype).

Habitat: Waitangi, in shell-sand.

This species is nearest to *E. micronema* Suter in shape, but it differs in having a considerably smaller aperture and no sculpture.

Estea gracilispira n. sp. Pl. 34, fig. 4.

Shell minute, elongate-oval, semi-transparent, white, polished, thin and fragile. Whorls 4½, including low dome-shaped smooth protoconch, which is not clearly marked off from the post-nuclear whorls. Apart from very faint obliquely retractive growth striae there is no sculpture, the surface of all whorls being smooth and glossy. The suture is false-margined by the base of the preceding whorl showing through. Spire tall, 1½ times height of aperture. Aperture almost circular. Peristome continuous, dilated slightly over the basal and columellar portions and adnate across parietal wall as a distinct connecting callus. In profile the outer lip is straight with the axis of the whorls. There is no true umbilical chink, but there is a slight cavity owing to the overhanging nature of the columellar lip.

Height, 1.25 mm.; diameter, 0.60 mm. (holotype).

Habitat: Off Owenga Beach, in 10 fathoms, in clean shell-sand.

In its thin, semi-transparent shell this species appears to be a *Notosetia,* but the aperture is definitely of the *Estea* type.

Genus LINEMERA Finlay 1924.

Linemera maclurgi n. sp. Pl. 33, fig. 2.

Shell small, elongate-ovate, moderately solid, white. Whorls 5, including a prominent protoconch of two globose, smooth whorls. Post-nuclear sculpture of prominent axials, crossed by less prominent spirals. The points of intersection are raised into rounded gemmules. There are seventeen axials on the penultimate and nineteen on the body-whorl, and the interspaces are a little wider than the width of the axials. The spiral cords are few, only two on the spire whorls, with a third developing from the lower suture on the body-whorl, and two more on the base. Spire tall, about one and two-thirds height of aperture. Aperture ovate. Peristome continuous, not variced. There is a long crescentic umbilical chink, and this is bordered by the lower of the two basal spirals.

Height, 1.8 mm.; diameter, 1.05 mm.

Habitat: Off Owenga Beach, in 10 fathoms, in clean shell-sand (holotype) ; Waitangi, in shell-sand.*

The previously described species all differ in having a greater number of spiral cords. The species is named after Mr. Tom MacClurg, whose launch was used for the dredging.

Genus MERELINA Iredale 1915.

Merelina waitangiensis n. sp. Pl. 33, fig. 3.

Shell nearest to *superba* Powell 1927, but differing from that species in having more numerous spiral ridges and fewer axials, which causes the enclosed rectangular interspaces to be more than twice as long as high. Penultimate whorl with thirteen axials. Spire whorls with four to five spirals, body-whorl with nine. In *superba* there are from three to five spiral ridges on spire whorls and eight on the body-whorl. Post-nuclear whorls 5, protoconch damaged. Spire tall, more than three times height of aperture. Colour uniformly buff.

Height, 4.3 mm. (actual), 4.4 mm. (estimated) ; diameter, 1.7 mm. (holotype).

Habitat: Waitangi, in shell-sand.

Genus SUBONOBA Iredale 1915.

Subonoba inornata n. sp. Pl. 35, fig. 3.

Shell minute, subcylindrical, thin, coloured uniformly pale buff. Surface dull, smooth except for weak spiral lirae. Whorls 4½, including bluntly rounded protoconch of 1½ smooth whorls. Spire tall, about 1½ times height of aperture. Post-nuclear whorls faintly angled at the upper third. Sculpture consisting of low,

*I have since found this species in a dredging from 170 fathoms, off the Bounty Islands.

indistinct spiral lirae, five on the penultimate and eight on the body-whorl and base. The width of the interspaces is about equal to that of the lirae. On the base the three spirals are grouped above, leaving the lower half smooth. Aperture large, oblique, ovate-pyriform. Peristome continuous. Outer-lip dilated oblique in profile with a shallow sinus above, and inclined forwards basally.

Height, 1.92 mm.; diameter, 0.9 mm. (holotype).

Habitat: Waitangi, on seaweeds.

This species is closely related to *Subonoba parvula* Powell 1931, but it differs in being larger and distinctly shouldered, and in having fewer spiral lirae. Both these species are difficult to place generically. Except for the absence of axial sculpture there is a strong resemblance to *Austronoba candidissima* (Webster), and a superficial likeness to *Striatestea bountyensis* Powell 1927, but in the latter the aperture is straight with the axis of the whorls, and the protoconch more narrowly conical. Although the aperture in *parvula* and *inornata* is more pyriform than in typical members of *Subonoba,* the shells are not dissimilar in other respects and may be provisionally located here until more is known concerning the anatomy of our Rissoids.

Subonoba cf. **paucicostata** Powell 1931.

Habitat: Waitangi, in shell-sand. The type is from off the Bounty Islands, in 50 fathoms.

Chatham shells have a slightly smaller body-whorl and there is an incipient sixth spiral ridge, which appears near the upper suture of the body-whorl, but there is insufficient material to determine if these differences are constant.

Not previously recorded from the Chathams.

Subonoba morioria n. sp. Pl. 35, fig. 2.

Shell small, ovate, thin, fragile, white and translucent. Whorls 4½, including a bluntly rounded protoconch of 1½ smooth whorls. Spire tall, about 1¼ times height of aperture. The sculpture consists of numerous fine and closely spaced spiral lirae, 9 on the penultimate whorl, and 14 on the body-whorl and base. The interspaces are mostly about half the width of the lirae, but those near to the upper suture are wider and equal to the width of the lirae. Aperture ovate, peristome continuous. Outer-lip with a shallow sinus above and inclined forwards slightly below.

Height, 1.9 mm.; diameter, 1.0 mm. (holotype).

Habitat: Waitangi Beach, in shell-sand.

This species has the same number of penultimate spirals as in *foveauxiana,* but is nearer to *fumata* in shape. From *fumata,* which also occurs commonly at the Chathams, *morioria* differs in having stronger spirals, a more inflated body-whorl and a shorter spire.

A lectotype of *S. foveauxiana* has been selected from Suter's two syntypes and a figure of it is given for comparison with the Chatham Island species. (Pl. 35, fig. 1.)

CYMATIIDÆ.

Genus CABESTANA Bolten 1798.

Cabestana waterhousei segregata Powell 1933.

Habitat: Owenga Beach (one badly worn specimen). Not previously recorded from the Chathams.

PYRAMIDELLIDÆ.

"Turbonilla" campbellica Odhner 1924. Waitangi, under stones.

Chemnitzia n. sp. Off Owenga, in 10 fathoms.

New genus and species aff. **Turbonilla.** Waitangi, in shell-sand.

New genus and species aff. **Pyrgulina.** Waitangi, in shell-sand.

Evalea sabulosa (Suter 1908). Waitangi, in shell-sand.

"Odostomia" cryptodon Suter 1908. Waitangi, in shell-sand.

Graphis blanda (Finlay 1924). Off Owenga, in 10 fathoms.

For the above identifications I am indebted to Mr. C. R. Laws, who has written a monograph of the N.Z. Pyramidellid Molluscs, in which will appear the new genera and species here listed.

The above species are all new additions to the Chatham Island faunal list.

VOLUTIDÆ.

Genus PACHYMELON Marwick 1926*

Subgenus PALOMELON Finlay 1926.

Pachymelon (Palomelon) wilsonæ n. sp. Pl. 36, fig. 18.

Shell large, solid, fusiform. Spire half height of aperture. Nucleus damaged. Post-embryonic whorls 5, spire whorls subangled at the middle, body-whorl moderately inflated, contracting gradually to a feeble fasciole. Sculpture consisting of narrow axial ribs, extending from suture to suture on the spire whorls, and to just below the periphery on the body-whorl. These axials are thickened slightly in the middle, where they cross the subangle. On the last half-whorl they become sub-obsolete. There are 14 axials on the penultimate whorl and 12 on the ante-penultimate. Aperture elongate, with a moderately wide but very shallow basal notch. Columella straight, with four strong oblique plaits, uppermost strongest, lower three becoming weaker in descending order. Inner-lip spread as a thin glaze in one wide sweep over the body-whorl. Colour pinkish-buff, maculated with three zones

**Pachymelon,* proposed as a subgenus of *Waihaoia* by Marwick, has been given generic status by Finlay in Laws (1932, p. 200).

of irregular zigzag markings of dark reddish-brown. Upper band below suture, middle band at periphery, and lower one bordering the fasciole.

Height, 112 mm. (estimated), 109 mm. (actual); diameter, 47 mm. (Holotype).

Habitat: Owenga Beach. (One well preserved dead shell and a fragment among debris cast up on the beach.)

The holotype was found by Miss B. M. Wilson, of Wharekauri. This makes a very important addition to the New Zealand Recent fauna, as it is the second known member of its subgenus. Watson's *Cymbolia lutea,* the type of *Palomelon,* is a unique species dredged by the "Challenger" Expedition in 275 fathoms, 250 nautical miles west of New Plymouth.† Compared with *lutea,* the Chatham shell is much larger and more stoutly built, with stronger axials and a shorter spire.

Buccinulidæ.

Genus Buccinulum Swainson 1837.

Buccinulum waitangiensis n. sp. Pl. 36, figs. 12 and 13.

This species has been recorded from the Chathams as *lineum,* by both Finlay and myself, but the collecting of a series of specimens at Waitangi, where it is common, demonstrates that the specific identity with the northern species can no longer be maintained.

From *lineum,* the Chatham species differs in shape, being proportionately wider, owing to the body-whorl being considerably inflated, and the colour lines, although variable in number, are always fewer than in *lineum.*

The holotype has three lines on the spire whorls, a further three round about the periphery of the body-whorl, and two towards the neck of the anterior canal. An extreme paratype has one line on spire whorls, three on body-whorl, and a fourth near canal neck. In *lineum* the colour lines are far more constant, four appearing on spire whorls and ten on body-whorl. However, quite apart from the colour pattern, the shape of the Chatham species is quite constant and very distinct from that of true *lineum,* specimens of which are figured for comparison. (Pl. 36, fig. 14.)

Height, 42 mm. (estimated), 41 mm. (actual); diameter, 21 mm. (holotype).

Height, 41 mm.; diameter, 19.5 mm. *(lineum).*

Habitat: Waitangi Beach.

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†See Marwick (1926, p. 282).

Genus COMINELLA H. and A. Adams 1853.

Subgenus EUCOMINIA Finlay 1926.

Cominella (Eucominia) ellisoni consobrina n. subsp. Pl. 36, fig. 8.

Four dead shells collected together with some hundreds of *C. iredalei* from the beach near Owenga, are definitely not the latter species, but are much nearer to the Pliocene *ellisoni* in shape, but not in sculpture. Furthermore, one of a series of shells from Titirangi, the type locality for *ellisoni*, differs from that species in having the characteristics of the Recent subspecies, which I here propose as new. Obviously this subspecies is between the common Pliocene *ellisoni* and the common Recent *iredalei*, but although a large number of specimens were collected, no connecting intermediates were found either at Owenga or at Titirangi. The three Owenga specimens are very worn and bleached, so there is just a possibility that they may have been weathered out from some unknown submerged outcrop of the Titirangi formation. However, this is unlikely, as many of the *iredalei* specimens exhibit the same degree of weathering as in the *consobrina* specimens.

Post-embryonic whorls, six. Sculpture of prominent axials and spirals. There are 17 axials on the penultimate, on the holotype and two paratypes, and 15 in the Titirangi specimen. A deep subsutural fold cuts across the axials, leaving a nodulous band at the suture, as in *iredalei*. Spiral sculpture strong, as in *ellisoni*, about six from subsutural groove to lower suture. Spire tall, a little more than height of aperture. In *iredalei* the spire is constantly lower than the aperture.

Height, 62 mm. (estimated), 60.5 mm. (actual); diameter, 29 mm. (holotype).

Height, 53 mm.; diameter, 31 mm. *(iredalei)*.

Height, 60 mm.; diameter, 31 mm. *(ellisoni)*.

Habitat: Owenga Beach; Titirangi (Pliocene).

The Titirangi specimen was collected by Mr. C. A. Fleming, who accompanied me.

PYRENIDÆ.

Genus ZEMITRELLA Finlay 1926.

Zemitrella finlayi n. sp. Pl. 36, fig. 6.

Shell small, elongate-oval. Whorls 5, including typical protoconch of two smooth papillate whorls. Spire tall, conical, one and a fourth times height of aperture. Body-whorl narrow, almost cylindrical. The only sculpture consists of eight closely spaced spiral striae at the anterior end of the body-whorl. Colour yellowish-brown, with a very narrow white line below the periphery and a spiral series of widely spaced dots just below, while on the sculptured anterior end there is a further series of white dots. In some of the paratypes there is in addition a peripheral series of white dots on the body-whorl, and in a few others all three white zones are more or less connected axially by zigzag white lines. Base of pillar with a very weak oblique plait, which is most distinct in half-grown shells.

This species differs from *chaova* in having a less inflated body-whorl and fewer spirals on the anterior end.

Height, 4.0 mm.; diameter, 1.7 mm. (Holotype).

Habitat: Waitangi, in shell-sand.

The holotype of Suter's *Paxula leptalea,* from 50 fathoms, off the Bounty Islands, is also figured (Pl. 36, fig. 5), as Finlay (1928, p. 256) has recorded *Paxula* n. sp. aff. *leptalea,* from the Chathams.

Philinidæ.

Genus Philine Ascanius 1772.

Philine cf. **constricta** Murdoch and Suter 1906.

Habitat: Off Owenga, in 10 fathoms. The single live specimen was crushed by the dredge, so its identification is a little uncertain. Not previously recorded from the Chathams.

CEPHALOPODA.

Argonautidæ.

Genus Argonauta Linn. 1758.

Argonauta nodosa Solander 1786.

Finlay recorded *A. argo* Linn. from the Chathams, but all the specimens I have seen are referrable to *nodosa.* Suter, in his Atlas, Pl. 72, has confused matters by figuring true *nodosa* as *argo,* although in his synonymy of *argo* he includes Kirk's *A. bulleri* from Portland Island, which, as shown by Kirk's figure, Pl. 4, is a true *argo,* having the ribs free from tubercles on the sides.

Now apart from *argo* there are two distinctive Argonauts found in New Zealand, both of which attain a large size and are similarly tubercular in sculpture. They differ in that one, *nodosa,* has "ears" or projections between the whorl and the normal sweep of the lip, while in the other, which seems to be Shaw's *tuberculata,* the lip swings out direct from the whorl in an even curve. These differences are constant in series and in all growth stages of both species.

Formerly *nodosa* and *tuberculata* were considered to be synonymous, but it seems likely from early figures that *tuberculata* represents the evenly arcuate lipped shell and *nodosa* the eared one. Unfortunately I have not been able to refer to Shaw's original figure of *tuberculata,* but W. Wood, 1825, in his "Catalogue of Shells," figures a *tuberculata* without "ears," and Tryon, 1879, Manual of Conchology, figures a *nodosa* with definite "ears."

Even if the names *tuberculata* and *nodosa* prove to be both applicable to the one type of shell, the former name must fall as a synonym of *nodosa,* which was published in the "Portland Catalogue" in 1786, four years prior to Shaw's species.

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Fig. 1. *Brookula (Aequispirella) finlayi* n. sp. (Holotype).
Fig. 2. *Linemera maclurgi* n. sp. (Holotype).
Fig. 3. *Merelina waitangiensis* n. sp. (Holotype).
Fig. 4. *Sinezona pauperata* n. sp. (Holotype).
Fig. 5. *Sinezona pauperata* n. sp. (Paratype).
Fig. 6. *Scissurella prendrevillei* n. sp. (Holotype).
Fig. 7. *Macquariella* n. sp.
Fig. 8. *Condylocardia pectinata chathamensis* n. subsp. (Holotype).
Figs. 9 and 10. *Munditia owengaensis* n. sp. (Holotype).

Plate 34.

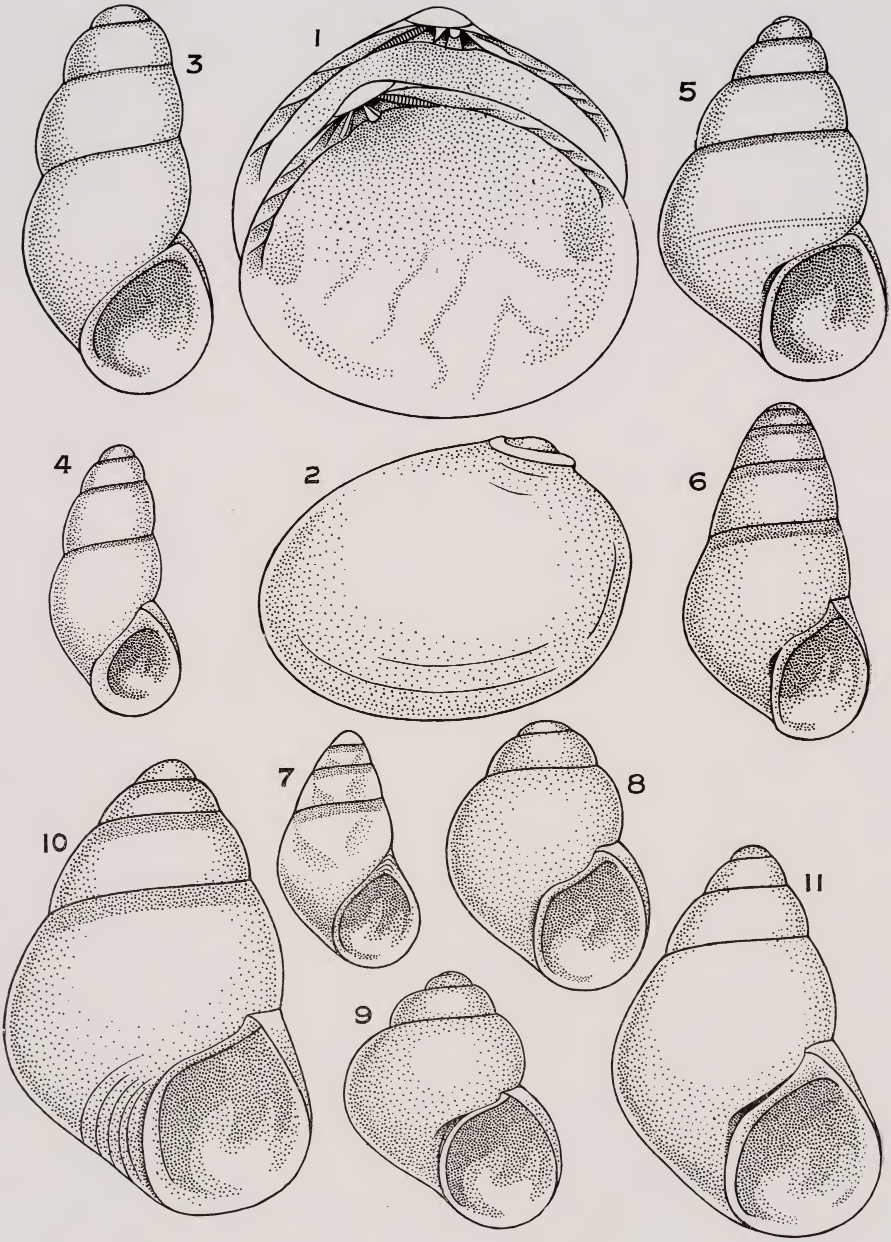


Fig. 1. *Perrierina insulana* n. sp. (Holotype).
Fig. 2. *Benthocardiella obliquata chathamensis* n. subsp. (Holotype).
Fig. 3. *Notosetia lubrica* (Suter) (Holotype).
Fig. 4. *Estea gracilispira* n. sp. (Holotype).
Fig. 5. *Notosetia infecta* (Suter) (Lectotype).
Fig. 6. *Notosetia exaltata* n. sp. (Holotype).
Fig. 7. *Notosetia lampra* (Suter) 10 fathoms off Owenga.
Fig. 8. *Notosetia subflavescens* (Iredale) (=*R. atomus* Suter) (Lectotype).
Fig. 9. *Notosetia atomaria* n. sp. (Holotype).
Fig. 10. *Notosetia neozelanica* (Suter) (Lectotype).
Fig. 11. *Notosetia verecunda* (Suter) (Lectotype).

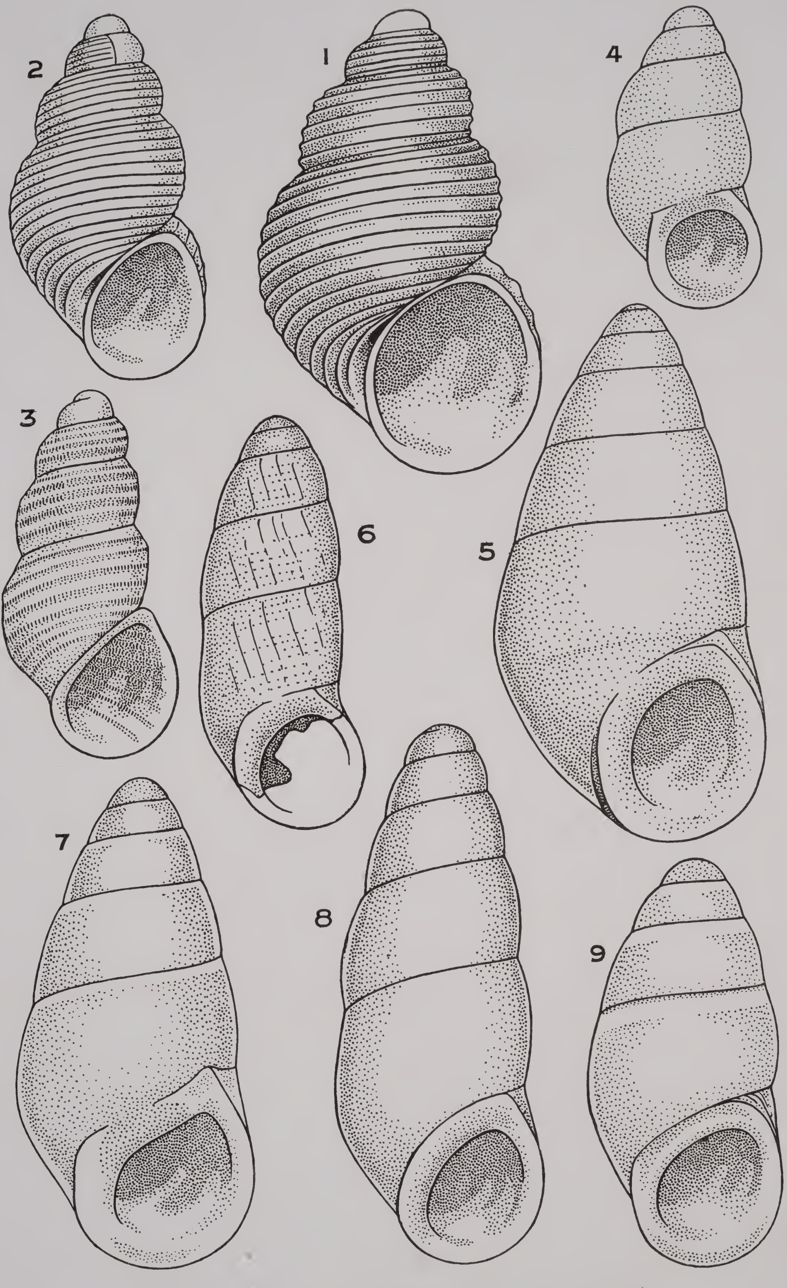
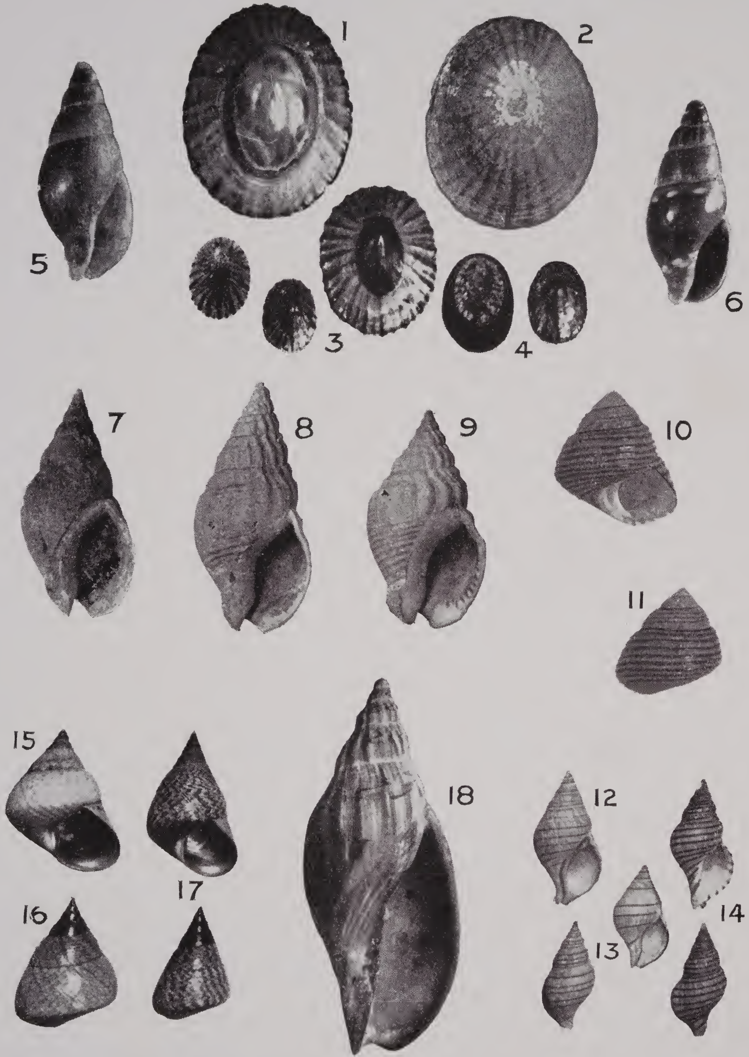


Fig. 1. *Subonoba foveauxiana* (Suter) (Lectotype).
Fig. 2. *Subonoba morioria* n. sp. (Holotype).
Fig. 3. *Subonoba inornata* n. sp. (Holotype).
Fig. 4. *Estea minor* (Suter) (Lectotype).
Fig. 5. *Estea guesti* n. sp. (Holotype).
Fig. 6. *Estea morioria* n. sp. (Holotype).
Fig. 7. *Estea subfusca* (Hutton) (Topotype).
Fig. 8. *Estea porrecta* n. sp. (Holotype).
Fig. 9. *Estea rekohuana* n. sp. (Holotype).



Figs. 1-4. *Cellana chathamensis* (Pilsbry).
Fig. 5. *Paxula leptalea* (Suter) (Holotype).
Fig. 6. *Zemitrella finlayi* n. sp. (Holotype.)
Fig. 7. *Cominella (Eucominia) ellisoni* (Marwick) (Topotype).
Fig. 8. *Cominella (Eucominia) ellisoni consobrina* n. subsp. (Holotype).
Fig. 9. *Cominella (Eucominia) iredalei* (Finlay) (Topotype).
Fig. 10. *Micrelenchus sanguineus morioria* n. subsp. (Holotype).
Fig. 11. *Micrelenchus sanguineus morioria* n. subsp. (Paratype).
Fig. 12. *Buccinulum waitangiensis* n. sp. (Holotype).
Figs. 13. *Buccinulum waitangiensis* n. sp. (Paratypes).
Figs. 14. *Buccinulum lineum* (Martyn) Rangitoto Id., Auckland.
Fig. 15. *Cantharidus opalus cannoni* n. subsp. (Holotype).
Fig. 16. *Cantharidus opalus cannoni* n. subsp. (Paratype).
Fig. 17. *Cantharidus opalus* (Martyn) Mount Maunganui, Bay of Plenty.
Fig. 18. *Pachymelon (Palomelon) wilsonae* n. sp. (Holotype).

Wood Carving in the North Auckland Area.

By GILBERT ARCHEY, Director.

This paper describes two unusual carvings from the North Auckland Peninsula, and discusses the special features of the wood-carving art of that area.

NEW CARVINGS.

The carvings comprise a canoe prow from Doubtless Bay (Pl. 37, fig. 1) and a carved slab from Awanui (Pl. 38). The canoe prow was recovered from a partly-drained swamp behind the sand-dunes at the northern end of Doubtless Bay, and was presented to the Museum by Mr. H. E. Vaile. It comprises a long narrow basal portion, which would have been fitted, as a lid, over the bow of the canoe, and secured by lashings passed through the rudely mortised holes (originally five) in each side. Rising from the front of the base is a head, set on a moderately long neck, behind which is a secondary head at the end of a long curved neck. The main head has the ears, eyes and nostrils clearly indicated, and the mouth is drawn out, giving the figure a bird-like aspect; the subsidiary head is also bird-like.

The eyes of the figure are represented by shallow incised ellipses, that of the main figure being contained within a depressed socket, surrounded above, behind and below with a raised rim armed with four tooth-like processes. Large triangular teeth are represented very clearly and boldly in the mouth of the main figure, in which also the ears are clearly indicated. An interesting feature is the presence, chiefly on the necks of both figures, of projecting elliptical knobs or processes irregularly arranged.

In another paper (Journn. Polynes. Soc. Sept., 1933) I have discussed the bird-like appearance of human heads in Maori carving, and the illustrations of canoe prows given here (Pl. 37, figs. 1-3) will also show how this bird-resemblance has resulted from the gradual elongation of the mouth of human heads in profile.

The Doubtless Bay prow may therefore be classified as a prow of the general coastal fishing canoe type (Pl. 37, figs. 2 and 3) which exhibits, in the deep socketed eye and elongated mouth, in the scattered processes, and the presence of a subsidiary figure, special local characteristics.

The rectangular slab illustrated on Plate 38 was discovered during draining operations in the Awanui swamp, and was presented to the Museum by Mr. G. Evans. Unfortunately, the whole slab was not recovered, and the missing portions are just those that were likely to have been most interesting. There are ten small, roughly mortised, rectangular holes on the back of the carving; they are irregularly arranged and bear no relation to the design on the front. I am unable to suggest the use or purpose of the slab.

The two human figures, one with arms upraised, the other with them almost akimbo, might be regarded as being in dancing attitudes: the trace of the lowest portion of the face in the right hand figure suggest that it was shown full face. Three straight sharp-pointed fingers and toes are represented, but the most interesting feature is the presence of conical spines projecting from body, neck and limbs. These spines are also present on the two figures and on the two vertical bars at the left end of the slab.

These two figures or heads are much unlike other forms produced by the Maori carver. On Plate 39, figs. 2 and 3, they are illustrated enlarged and reversed for better comparison with the Doubtless Bay canoe prow head (fig. 1). They are very bird-like, particularly fig. 3, and a most interesting item is the apparent attack on a man's legs by fig. 3, and the successful swallowing (?) of the man by fig. 2, which has a small human figure faintly indicated in the position of the gullet. The upper figure (2) has two teeth, and the lower (3) has one tooth in each jaw.

BIRD OR HUMAN HEADS?

The question of their bird or human nature arises here. The beak-like mouth, and the projections, if regarded as feathers, though there is no particular reason why they should be, might support the bird view, while the presence of teeth, the fact that the putative feathers are also represented on the vertical bars and appear to be part of the general decoration, and the very considerable resemblance in details of figure 2 to the canoe prow (fig. 1), which, as we have already seen, is developed from the typical human-headed prow, can be quoted in favour of their human nature. It is most unfortunate that the heads are missing from the human figures of the slab, for they might have provided the necessary clue. On the whole, I am most impressed by the fact that both the heads on the Awanui carving stand *en series* with the various representations of the *manaia*, which I have shown elsewhere (Journ. Polynes. Soc. Sept., 1933) to be human figures with the face in profile.

Skinner (1933, pp. 107 and 110-113), in precursory reference to the conclusions to be presented here and in Journal of the Polynesian Society, September, 1933, has discussed "The Maori Rendering of a Bird's Head," and, as instances of this, cites (p. 110, fig. 52) a figure from Waverley in the Wanganui Museum, and the Moriori curved stone *patu* illustrated by him in the Bishop Museum Memoirs, vol. 9, Pl. 30, which are similar to the Maori bone weapons known as *waha ika.*

The small carved head above the typical human figure in the Waverley specimen might very easily be a naturalistic bird, but it might also be a normal *manaia* head—the carving is too badly worn to be certain—and, as the present writer has shown (1933) the *manaia* head is a conventionalised form of the human head in profile. Moreover, even if this head were definitely a naturalistic bird, such representations in carving are too few, and the early stages of the development of the typical *manaia* from an undoubtedly human rendering are too numerous, to warrant the conclusion that the *manaia* is a humanised bird.

While the Moriori curved *patu* has some resemblance to a bird in outline, a bird is a very unlikely model for such an implement as a club, particularly if, as in this case, the weapon would have to be held upside down to exhibit the resemblance. On the other hand, the curved outline of the *patu,* as naturally held, does feel in harmony with the sweep of the blows for which it was intended, and is a type of curve by no means uncommon for striking weapons in other parts of the world. Due attention must, however, be paid to the illustrations given by Skinner (1931, p. 185) of *patu* from the Chatham Islands (fig. 2) and New Zealand (fig. 4), which have naturalistic birds carved on the butt.

The reference of the shape of these clubs to a natural form is further confused by the occasional presence on them of curved ridges at the base of the blade: they are indicated on the Auckland Museum and the Otago Museum specimens figured by Skinner (1923, Pl. 30, fig. d, and Pl. 27, fig. b) and on a straight *patu* recently presented to the Auckland Museum by Mr. Cyrus Cannon. These ridges are eyebrows, as has been recently demonstrated by Skinner (1931, pp. 184-187, figs. 9-11), the whole blade of the *patu* being in these cases the outline of an otherwise featureless human face.

As an instance of the "conventional rendering of birds by Maori artists," Skinner (1933, pp. 111-113) cites a carved bone thatching needle and a wooden memorial carving from Opotiki, in which he says, "the head is strongly humanised, eye and eyebrow following the human convention. The nose and nostril represent a bird's beak." I do not follow the last sentence, because in the illustration given (figs. 52-53) the nostrils are clearly represented separate from the beak. The supposed bird beaks are, however, simply the lips of a human face elongated in conformity with the long, narrow form of the implement or slab, as will be readily seen if Mr. Skinner's figures are viewed reversed vertically, as I have reproduced them here (Pl. 40, figs. 8-9), and compared with the other carvings illustrated beside them.

NORTHERN PENDANTS.

In the same paper Skinner also gives illustrations (p. 108) of bone and greenstone pendants representing "bird-headed men," in which the human bodies can be readily recognised, though the interpretation of the head depends upon the acceptance or rejection of the conclusions put forward by the present writer (1933). But, in any case, reference may be made to the general resemblance of these pendants (Pl. 41, figs. 2-3) to the elongated figures (fig. 1) which form the leading motive in trapezoid canoe prows such as the fine British Museum specimen illustrated, by kind permission of the Director, in Pl. 49, fig. 1, of this paper.

In mentioning pendants, reference may be made to the *marakihau* and the *pekapeka*, of which the latter is regarded by Skinner (1933, p. 7) as a representation of a bird-headed man, occasionally with human heads.

When the greenstone *marakihau* was first described (Archey, 1927) it was referred to as of the *pekapeka* type, with which identification Skinner (1932, p. 209) disagreed, pointing out its undoubted connection with the *marakihau* in wood. In his recent paper (1933, p. 7) he has dealt with both *pekapeka* and *marakihau*, and refers to certain of the latter as having been "strongly influenced by the *pekapeka* form, being perhaps more correctly described as a hybrid between the two forms," from which it appears that he regards them as separate and independent forms.

I suggest, however, that they are not separate, but are genetically related forms (Pl. 42, figs. 1-8), of which the *marakihau* (figs. 1-5) is the primary, being based, as Skinner pointed out, on the *marakihau* in wood carving. The *pekapeka*, instead of influencing the *marakihau* in its own direction, seems rather to have been derived from it by the addition of a head (Pl. 42, fig. 6) at the lower end (a common wood-carving detail, cf. pl. 41, fig. 5). Through the subsequent turning of the pendant sideways (figs. 7-8) there has been finally evolved the typical double human figure in which two heads may share one twisted U-shaped body with a variable number of arms and/or legs. Thus the three pendants, the elongated, sinuous "*whakakaipiko*" (Pl. 41, fig. 2), the *marakihau* and the *pekapeka* may be linked up with corresponding figures in wood carving.

It may be added that the bird's head which Mr. Skinner (1932, p. 209) supposed might be represented below the head of the Kaikohe *marakihau* (Pl. 42, fig. 1) cannot be recognised there, and that comparison of the general stance of the human figure in this pendant with that of similar figures in wood-carving affords support for the original identification of this feature as the left arm.

NORTH AUCKLAND CARVINGS.

But to return to the northern carvings described above and their relationships: the presence of common features in these two carvings has already been mentioned. The irregularly disposed angular projections are the most obvious: but attention should also be given to the form of the mouth in Pl. 39, figs. 1 and 2, the representation of the teeth, and the carving of the eye, which in each case is a simply incised outline within a more deeply carved socket with toothed margin.

These features are sufficient to indicate that the two specimens belong to the same school of carving, and it will be interesting to enquire whether they are related to other carvings of the same area.

While the general resemblance of these two carvings to other North Auckland carvings is not obvious, an examination of the "full-face" of the Doubtless Bay prow (Text fig. 1) will reveal a general resemblance to the heads on certain bone boxes from North Auckland (Pl. 41, fig. 4), and a more definite resemblance to them in certain details, i.e., the raised eyebrow-ridge of Pl. 45, fig. 3, the triangular teeth in the same figure and in figs. 1 and 2, and the detail of the elongated nose, which can be compared with Pl. 41, fig. 4, and the noses on the bone boxes illustrated on Pl. 44.

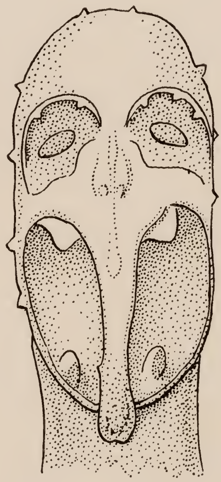


Fig. 1. Doubtless Bay prow, front view.

Teeth of the same triangular form are also present in the terminal figures of the Kaitaia carving (which has also a simply incised eye-outline) (see Pl. 46, fig. 2), and in the Hokianga bone box (Pl. 44, fig. 2), which has pointed fingers and toes like those of the Awanui slab. Pointed or claw-like fingers and toes rendered rather more decoratively are indeed very common among North Auckland carvings.

It will be seen, therefore, that both the Doubtless Bay and the Awanui carvings can be regarded as specialised or extreme types of the carving typical of the North Auckland area.

NORTH AUCKLAND AND RELATED ART AREAS.

This North Auckland art deserves some study, because it has been referred to as being especially Melanesian in type, and has been cited as evidence of the presence of a culture other than typical Maori in this region.

One characteristic feature of this area is the elongation of the human head, often with a high, narrowing forehead, as can be seen in the Kaipara carvings (Pl. 41, figs. 5 and 6), and the Hokianga burial chest (fig. 4), in all of which the wide-open mouth, with its four teeth, is the broadest part of the face; the lower lip is usually pointed downwards medianly, and is not obscured at this point by the protruding tongue.

The eyes are never ring-socketed for *paua* shell inlay, as in the South, but are either protruding (Pl. 45, fig. 2), or represented as flat discs with incised outline.

The whole figure, too, is usually long and narrow (Pl. 41, figs. 1 and 6), though this narrowing of the human figure is not uncommon in the Rotorua district, where, however, it is usually confined to subsidiary figures overlying the main carving (see Archey, 1933, Pl. 6). It is not, of course, suggested that the characteristics mentioned above are exclusive to the Northern area, or that they are the only renderings of those details to be found in that area; they are, however, most common there, and not usual elsewhere except in certain adjoining areas, where related styles occur.

The elongated, claw-like hands and fingers have been referred to above; and a further feature to be mentioned is the shallowness of the relief decoration, which becomes lower in relief as we go further north.

The elongated head with a high, domed and undecorated forehead, and with flat disc eyes, can also be observed in the figures on the British Museum trapezoid canoe prow (Pl. 49, from Journ. Anthr. Inst., vol. 29, Pl. 30), particularly in those on the base of the anterior and posterior marginal bands.

It will thus be seen that while the Northern art retains the fundamental characteristics of Maori carving, it modifies them in a local fashion.

THE KAITAIA CARVING.

The Kaitaia carving (Pl. 46, fig. 2) claims some consideration in a discussion of the wood-carving of the North Auckland area. Skinner's interpretation (1921 a, p. 93) of this carving as akin to the type of *pare*-composition, illustrated in Pl. 46, fig. 2 and fig. 3, can be readily followed, for in all three we have a central figure on a base, and a main terminal figure at either end, each joined to the central figure by a narrow curved border.

With regard to the terminal figures themselves: Appreciation of the Maori carver's propensity to distort the human figure in accordance with his mood or the form and proportions of the design in hand will render Skinner's original interpretation (1921a, p. 93) of these as *manaia*-derivatives quite as acceptable as his subsequent agreement (1921 b, p. 247) with Waite (1921, p. 246) that they might be reptilian; but in any case, whether human or reptilian, the rendering of the teeth is typically northern.

The central figure's straight mouth, with straight, protruding tongue, is repeated in the Whangamumu "chevroned" pendant (J.P.S., 32, p. 29) and the Waitotara stone pendant (Maori Art, Pl. LVI.), and is reminiscent of the Marquesan rendering of the mouth. The chevrons of the Kaitaia carving add another detail of association with the ivory and bone "chevroned" pendants. In an ivory pendant (Pl. 46, fig. 1), recently discovered in a cave at Coromandel, the chevrons are simplified limbs, thus enabling us to recognise as toes or fingers the notching at the end of the chevrons in the Cape Campbell (Maori Art, Pl. 47, 2) and the Waikouaite (ibid, Pl. 47, fig. 1) examples, and perhaps to associate the conventionalised limbs of these pendants with those in the small ear-ornaments from the Marquesas (Linton, 1923, Pl. 79, fig. B).

The Kaitaia carving chevrons may also be limbs, but if so the carver has confused the issue by omitting the notched ornament of the upper and lower bands from the place of junction of the chevrons with the bands where one would expect to find it. Should, however, the Kaitaia carving chevrons be finally established as limb or body conventions, the whole composition will be even more readily related to *parc,* such as the Hauraki carving.

These apparently older carvings, in wood and bone, may possibly be examples of an earlier conventionalisation of the human figure in New Zealand, one producing designs in which a simple succession of figures was the main feature. The simplicity of the designs, the fact that all the examples have been found in circumstances indicating some antiquity, lend force to Skinner's suggestion that they may represent an earlier art in New Zealand. Ultimately, these fragments may be definitely associated with the results of the archaeological studies of Skinner and Teviotdale in the South Island, and of Skinner in the Chatham Islands, and with such eastern Polynesian carvings as those illustrated by Emory (1931, p. 253), and may thus throw some light on the culture of the earlier migrants of eastern Polynesians to Aotearoa, whose history and traditions seem not to have survived the subsequent ascendancy of the Fleet migrants.

RELATED SCHOOLS.

We may now compare the art of the North Auckland area with what seem to be related schools in Hauraki and Taranaki. The features to be mentioned indicate that the carving in the three areas concerned possess, in common, a fundamental characteristic with its associated details, in which they differ from the carving of other North Island areas.

On Plate 48 are illustrated a door-lintel, or *parc,* from Patetonga, Hauraki district (fig. 3), and another from Rotorua (fig. 1). In the former the seven human figures are prominent, and except for the central one, are represented in lively attitudes, giving the impression of rhythmic vigour; the pierced tracery of interlocking loops, while neither losing nor denying the feeling of movement of the figures, is subsidiary and less tumultuous, like the quieter, breeze-rippled shallows bordering a sturdy dancing stream.

In the Rotorua *pare* the figures are no less prominent, but being equal in size, and in a more stationary attitude, give a very desirable sense of stability to the composition; while the feeling of rhythmic movement is now taken up by the more strongly emphasized spirals. This fundamental difference in rhythm emphasis, on the figures in the Hauraki carving, and on the spirals in the Rotorua area, is accompanied by differences in superficial detail decoration. In the Hauraki carving the limbs of the figures are more naturalistic and but little decorated, while the lips are narrow bands with a simple pattern; in the Rotorua *pare,* and in Rotorua-East Coast carvings generally, the human figures usually have their natural form modified by an emphasis of limb joints and facial features obtained by first enlarging them and then covering the expanded surfaces with a double spiral. Other details of difference are the more slender pointed figures and the triangular feet, with pointed toes, in the Hauraki carving, and the straighter, thicker, blunt-ended fingers, and the broad foot with the separated, stumpy toes in the Rotorua example.

It should be noted, however, that compositions with the emphasis on the figures are not confined to the Northern-Hauraki-Taranaki areas, for there is a type of *pare* (Pl. 46, figs. 3-4) in which the space between the three main figures is filled on each side with three subsidiary figures represented with some degree of realism in fig. 3, but conventionalised to elongated *manaia* in fig. 4. Nevertheless, both the main and the subsidiary figures in these *pare* are definitely comparable with those in the Rotorua *pare* (Pl. 48, fig. 1), and reveal the same type of surface decoration with spirals, which, to some extent, subdue the effect of the outlines of the figures themselves.

An examination of carvings from North Auckland (Pl. 41) and Taranaki (Pls. 47, 50) will show that they share with the Hauraki carving the features I have mentioned, i.e., emphasis on the human figure, instead of on the intervening detail, the simpler decoration of the figures and the local manner of representing fingers and toes.

A recently discovered *pare* (Pl. 48, fig. 4) from a swamp at Thornton's Bay, near Thames, exhibits the same general design as the Hauraki lintel. It has but five figures, crudely but none the less vigorously expressed, two of them having their arms linked, as have a couple in the Hauraki *pare:* this linking of arms and legs is also a feature in Taranaki carving, where it is carried still further in the linking of arms, legs and bodies in a very involved manner (Pl. 47, fig. 2). The Te Puke *pare,* presented to the Auckland Museum by Mr. F. Crossley Mappin (Pl. 48, fig. 2) has the same seven figures as the Hauraki lintel, whose finish, however, it lacks; it exhibits, moreover, the influences of Arawa and East Coast work in the less vigorous attitudes of the figures and the greater prominence of the spirals and loops, with which they are covered.

The trapezoid form of canoe prow (Pl. 49, fig. 1) is apparently a northern type (Hamilton, 1896, p. 12; Best 1925, p. 99, fig. 62). In the primitive-looking form of the trapezoid prow (Pl. 49, fig. 2) from Mokau, North Taranaki, in the Auckland Museum, the hinder figure is tolerably realistic, the central one has a fairly representative body and arms, and a stylised *manaia* head, the terminal or apical figure is further conventionalised, while at least two other conventionalised heads can be recognised among the loop-detail. Both in the rendering of the loop-detail and in the superficial decoration, this carving can be associated with the Hauraki and the Thornton's Bay carvings.

The large and more perfectly executed trapezoid prows display more definitely the difference between the Northern and the Central tendencies in carving, for in the Northern type (Pl. 49, fig. 1), not only are the figures themselves elongated, and treated, in the details of head, legs, hands and feet, and in the shallow surface detail, in the Northern manner, but here again movement and rhythm are suggested in the emphasis on the writhing, undulating figures, while the loop-detail is relatively subdued. In the standard type of canoe-prow (Pl. 49, fig. 3) the spirals have even greater relative prominence than in the house carvings previously instanced; a much reduced and conventionalised figure is squeezed in between the spirals, which, in the strength and vigour suggested by their whorls, are scarcely subsidiary to the leading human figure.

The general impression left by this preliminary and by no means fully developed or documented study of carving in the Hauraki, the Central and the North-western areas of the North Island is that the Hauraki schools might be regarded as the least specialised of the three.

In its composition it frequently uses a naturalistic or only moderately conventionalised human figure, sparingly overlaid with detail; rhythm is expressed in the vigorous attitudes of the figures themselves, while the intervening tracery is still subsidiary and presents the interlocking loops in a less specialised or less elaborate form. All of these features are also to be found in the North Auckland area, where, however, the human figures tend to be longer and narrower, more snake-like and with shallower surface detail.

The Taranaki carvings studied exhibit the same emphasis on the figures, which are often entwined together in an involved manner; the intervening detail is reduced or degenerate, and is usually only in relief and not pierced. All three areas have in common certain methods of rendering details, such as hands and feet.

The carvings of these north-western areas may thus be regarded as related local schools of an art that is essentially Maori, an art that might even be considered as not very far removed from the generalised Polynesian habit of human figure portrayal, for, although the human figures may be somewhat conventionalised, they are still the leading features in a composition, and the spirals, when used, are less developed or specialised. The fact that the Hauraki and North Taranaki districts are both in the Tainui canoe area may possibly have some significance in connection with these carving similarities.

In the Bay of Plenty-Poverty Bay areas we find a different convention, both in the more stable attitudes of the human figures and in the general composition, these differences on the whole having to do with the greater perfection and increased use of the spiral. Even when human figures are used prominently in a design, the deeply carved spirals on their hips, shoulders and facial features not only reduce the prominence of the human form, but also frequently assert themselves above it. But it is in the intervening pierced detail of the Central-East Coast areas that the spiral has exerted its full sway, subduing and often almost eliminating the human figures, and certainly displacing them as the medium for conveying that sense of vigour and rhythm which the Maori carver of olden days seldom failed to express.

ACKNOWLEDGMENTS.

Most of the photographs of the Taranaki carvings have been kindly supplied by Mr. W. H. Skinner, Professor R. Speight and Mr. W. R. B. Oliver, while the other photographs were prepared by Mr. L. T. Griffin, to all of whom I desire to express my thanks for their much appreciated help.

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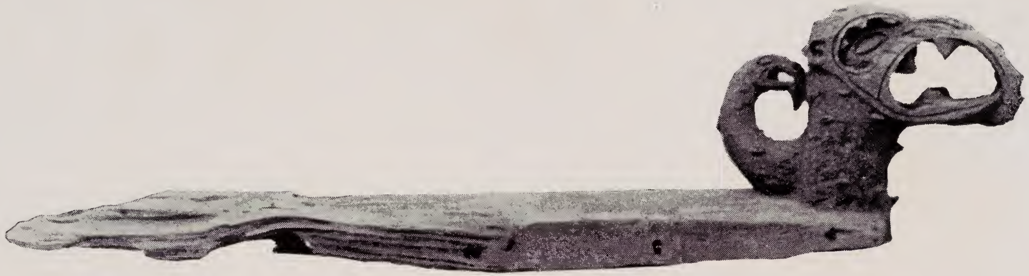

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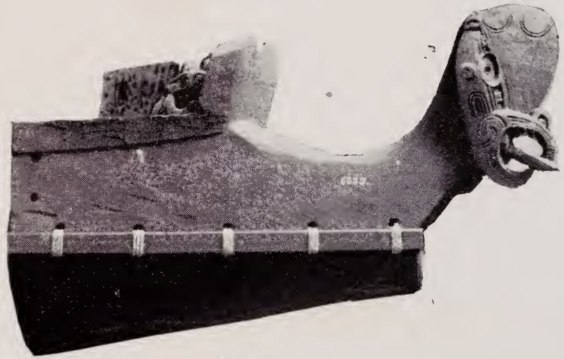

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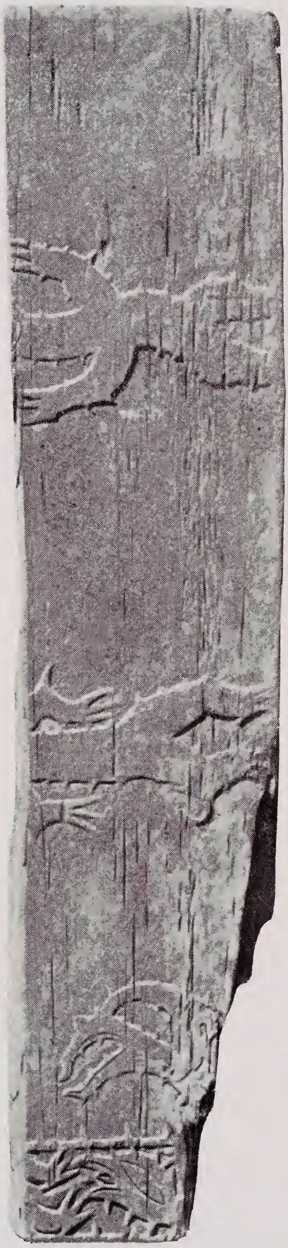
Fig. 1. Canoe Prow, Doubtless Bay. Presented: Vaile Collection, Auckland Museum. L. 42 cm.

Fig. 2. Prow, Coromandel. Auckland Museum. Presented: Miss L. M. Cranwell.

Fig. 3. Prow, locality unknown. Auckland Museum.



Carved slab, Awanui. Auckland Museum. Presented: Mr. Geo. Evans.

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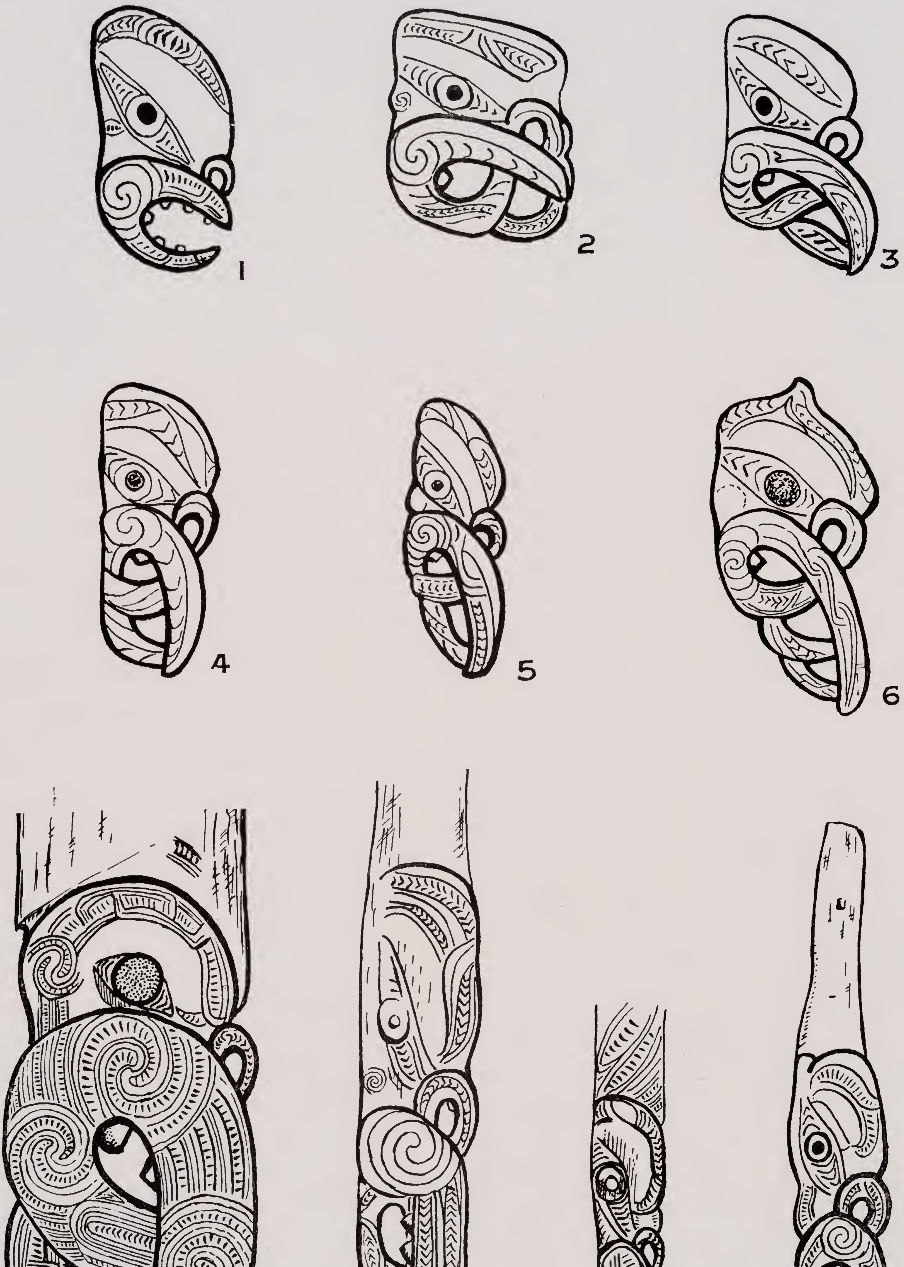
Fig. 1. Head of Doubtless Bay prow.

Figs. 2 and 3. Heads on Awanui carving.

PLATE 40.



Heads from various carvings, showing evolution of the *manaia*.

PLATE 41.

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Please contact Auckland Museum for more information.

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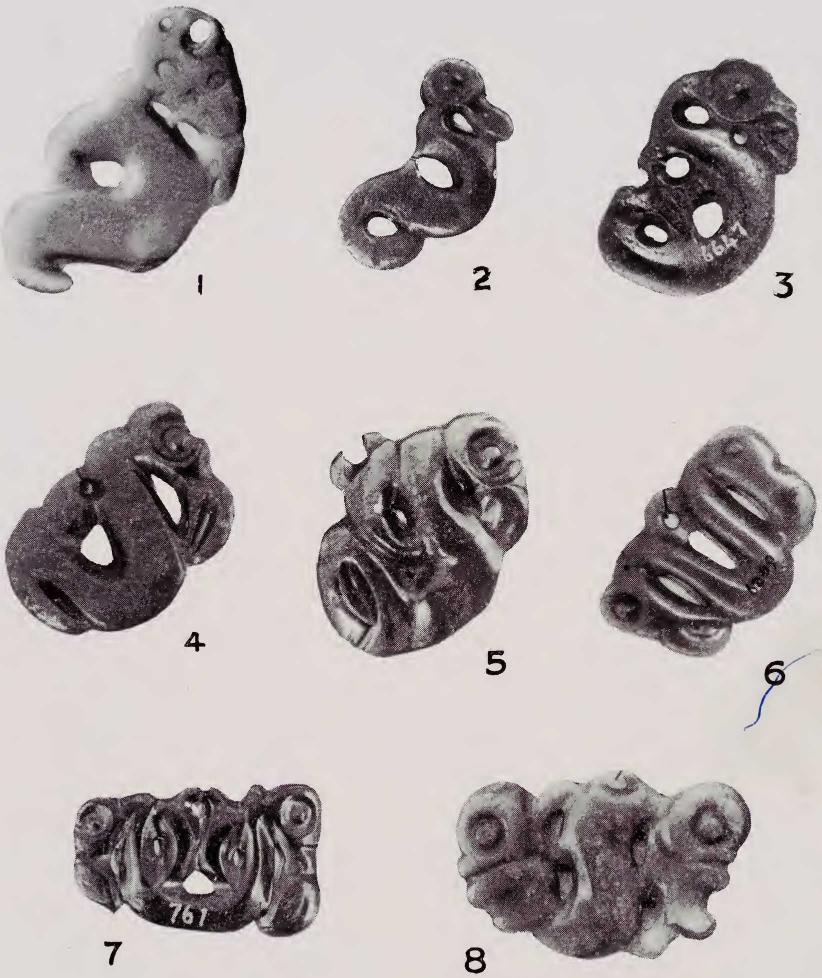
Fig. 1. Elongated *manaia;* detail from canoe prow in British Museum.
Fig. 2. Greenstone pendant, "*whakakai-piko,*" Mahurangi. Auckland Museum.
Fig. 3. Greenstone pendant, East Coast. Auckland Museum.
Fig. 4. Carved burial chest, Bay of Islands. Auckland Museum. Presented: Hon. Vernon Reed.
Fig. 5. Carved wooden slab, Helensville. Auckland Museum.
Fig. 6. Carved wooden slab, "near Auckland." Wanganui Museum.



Evolution of *pekapeka* (figs. 6-8) from *marakihau* (figs. 1-5).

Auckland Museum Collection.

Fig. 1. 10307. Kaikohe. Presented: Vaile Collection.
Fig. 2. 6646. N. Cape District.
Fig. 3. 6647. N. Cape District.
Fig. 4. 6421. N. Cape District: Vaile Collection.
Fig. 5. 5613. Te Kuiti.
Fig. 6. 6209. Hokianga.
Fig. 7. 761. Ohaeawai.
Fig. 8. 6210. Hokianga.

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North Auckland Carvings.

Figs. 1-4. Nos. 5652-5655. Bone-chests from Hokianga. Auckland Museum. Presented by Maoris of the district.

In Best "The Maori," vol. 2, p. 9, these are incorrectly attributed to the Dominion Museum Collection.

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North Auckland Carvings.

Bone-chests in Auckland Museum.

Fig. 1. 5657. Hokianga.
Fig. 2. 5243. Hokianga.
Fig. 3. 6404. Bay of Islands. Presented: Hon. Vernon Reed.
Fig. 4. 5660. Hokianga.
Fig. 5. 6405. Bay of Islands. Presented: Hon. Vernon Reed.

North Auckland Carvings.

Fig. 1, 5694; fig. 2, 5651. Skull boxes from Whangaroa.

Fig. 3. 19458. Skull box from Auckland Museum.

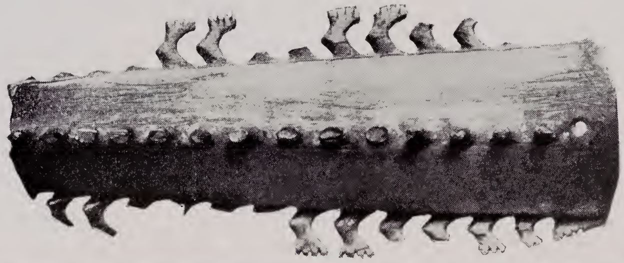

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Fig. 1. Ivory "chevroned" pendant from Coromandel.
Fig. 2. The Kaitaia Carving. Auckland Museum.
Fig. 3. Carved door lintel, or *pare,* East Coast. Auckland Museum.
Fig. 4. Carved *pare,* locality unknown. British Museum.

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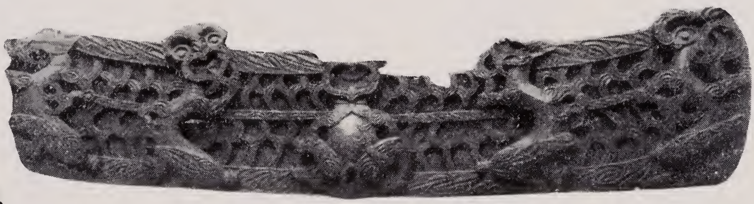

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Carved lintels, *pare*, from Taranaki.

Fig. 1. Taranaki Museum.
Fig. 2. Dominion Museum.
Fig. 3. Auckland Museum.
Fig. 4. Canterbury Museum.

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Rotorua, Bay of Plenty and Hauraki Carvings.

Auckland Museum.

Fig. 1. Carved *pare,* Rotorua. Presented: Mr. Justice Gillies.
Fig. 2. Carved *pare,* Te Puke. Presented: Mr. F. Crossley Mappin.
Fig. 3. Carved *pare,* Patetonga, Hauraki Plains.
Fig. 4. Carved *pare,* Thornton's Bay, Thames.

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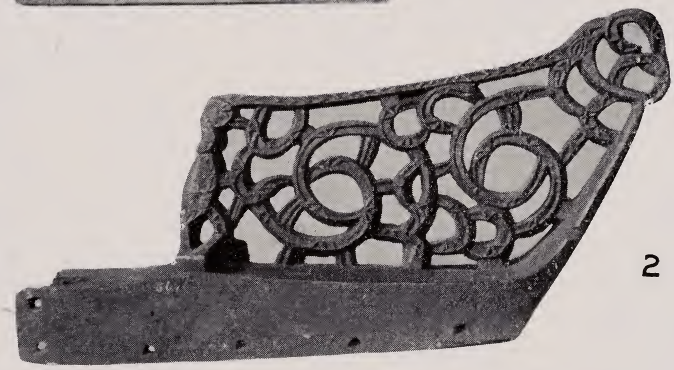

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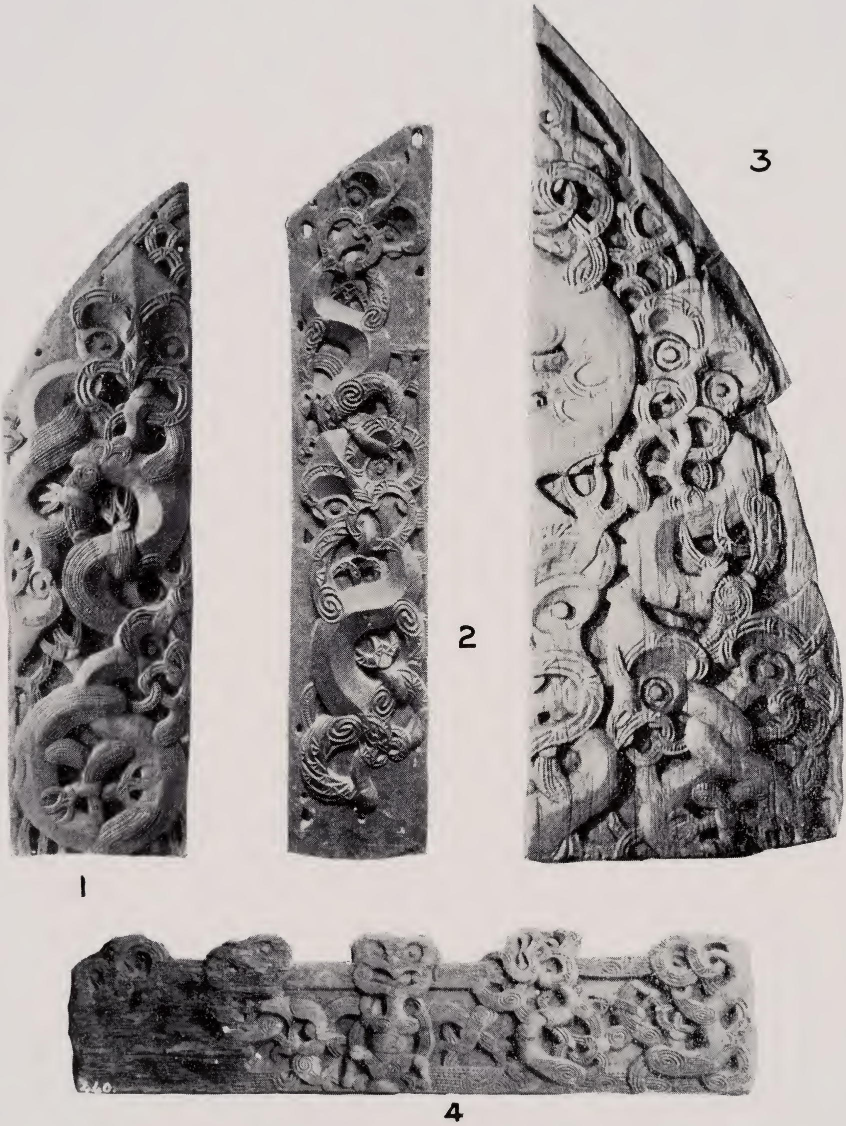
Fig. 1. Northern type of canoe-prow. Locality unknown. British Museum.

Fig. 2. Canoe-prow from Mokau, N. Taranaki. Auckland Museum.

Fig. 3. War-canoe prow, carved by Wiremu Kingi, the Ngatiawa chief, about 1860. Auckland Museum. Lent by His Majesty the King.



Taranaki Carvings.

Figs. 1, 3 and 4. Taranaki Museum.
Fig. 2. Dominion Museum.

These carvings, particularly figs. 1-3, should be compared with the Kaipara carvings illustrated on Pl. 41, figs. 5 and 6.

Induced Dominance of Microlaena avenacea (Raoul) Hook. f., in a New Zealand Rain-Forest Area.

By L. B. MOORE, M.Sc., Auckland University College, and

L. M. CRANWELL, M.A., Botanist.

The following paper gives a brief account of a rain-forest in the Thames Sub-district of the South Auckland Botanical District of New Zealand, and describes the development within it of a comparatively stable indigenous induced community dominated by the tall tussocky grass *Microlaena avenacea.* This replacement of one formation (forest) by another (grassland) is the more remarkable in that it has occurred without the intervention of bush-felling or fire, but depends simply upon the progressive action of introduced animals—cattle, pigs and goats.

Practically all the observations on which our conclusions are based were made in the course of a survey of the vegetation of Te Moehau (888m.), the highest and most northerly peak of the broken range that forms the backbone of the narrow Coromandel Peninsula.

In undertaking this survey and throughout its course, as in all our botanical work, we have been indebted, for generous personal help and encouragement, to Dr. L. Cockayne, of Ngaio, Wellington. The special study of the aspect here dealt with was suggested to us by Dr. H. H. Allan, Systematic Botanist at the Plant Research Station, Palmerston North. We particularly thank him for advice on points requiring expert knowledge of agrostology. We should like to express our gratitude also to Mr. G. O. K. Sainsbury, of Wairoa, who checked our identifications of mosses, and to Mr. K. W. Allison, of Rotorua, who kindly named the hepatics.

Except where otherwise mentioned the taxonomic nomenclature used is that of Cheeseman's "Manual of the New Zealand Flora" (2nd Edition) for flowering plants and ferns, and of Dixon's "Studies in the Bryology of New Zealand" for mosses. For hepatics, where there is no general text book available, the authority is quoted with each of the few species mentioned.

Ecological terms are used as defined by Cockayne (1928).

So little has been written concerning *Microlaena avenacea* either in primitive or modified communities, and so little virgin ground remains for investigation, that its original status in New

Zealand forests would be difficult to ascertain. Despite various general records of abundance it appears to be nowhere a common plant in relatively unmodified communities. The succession we describe, therefore, adds to the list given by Cockayne (1928) and supplemented in a recent paper (Cockayne, Simpson and Scott Thomson, 1932), another striking example of the induced dominance of an indigenous species not well represented in the primitive vegetation of this country.

Certainly on Te Moehau there is every indication that *Microlaena* has until recently occurred only very sparingly in areas where it is now almost a pure dominant. Here, where change is still proceeding rapidly, every stage can be seen, and the succession traced with some degree of certainty from the modification of primitive forest to the establishment of a ground-cover of grass, frequently continuous for many hectares at a stretch. Everywhere dead and drying trees or fallen trunks testify to the recent conquest of the forest.

In this remarkable change from forest, the climatic climax for this district, to grassland, man's influence, apart from the initial liberation of cattle, pigs and goats, has been negligible.

Before describing the stages in succession we give a general review of the forest involved, as it appears in least modified portions.

PRIMITIVE FOREST.

The characteristics of this rain-forest before interference are: closed canopy provided by tall trees, an abundance in the middle tiers of saplings, and a wide variety of seedlings, filmy and other ferns and bryophytes amongst the fallen leaves on the humus-rich forest floor. A profusion of epiphytes, both phanerogamic and cryptogamic, of root-climbers and of lianes is typical and physiognomic.

These features are common to several associations, in which also the various stages in succession are quite comparable, although the species-content differs somewhat. The forest is dominated below 510 m. by *Beilschmiedia Tawa* (tawa association), and from 510 m. to 750 m.—the upper limit of *Microlaena*—by *Weinmannia racemosa* (kamahi association), while on certain aspects between 600 m. and 780 m. there occurs a rather peculiar and more restricted rimu-kauri *(Dacrydium cupressinum—Agathis australis)* community to be described in detail in a later paper. Taking a rapid survey of the whole of the forest concerned, the most important members may be listed in the following groups relative to height above ground level.

Estimated frequency is indicated by the following symbols: d., dominant; v.a., very abundant; a., abundant; f., frequent; o., occasional; l., local.

(1) THE CANOPY, which, though always closed, is at lower altitudes rather irregular, the trees varying in height from 9 to

18 metres; but higher up the mountain it presents a more uniform appearance, the trees being about 6 to 9 m. in height and without taller projecting individuals. To this canopy belong *Weinmannia racemosa,* always abundant, and where dominant often with taller crowns projecting conspicuously above the general level; *Quintinia serrata* and *Ixerba brexioides* v.a., somewhat shorter than the dominant in each association, but always forming a considerable portion of the canopy in the area under discussion; *Suttonia salicina,* its importance increasing with altitude and comparable with that of *Quintinia* and *Ixerba* in kamahi forest; *Dacrydium cupressinum* o.–d., big trees projecting above general canopy level in tawa and kamahi associations; *Podocarpus ferrugineus* o., increasing in frequency with altitude; *Agathis australis* l.a.; *Podocarpus Hallii* scattered throughout; *Knightia excelsa* o.–f.; *Carpodetus serratus* o.; *Nothopanax Edgerleyi* o.–l.a., usually beginning life as an epiphyte; *Olearia Cunninghamii* l.a., possibly an indicator of the position of old landslips; *Metrosideros lucida* o., nowhere large; *Laurelia novae-zealandiae,* big trees in steep gullies, otherwise o.

Especially characteristic of the lower slopes are *Beilschmiedia Tawa* dominant up to 510 m. and not occurring above 600 m.; *Melicytus ramiflorus,* as abundant and important in tawa as *Quintinia* and *Ixerba* are higher up; *Hedycarya arborea* o.; *Fuchsia excorticata,* as a big tree almost confined to stream sides, and frequently associated there with *Schefflera digitata.*

Of the species that rarely or never descend into tawa forest the most important are *Phyllocladus glaucus, Nothopanax Colensoi* and *Griselinia littoralis,* as well as *Dracophyllum recurvatum* Col. (see Oliver, 1928) which in kamahi forest forms a real tree with stout trunk, rather erect, very rigid branches and large tufted heads poking through the canopy.

Epiphytes which add to the leafiness of the canopy of tawa forest are *Astelia Solandri,* with which are often associated the filmies *Hymenophyllum flabellatum* and *H. rarum, Asplenium adiantoides, Lycopodium Billardieri* and *Dendrobium Cunninghamii,* as well as the woody epiphytes *Pittosporum Kirkii, P. cornifolium,* and *Senecio Kirkii.* At higher altitudes the tree crowns show typically numbers of leafless branch tips, the smaller ones rather tightly covered with mats of the mosses *Dicnemon calycinum* and *Macromitrium* spp., while those of greater diameter are made to appear even bigger by deep loose cushions of the liverwort *Lepicolea scolopendra* (Hook.) Dum., with which are mixed in varying proportions the filmy *Hymenophyllum multifidum,* and of mosses the tufted *Holomitrium perichaetiale* and the cord-like *Cladomnion ericoides.* The leafy parts of the scrambling climbers *Metrosideros florida* and *Rubus australis* (in the tawa), *Metrosideros albiflora* (in kamahi), and everywhere *Rhipogonum scandens* and *Rubus schmidelioides* add to the density of the forest roof.

(2) MIDDLE LAYERS. Shorter trees and shrubs are mixed with saplings of the taller species. Occurring throughout are

tree-ferns, never very abundant in primitive forest, but represented by *Dicksonia squarrosa* o., *Hemitelia Smithii* o., *Cyathea dealbata* o., and *Cyathea medullaris* o., sometimes very tall in the gullies.

With these are associated *Drimys axillaris* f., *Coprosma grandifolia* always f., sometimes also *C. lucida, Coprosma foetidissima* increasing with altitude, the laxly branched *Alseuosmia macrophylla,* and *Senecio Kirkii* as a sturdy terrestrial shrub.

Rhopalostylis sapida, Nothopanax arboreum and *Geniostoma ligustrifolium,* though characteristic of the lower tawa, barely reach the altitude at which *Microlaena* becomes important. *Dracophyllum latifolium,* a slender tree with widely spread branches topped by sparse tufts of leaves, is abundant in this tier in the tawa forest, but only very rarely does it occur with *D. recurvatum* above the tension belt between kamahi and tawa.

Confined to higher altitudes are *Ascarina lucida,* a compact, bushy little shrub favouring ridges, and the luxuriant purple-stemmed *Nothopanax laetum,* handsomest of all the araliads, and especially characteristic of stream-sides.

Epiphytes are again important on lower trunks of tall trees. Often associated with *Astelia* may be *Tmesipteris tannensis, Lycopodium Billardieri, Asplenium adiantoides, A. flaccidum, Earina mucronata* and *E. autumnalis.* The tufted fern *Polypodium grammitidis* is abundant everywhere. Trunks and low boughs of big trees usually bear some filmy-ferns—*Hymenophyllum sanguinolentum, H. dilatatum, H. demissum, H. flabellatum, H. tunbridgense, H. multifidum* and *Trichomanes reniforme,* are all well represented. Mixed with them are more or less *Lepicolea scolopendra* and *Mastigophora flagellifera* (Nees) Mitt.

Madotheca Stangeri G.L. & N., *Camptochaete arbuscula, Cyrtopus setosus, Weymouthia* spp. seem to be confined to tawa, where they are abundant and always conspicuous. *Hypopterygium concinnum* is also epiphytic towards the bases of trunks.

Of climbers, kiekie *(Freycinetia Banksii)* is abundant throughout and always of physiognomic value. The ratas *(Metrosideros florida, M. scandens, M. albiflora)* mentioned in the description of the canopy, here produce their juvenile leaves, whole trunks frequently being clothed for a metre or more from the ground with their mosaic. Particularly characteristic of the tawa association are three climbing ferns—*Lygodium articulatum, Blechnum filiforme* and *Polypodium diversifolium.*

(3) FLOOR COVER. Abundant throughout are the mosses *Dicranoloma Menziesii, Leucobryum candidum, Ptychomnion aciculare,* with *Camptochaete arbuscula* rather more frequent in tawa. In wetter places *Sciadocladus Menziesii* and the liverworts *Schistochila nobilis* (Hook.) Dum., *Trichocolea australis* St., and species of *Aneura* are noteworthy. Of filmy ferns *Hymenophyllum demissum* is most striking in tawa, while *H. ferrugineum* is occasional towards its upper limits, as also above in the kamahi. *Trichomanes reniforme*

is abundant on old trunks and on wet ground, and the herbaceous creeper *Nertera dichondraefolia* is everywhere in damp places. *Blechnum discolor, B. Fraseri, B. fluviatile,* and *B. lanceolatum* were probably only occasional in the untouched forest, while in the tawa *Asplenium bulbiferum* and *Leptopteris hymenophylloides* would be fairly common. In the kamahi the pale stiff fronds of *Lindsaya cuneata* and the neat little fans of leaves and dainty white flowers of *Libertia pulchella* are a feature of the otherwise dark floor. Here also in the kamahi occur *Blechnum Pattersoni* var. *elongata* and *B. nigrum* in abundance by rocky streams, *Trichomanes Lyallii* o., on damp banks and rocks, and *Trichomanes strictum* characteristically hidden in wet pockets under the elevated much-branched roots.

Microlaena avenacea would not be entitled to mention as one of the important members of this original forest. As far as we can judge it would be represented only by widely separated individuals in the form of slender tufts. It still occurs thus on shaded rocky stream sides.

The important ecological factors are:—

(1) **High and evenly-spread precipitation.** For the sub-district Cockayne (1928) gives 165 cms. annual rainfall, distributed as follows—spring 24.2%, summer 18.2%, autumn 26.8%, winter 30.7%. No local records are available.

(2) **Equable temperature** owing to proximity to the sea, though Cockayne's figures for the sub-district (27°C and –4°C) are certainly exceeded at the highest altitudes.

(3) **High winds** striking from all quarters across long stretches of open sea. Local incidence of wind is affected by the configuration of the steep, narrow gullies.

(4) **A shallow soil,** full of rock fragments and easily bared to the substratum of greywacke or allied rocks.

(5) **Total absence of browsing animals** in the primitive forest.

In the early days of settlement pigs, goats and cattle were introduced and soon became wild on the lower slopes of the mountain. The dates of these introductions cannot be checked, but Adams (1888) mentions that cattle were feeding on native grasses at Torehina, 9 miles south, and Maclaren (1898) speaks of a main ridge track "worn into mud by the wild cattle that abound on Moehau." It would appear then that in no portion have they been effective for more than 50 or 60 years. Wild cattle (of the old stock at least) have been wiped out, but pigs and goats thrive, and in spite of more or less organized killing in recent years they are increasing in numbers and in cumulative effect, tending always to intensify the destructive influence of habitat factors with which the vegetation was formerly in equilibrium.

STAGE I. OF SUCCESSION TO GRASSLAND.

The first obvious effect of these animals is the baring of the forest floor, due to trampling or browsing on seedlings, small plants and low boughs. Pigs root and further disturb the leaf-cover. All this tends to alter the relations with surface-water, which, instead of being held and absorbed, is now free to flow, carrying with it loose leaves, etc., and soon stripping the humus layers below. Retardation of the decay of newly fallen matter follows, with general impoverishment of the soil. Increased wind at ground levels, an inevitable result of the removal of the lower tiers of vegetation, hastens the drying of this bare soil and is, moreover, responsible for the dislodgement of weaker saplings.

At the same time the **continuity of the canopy** is being impaired by falling of trees due to (1) normal over-maturity, (2) premature death following (a) damage to surface roots, (b) ring-barking or wholesale stripping of bark, (c) uprooting of whole trees. This latter is more characteristic of the short superficially rooted trees of higher altitudes.

Landslips, an ever-present danger on these steep slopes, increase in size and number.

The **seed-bed** now provided by the forest-floor may be a bare, impoverished soil, subject to considerable wind action, involving rapid evaporation of water and subsequent dryness, and also exposed to moderately strong light. Though these conditions are impossible for the seedlings of many species which normally form the canopy and upper layers, there are others, comparatively unimportant or even rare in the original forest, which can colonise and hold such a seed-bed. Amongst these the ferns, notorious for their ability to germinate on bare ground, are the most successful, and of these *Hemitelia Smithii* soon springs into prominence. With it are associated in almost equal numbers *Blechnum discolor*, of humbler stature; and in varying quantities according to local conditions *B. procerum* where rather wet, *B. Fraseri* in drier places, and *B. fluviatile* favouring shade. *Drimys axillaris*, *Ascarina lucida*, three species of *Coprosma* (*C. foetidissima*, *C. grandifolia* and *C. lucida*), *Brachyglottis repanda* and *Olearia Cunninghamii* not only survive as small plants from the previous undergrowth, but also regenerate rather freely under the new conditions.

Epiphytes (to some extent) and the scrambling climbers, notably *Freycinetia Banksii* and *Rubus schmidelioides*, thrive and form almost impenetrable masses on ridges where the host trees fall earliest. With this last exception the new undergrowth is not closed, the spaces between the umbrella-shaped *Hemitelia*, the tufted blechnums and the bushy shrubs being taken by a fairly sparse growth of *Carex* spp., *Uncinia australis* (distributed by animals) or slender shade plants of *Microlaena*, their seeds presumably wind-borne from the scattered tufts of the original forest.

The forest has now reached the end of Stage I. of the change.

Position summarised:

(1) CANOPY: Now discontinuous—original dominants still present.

(2) MIDDLE LAYERS: Majority of the smaller trees persisting, *Weinmannia* probably most abundant in both associations. Saplings few, but the tree-fern *Hemitelia Smithii* increasing.

(3) GROUND COVER: As detailed above—rather poor herbaceous content; tufted ferns increasing; *Microlaena* present only as tufts or in small, scattered patches.

STAGE II.

The ferns now grow apace, and if the action of animals were only a temporary set-back, the tree-ferns, of which *Hemitelia Smithii* is by far the most important, would act as nurse plants in the regeneration of something very nearly approaching the original associations in composition and structure. As it is, everywhere, in the abundance of epiphytes and woody hemi-epiphytes which find lodging on *Hemitelia* trunks (where they are for some years out of reach of the destructive influences at work on the forest floor), one sees signs of the struggle made by the forest to re-establish itself. That this is not accomplished is due not only to the continued action of the factors already enumerated, but also to the special attraction these aggressive ferns hold for pigs. *Hemitelia* fronds are chewed by goats, and the trunks even more frequently knocked over and ripped longitudinally by pigs to expose their central core of food-rich mucilage. The starchy rhizomes of most of the tufted species are an added incentive to rooting.

With repeated baring of the floor and the continual fall of tall spreading trees now that the mutual protection of the closed canopy is gone, conditions are even less favourable to the seedlings normal to forest. On the other hand the aggressors—the ferns, the shrubby species of catholic tastes, and particularly *Microlaena,* are just as well suited as before, and now have the added advantage in their spread of an adequate supply of spores or seeds right at hand. Colonisation of the bare ground is hastened, too, by the vegetative spread of several species, notably *Blechnum discolor* (rhizomes), *Hemitelia* (adventitious buds) and *Microlaena*—this latter outpacing the rest and with them forming a complete ground-cover both in sunlight and shade. In many places the root-climbing *Freycinetia* persists, sprawling over the ground where light conditions are now so favourable for its growth and spread that it may cover several square metres at a stretch with its rather slender, brittle stems, topped by great arching tufts of yellow-green lanceolate leaves. *Paesia scaberula* now appears, becoming more or less abundant on drier, more insolated knobs, where it is often associated with a little *Histiopteris incisa* or *Gleichenia Cunninghamii,* and much greater quantities of *Acaena sanguisorbae,* its seeds carried by the various animals.

The end of Stage II. of change then shows (Pl. 51, fig. 1):

(1) CANOPY: The big trees have disappeared and the canopy is now formed by the survivors from the second layers (trees and shrubs from 5-6.5 m. high). The original species of the forest are still well represented—*Weinmannia racemosa, Olearia Cunninghamii, Suttonia salicina, Quintinia serrata, Ixerba brexioides, Coprosma grandifolia* and *Senecio Kirkii* occur at all altitudes. *Nothopanax Edgerleyi* (apparently less vulnerable than *Nothopanax Colensoi)* and *Melicytus ramiflorus* are still conspicuous in tawa, while *Phyllocladus glaucus* and *Griselinia littoralis* show similar staying-power in the kamahi.

The number of trees and the continuity of the canopy seem to depend almost entirely on wind. In a few shallow, sheltered valleys the crowns are still almost touching, but on exposed ridges the few severely pruned individuals that remain are widely separated and seem to owe something in their persistence to protective masses of such climbers as *Freycinetia Banksii, Metrosideros albiflora, M. hypericifolia, M. florida, M. scandens* or *Rubus schmidelioides,* which at least temporarily break the full force of the wind.

(2) MIDDLE LAYERS: *Hemitelia* is occasional to dominant, sometimes forming a new canopy about 6 feet above the ground between widely separated taller trees. *Drimys axillaris, Ascarina lucida, Brachyglottis repanda, Dracophyllum recurvatum* and *Hebe macrocarpa* form compact bushes of about the same height. *Freycinetia* occupies large areas.

(3) GROUND COVER: *Microlaena* is dominant. Associated with it are *Paesia, Histiopteris, Uncinia, Carex* and quantities of the various blechnums mentioned in Stage I. Together they form a mixed but fairly continuous cover in which logs and their half-dead epiphytes lie partly concealed.

STAGE III.

The inroads of pigs and goats continue. The fern population suffers as before, while *Freycinetia,* so important in Stage II., also succumbs. Its leaves are chewed and it is soon damaged by wind, but perhaps most devastating of all is the smashing of the brittle stems, thus exposing fresh portions of the interior of each clump.

Of the remaining trees kamahi persists longest, and though immune from direct animal attack, eventually it also is eliminated by wind action in all exposed parts. *Hemitelia,* hardy though it is, falls sooner or later before the same force.

Bare ground is once more available, but now in circumscribed areas hemmed in by *Microlaena. Paesia, Histiopteris* and/or *Acaena* may take charge temporarily, but they are soon encroached upon and swamped by the all-conquering grass.

Stage III. then is characterised by complete dominance of *Microlaena* as a ground-cover.

The ridges in particular show (a) total loss of canopy, (b) presence of scattered dying trees mainly derived from the middle layers of the forest. Ridges where this stage has been attained may be recognised from afar by the tawny mantle, which seems to have been thrown over them, its ragged fringes picking out the subsidiary spurs.

Only upon nearer inspection does one realise how many depressions, both large and small, are also dominated by *Microlaena.* As far as we can see the succession has proceeded on the same lines here in comparative shelter as it did in the open, the only differences in result being in the persistence of a more or less ragged canopy of relic trees. The presence of this canopy alone deprives *Microlaena* of the physiognomic dominance it enjoys in the open.

Everywhere in Stage III. stretches this expanse of *Microlaena,* its broad, rather harsh leaves standing rank on rank, softened in summer by the feathery daintiness of its slender inflorescences. Only on plunging waist-deep into this green, waving sea does one realise that it is not only in the trees of the park-like valleys that the forest leaves its mark. Ferns still occur, and everywhere the trailing *Rubus schmidelioides* gives a sharp reminder that it grows as vigorously through the grass as did its old stock stretching up into the tree-tops.

Even on those ridges that appear quite bare from a distance a few decadent trees still stand, their epiphytes now those of the old forest canopy (Pl. 52, fig. 1). Hidden tree-trunks are rotting everywhere, and where they project a little they bear a wind-bitten tangle of lianes.

A few of the smaller trees have shown themselves as adaptable as the lianes. Some, after falling, have grown sideways along the ground, and there, with their crowns partly protected by the grass, they thrive and flower. *Dracophyllum recurvatum, Knightia excelsa* and *Alseuosmia macrophylla* all behave in this way. *Dracophyllum* is perhaps outstanding for its staying-powers. It is characteristic of the windiest knolls, its great globular heads of shining green and crimson-stained leaves showing like gems in the pale matrix of *Microlaena* (Pl. 52, fig. 2). These plants are mainly survivors from the lower tiers, but many must have become established as seedlings well ahead of the general spread of the grass. Less abundant by far are *Drimys axillaris, Ascarina lucida, Hebe macrocarpa,* and *Brachyglottis repanda,* all in their young, bushy stages, and all showing signs of having been trimmed by animals. As yet these species offer no serious challenge to *Microlaena's* possession of ridge and hollow, though *Hebe* here and there forms small thickets, becoming more open with age.

Careful search shows that between the tufts of *Microlaena* little can establish itself. *Marchantia tabularis* Nees is not uncommon. Attenuated individuals of *Acaena sanguisorbae* var. and *Hypolepis tenuifolia* ramify amongst the grass, together with odd rejuvenated lianes of *Muehlenbeckia complexa*. *Juncus vaginatus* and a few species of *Carex*, also of tussocky life-form, may hold their own, but they show little sign of spreading. *Libertia ixioides* and *L. grandiflora* are locally abundant at lower levels, and surprisingly enough a few plants of *Gnaphalium keriense* were seen at about 750 m. On dry rock or clay uncolonised by *Microlaena*, *Metrosideros hypericifolia* and *Muehlenbeckia complexa* persist as low tight mats, and with *Danthonia semiannularis* var. *nigricians*, *Ranunculus hirtus*, *Oxalis corniculata* and *Gnaphalium luteo-album* form an open community. Exotics, conspicuously absent elsewhere, occur sparingly here, chief being *Festuca bromoides*, *Anthoxanthum odoratum*, and *Prunella vulgaris*. Only one plant of *Cnicus lanceolatus* was noted.

Cockayne (1928, p. 361) has pointed out that exotics do not gain entrance into primitive vegetation. It is even more remarkable that they are practically absent throughout a change from forest to grassland.

EXTENT ON MOUNTAIN.

Isolated plants of *Microlaena* are found on both ridge and stream-side almost to sea-level, but the species is aggressive only between 450 and 750 m. The succession described above is therefore co-extensive in altitudinal range with *Hemitelia Smithii* rather than with the species which is ultimately dominant. The upper limit is well defined (Pl. 52, fig. 1) and coincides with a somewhat abrupt change in structure in the original vegetation which here becomes either a wind-swept, mossy forest into the dark interior of which animals penetrate little, or a tight, low cover of species as aggressive as *Microlaena*, but better suited to the boggy conditions characteristic of the cloud-belt. *Astelia trinervia*, comparable to a grass in its tussocky growth-form, is here locally dominant, but is open to attack by pigs, which relish the mucilage so copiously exuded from the torn leaf-bases. Where *Astelia* has been cleaned out quite bare soil is left. Though this seems to be as yet too humus-rich and boggy for *Microlaena*, its seedlings have occasionally managed to establish themselves. It remains to be seen whether they will act as centres in the upward extension of the grassland formation.

The lower limit is less well marked and much more difficult to account for. It is a significant fact that it coincides with that of *Hemitelia*, which would thus appear to be essential to the initiation and progress of the succession. Below this level bracken (*Pteridium aquilinum*), manuka (*Leptospermum scoparium* and *L. ericoides*) and occasionally *Aristotelia racemosa*, are aggressive in clearings. Though the first three species occur sporadically right up to the highest point on the ranges (but there also as aggressors) within the stated altitudinal limits they are not even locally abundant, and nowhere compete with *Microlaena* for the possession of fresh ground.

Though animals have been and still are free to range over the whole mountain, and no part can be considered strictly primitive, there are places, especially on the colder south-west slopes, where modification has been negligible and the original structure is preserved. Very steep faces, likewise, are practically untouched and where the soil is boggy a different succession is induced. With these exceptions, on every aspect of the mountain whether ridge, slope, or valley, a similar series of changes has been set in train. The stages described above are unavoidably somewhat schematic, but there is a remarkable uniformity in the whole succession, despite the very considerable floristic differences in the associations involved.

By far the greater part of the kamahi and tawa forest is similar in a general way to that described in Stage I. Whether this is in every case a stage in the same developmental succession towards grassland is not clear.

Stage II., more easily identifiable because of the definite establishment of *Microlaena,* occupies extensive areas mostly on flatter ridges and more gentle slopes, as well as always forming a broader or narrower band separating stages I. and III.

Stage III. is well represented in some half-dozen places. Many hectares on exposed ridges are practically devoid of trees, and the largest of these are of physiognomic importance in any view of the mountain. The total area held by any one stage can scarcely be estimated, but the greater part of the mountain within the altitudinal range of *Hemitelia* seems to be involved in one stage or other of the succession.

The **increase of ferns** after local or wholesale modification or destruction of rain-forest of this kind, e.g., after the fall of individual trees, landslips, or burning, may be considered normal, and often provides the shelter essential for the re-establishment of a community similar to, if not identical with the original. On Te Moehau the problem differs in that here the action of the destructive agents, the animals, is progressive, and especially detrimental to those very plants which represent the first stages in normal regeneration.

The new succession will depend on (1) propagules available, (2) ability of incoming species to establish themselves and persist under the particular conditions induced in the moribund community. As far as (1) is concerned the choice is wide, since animals, wind and water are efficient carriers on a slope where a vertical section from sea-level to 888 m. is not more than 5 km. in slant height, and where the plant-cover includes lowland pastures with exotic and indigenous grasses and weeds, manuka scrub, rain-forest, and the peculiar subalpine communities of the summit.

The phenomenal success of *Microlaena* indicates some peculiar fitness for colonising, either in structure or life-history, and this was sought in a more detailed study of the plant itself.

AUTECOLOGY.

SYSTEMATIC POSITION: *Microlaena avenacea,* sometimes called "Bush Rice Grass," is an endemic species of a genus which together with *Hierochloe* represents the tribe *Phalarideae* in New Zealand.

HABIT: The plant is tussocky, consisting of more or less closely packed tufts, reaching a height of 60-120 cms. The leaves arising round the bases of the tall unbranched culms are broad (c. 1.5 cms.), flat and harsh, with one prominent vein showing lighter than the rest of the blade, which is pale green or even glaucous. In exposed positions the tips of the leaves are often torn and discoloured, this raggedness being especially noticeable in winter. The sheaths are long and thin, and, as is indicated in the habit sketch of the plant, they give each tuft a narrow fan-like appearance. The blade may be either erect or drooping.

PHENOLOGY: On Te Moehau we look on the species as a midsummer flowerer. Though we know the range well in the summer months we have seen it at the height of its flowering season only in the late days of December and the early days of January. In the shade the season may be more protracted, as flowers are usually less advanced there than in the open.

INFLORESCENCE: The panicle is tall, the main axis slender, giving off compound hair-like branchlets at irregular intervals. The spikelets are conspicuously awned. They occur singly, greenish white in the open, or of a jade colour in the shade. However sparse they may appear on an individual, when seen in the mass they give such a generous feathery look as to transform the whole landscape.

The **fruits** soon mature, and owing to their method of attachment they are shed almost immediately, the sooner if they are exposed to wind, leaving the small, but conspicuous, glumes to whiten in the sun. The old panicles are eventually trampled down, or broken by wind, and typically by winter only the rather short more or less bleached leaves remain.

ROOT SYSTEM: The extent and importance of the root-system is shown by the following measurements of a fairly compact tussock taken from the top of a windy ridge (Stage III.).

Total height of flowering plant ..	58 cms.
Length of leaf	23 cms.
Depth of root-system	17 cms.
Spread of root-system	50 cms.

This depth of root-system is typical in that it represents ramifications throughout the whole of the shallow superficial soil. When sods of this size, or even much larger, full of the long, wiry, much-branched fibrous roots are occasionally upturned by pigs (in search of food) the more or less weathered greywacke subsoil is fully exposed.

Even in the seedling the root-system is well-developed. The young roots are slender, closely packed and of a pale straw colour. As the plant grows, more roots appear amongst the younger leaves of the elongating rhizome, as also on the offsets as they mature. Gradually the whole leafy portion of the tussock is thus lifted slightly, and the roots must plunge through an open accumulation of leaf-debris to reach the ground. This raising seems to be something of an advantage, especially where there is a tendency to local crowding of old tussocks and their litter.

VEGETATIVE SPREAD: Already in the seedling a vigorous vegetative growth is foreshadowed. The accompanying sketch (Text fig. 3) shows how early in development lateral shoots may appear. One bud has pushed into prominence after rupturing the sheath of the living leaf subtending it, while four more, hidden in the axils of the upper leaves, will soon appear. Such extravaginal shoots are always given off in rapid succession, so that a many-branched root-stock is developed (Text fig. 4). This lies above the soil level and is for long clothed by the sheath bases after the withering of the leaf-blades. Secondary roots develop freely. Normally under forest conditions the internodes remain short and the erect sheets are crowded together to form a rather compact tussock. Although a number of buds always so contribute to the formation of tussock, we have found that on Te Moehau in the open, many may, by elongation of one or more internodes, develop into stolons which are thrust far out radially from the parent plant. The stolons are stout, glabrous and often capable of removing the fans they bear 15-25 cms. from the older portions of the tussock. Each node roots and is firmly attached as it touches the ground, so that, except where tussocks are isolated, it is almost impossible to lift the whole root system intact.

The crowding of tussocks is not always overcome by the arching of the stolons. As is clearly shown in the sketch of a portion of an old clone (Text fig. 1), some of the nodes fail to reach the ground at all, simply through the bulk and lateral pressure of tall tufts hemming them in. In this state they grow on with undiminished vigour, either sprawling or almost erect, and often produce more or less normal sized panicles. Sturdy unbranched aerial roots frequently emerge from the unanchored nodes, but these are invariably short lived if the erect habit persists.

Death from old age, over-crowding, or even from rooting of pigs in search of food may follow for portions of the clone, and always individual tufts are being separated through the severing of the old stolons that link them. With such opening up the erect stolons are free to fall to the ground, where true anchoring and absorbing roots at last develop, instead of the earlier abortive aerial ones. This is the procedure where *Microlaena* is dominant and conditions fairly stable. In this way the exceptional vigour

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Fig. 1 (opposite). Portion of flowering clone, showing long internodes and abortive aerial roots. Drawn from specimen collected on ridge.
Fig. 2. Root-stock from forest interior plant, showing short internodes.
Fig. 3. Seedling, showing first innovation shoot.
Fig. 4. Older seedling, showing three innovation shoots.

of the plant finds outlet in the exploitation of breaks in its own cover, and thus the even growth, so widespread on Te Moehau, is maintained. Naturally, where plenty of room is available for the plant to test its colonising powers, the stoloniferous habit stands it in splendid stead, and hence is of paramount importance in aggression as in maintenance of the community.

PART PLAYED BY SEEDS: The importance of the role of seeds in colonisation cannot, however, be under-estimated. They came somehow from the recesses of the original forest, and establishing, they have been the source of plants which must take up the struggle for supremacy from the beginning under totally new conditions. The progeny of the shade-loving tufts must be equally tolerant of light, of alternating drought and rain, and of greater temperature extremes than would obtain in the forest. Such broad tolerance is rare, but is demonstrated in the special success of *Microlaena* in widely differing situations, from the shadow and damp coolness of a stream-side forest station to the wind and heat of the exposed ridges. Here in the sun the big profusely-flowering tussocks produce infinitely more seed than ever appeared on the meagre culms in primitive forest.

SEED DISPERSAL: The individual fruits are relatively heavy and tend to fall immediately around the parent tuft, either into the maze of tangled stolons and drying leaves or, if it is isolated, towards its periphery and roughly as far removed from it as the outward sweep of the drooping branchlets of the inflorescence. The proof of the efficiency of this method of dispersal is seen in the local distribution of seedlings, which are always abundant against the outer margins of the tussocks. Thus in the spread of the indigenous induced community it may be said that *Microlaena* works steadily and rapidly along a vegetative front with a narrow outer fringe of seedlings.

Seed dispersal must often be more haphazard than this. Rain-wash and wind play their parts, but it is significant that we have seen neither seeds nor inflorescences blown through the air. The long awns tend to cling to any hairy surfaces, so it is probable that animals are rather important in dispersal over wide areas.

Viability of the seeds must be fairly high, as seedlings of all sizes were seen in January, usually the peak of the flowering season. Only once have we collected flowers that suggest that the dispersal of seeds might continue throughout the year. This was in May, that is, at the beginning of winter, but a solitary record such as this may have little bearing on the main problem of the source of seed supply.

HABITAT CONDITIONS: Seeds germinate freely on *Hemitelia* trunks up to a height of 90-120 cms., and on top of fallen logs. Flowers are often produced on epiphytic plants, showing that *Microlaena* is not restricted to any narrow limits in habitat conditions. Its failure to establish itself on very boggy places suggests a preference for rather well-drained situations, but its absence from the upper parts of landslips and from the very steep jagged rock outcrops that occur here and there on the ridges, proves that it is fairly sensitive to over-dryness of substratum.

As indicators of the range in the humidity of the atmosphere even where *Microlaena* has attained dominance, the epiphytes on the remaining trees on an exposed ridge might be compared with those in the shade of an adjacent park-like valley. On the ridge-top, on almost leafless trees, is *Astelia Solandri,* with its usual accompanying species *(Asplenium flaccidum, Dendrobium Cunninghamii, Earina autumnalis* and *Senecio Kirkii* especially noted). Partly dead masses of *Lepicolea scolopendra,* with more or less of the mosses *Macromitrium longipes, Dicnemon calycinum, Cladomnion ericoides* and lichens *Pannaria* sp. and *Sphaerophorus* sp., as well as cushions of *Dicranoloma Menziesii* and *Leptostomum inclinans,* together almost cover the trunks, while short tufts of *Usnea* sp. are quite common on terminal twigs. Particularly characteristic of this station, on trunks of tree ferns and decadent trees, is the coriaceous leaved fern *Polystichum adiantiforme.*

Polypodium diversifolium and *Madotheca Stangeri* (G.L. and N.), somewhat stunted where exposed, grow more luxuriantly on the trees of the valley. Here, from the spreading branches of sheltered *Melicytus ramiflorus* and *Fuchsia excorticata* and even from the nodes of the liane *Rhipogonum scandens* hangs the pendant moss *Weymouthia mollis,* its soft julaceous branches up to 30 cms. long and almost touching the tall plumes of the flowering grass below.

Grey and orange digitate *Sticta fragillima* abundant on rocks, and an occasional plant of the dendroid moss *Sciadocladus Menziesii* amongst the *Microlaena* tussocks are just as definitely relics of the original forest floor, and argue strongly against any radical change in habitat conditions.

OCCURRENCE OF MICROLAENA AVENACEA IN OTHER PARTS OF THE NEW ZEALAND BOTANICAL REGION.

With adequate means of seed dispersal, a very efficient system of vegetative reproduction, adaptability to a wide range of light, humidity and edaphic conditions, comparative immunity from animal attack, and a growth form suited to exclude competitors, *M. avenacea* would appear to be one of the best equipped species for aggression in forest, and might be expected to attain quite widespread dominance throughout its altitudinal and latitudinal range.

Buchanan (1880) says: "A tall, handsome grass, growing at low elevations. . . . Common in forest lands, and usually found there in small tussacs, which, by their confluence, often form large patches of a close, harsh sward, especially in the more open places."

According to Cheeseman (1925) it is abundant in forests throughout North, South and Stewart Islands, from sea level to 2,500 feet, and is "in forest, but not common," in Auckland Islands.

Cockayne (1928) records the species of podocarp-broad-leaved dicotylous lowland forest of both dry and wet ground, in the latter as a semi-obligate species of kahikatea *(Podocarpus dacrydioides)* semi-swamp forest. It is mentioned particularly in the description of this last community in the North-western Botanical District, where "As ground plants tall *Blechnum procerum, Astelia nervosa* var. *silvestris* and *Microlaena avenacea* are everywhere, and *Nertera dichondraefolia* and *N. depressa* are common. *Dicksonia squarrosa* is the dominant tree fern, and there is some *Hemitelia Smithii.*" It is also included in the list of important members of one or more of the associations of montane and subalpine bog forest, of which the physiognomic trees are *Nothofagus*, cupressoid podocarps and *Libocedrus.*

Allan (1926) in a description of the podocarp forest on the flood plain of the Rangitata (E. Bot. Dist.) at 240 m., where *Podocarpus dacrydioides* is dominant and *P. spicatus* subdominant, and there is a dense undergrowth, states: "Floor plants are *Uncinia uncinata, Nertera dichondraefolia, Blechnum discolor, Microlaena avenacea, Hymenophyllum demissum,* but only where there is not an excess of water." Again, still treating of the same community, he says: "Where cattle enter milled forest open spaces increase and the forest becomes separated into clumps. Of special attraction to cattle are *Uncinia* spp., *Carex* spp., and, to a less extent *Microlaena avenacea.*"

Our own work on Te Moehau has been supplemented by more general observations made during the last few years on diverse and widely separated examples of vegetation throughout the North Island.

Though nowhere, either in our notes or in the literature consulted, is there any reference to another example of such widespread induced dominance of *Microlaena avenacea* as we have described on Te Moehau, there is sufficient evidence of its comparative rarity in primitive forest and its tendency to increase as this is modified. Its phenomenal success in our area must depend on some quite local factor or combination of factors.

TAXONOMIC PROBLEM ARISING FROM STUDY OF INDIVIDUAL.

As has already been emphasised more than once, the stoloniferous habit is here of extreme importance. It is of interest, then, that the production of stolons is not mentioned in the Manual (Cheeseman, 1925) description of *M. avenacea,* leaving the inference that it must be a compact tussock of some kind. This overlooks the definite suggestion of extravaginal branching made by Raoul (1844) in the original description—"Radix repens more *Avenae pratensis.*" On the other hand, *Microlaena Carsei,* according to Cheeseman (1915), the author of the species, is characterized by the vigour of its stolons. Our specimens certainly correspond with none of those of *M. Carsei* in the Cheeseman Herbarium, and by their habit they would appear to be excluded from *M. avenacea.* In our opinion the growth-form of this latter species is inadequately treated in current descriptions, which, however, cover the case of the crowded tussock habit sufficiently well. This does not preclude the possibility of the development of stolons, especially under changed habitat conditions, so we have no hesitation in claiming that ours is an epharmonic form of the forest interior grass.

By the same token it is yet possible that the rare and consequently little known *M. Carsei* may be either a jordanon or some habitat form of *M. avenacea.* Reference to Carse's full and interesting series of specimens in the Herbarium of the Museum shows that all were collected in open places in kauri forest, giving more than a hint that they also belong to more or less modified forest. The status of *M. Carsei,* however, and particularly that of *M. avenacea,* are problems for the taxonomist. All we can do is to draw attention to the undoubtedly powerful influence of environmental factors on life form.

It may be of interest to note that though *M. stipoides,* a much smaller pasture grass, occurs in abundance in the lowlands and up to a height of about 300 m. on Te Moehau, where in small ridge openings it is associated with *M. avenacea,* we have seen no indication that the two species cross. *M. polynoda* was recorded for Coromandel by Adams (1888), but we have not seen it here. It appears, then, that the possibility of hybridism is very remote.

ECONOMIC ASPECT.

Of *M. avenacea* Buchanan (1880) says: "This grass is greedily eaten by cattle during winter, when it then becomes valuable in supplementing the more nutritious leaf food from certain trees, such as Karaka *(Corynocarpus laevigata),* Mahoe *(Melicytus ramiflorus),* and several others which form their chief food during that season in many places. This species can hardly be recommended for cultivation, as in open country it would very probably become harsher and less succulent; but settlers living in the neighbourhood of forests would be repaid the trouble of collecting seed and sowing it among the trees, and by that means increasing the amount of winter food for their cattle."

Adams (1888) and Allan (1926) also mention its being eaten by cattle.

We have been told, but have no means of verifying the statement, that while cattle remained on Te Moehau they grazed on *M. avenacea* and that, since this check has been removed, the grass has shown a marked increase in rate of spread.

Certainly our observations show that no animals now on the mountain feed to any appreciable extent on the grass. Fortunately, the "bush" is not now so often expected to provide winter feed for cattle, the farmers realising that in this area at least the loss of numbers in the unfenced upper parts of the mountain more than balances any profit gained from those that do return to the pastures in spring.

As a fodder plant, therefore, the grass is of little value. The community, nevertheless, is of very considerable economic importance in that it provides a close cover on ridges and slopes, where, with destruction of forest, landslips and floods become a real danger to the farms below. While its work in holding soil and lessening run-off amply justifies its existence, it must not be forgotten that the very presence of this grassland is an indication of a sorry state of affairs. It bears testimony to the fact that hordes of destructive animals are being maintained on land owned and controlled by the State. Not only are these useless as revenue producers, but they are a constant menace, destroying the natural balance between the vegetation and its environmental factors. *Microlaena* temporarily saves the situation, but there are places where it is powerless. Even if, ultimately, the boggy summit parts of the mountain, the very steep faces, and the rocky portions of landslips are colonised, in the interval between the opening up of these and the re-establishment of ground-cover there is grave danger.

Interesting though it would be to watch this great experiment to the end, to find to what extent the forest would ultimately be ousted and its place usurped by grassland, we know that it is of more permanent value to advocate the extermination of animals from this easily isolated area and a more strict interpretation of the name State Forest Reserve even now applied to the greater part of Te Moehau.

SUMMARY.

1. An account is given of the development of a community dominated by *Microlaena avenacea* depending upon the progressive action of introduced animals in rain forest.

2. The composition and structure of the original forest, the ecological conditions to which it is subject, and the succession itself, are briefly described. The main changes are (a) opening of forest, (b) increase of ferns and *Microlaena,* (c) destruction of ferns and dominance of *Microlaena.* The succession is strictly limited in altitudinal range.

3. Reasons for the success of *Microlaena* are sought in the study of its autecology.

4. Records of the occurrence of the species in other parts of New Zealand are briefly reviewed, its taxonomic status discussed, and the protectional value of the indigenous-induced community stressed.

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1

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Fig. 1. Typical opening in Stage II., showing *Microlaena* in full flower, abundance of *Hemitelia* and shrubs surviving from tawa forest.

Fig. 2. *Microlaena* stretching through park-like area. Dead trunks and dying tree-ferns in foreground.

1

2

Fig. 1. Stage III. at 700 m., showing well-marked upper limit on left. Dark patches in foreground are *Muehlenbeckia* and *Paesia*.

Fig. 2. Typical short-trunked *Dracophyllum recurvatum* persisting in Stage III.

Description of a Rare Lophotid Fish from Cape Runaway, New Zealand.

By L. T. GRIFFIN, F.Z.S., Assistant Director.

Having recently received a perfect specimen of the rare Crested Band Fish, or, as it is sometimes called, Unicorn Fish, I am now able to re-figure and re-describe this interesting species.

The synonymy of the species, both generic and specific, is involved and uncertain, and I have therefore followed the recommendation of Mr. Gilbert Whitley, of the Australian Museum, to present it in full in this paper. I desire also to thank Mr. Whitley for his valuable help in working out the details of the synonymy which is given below.

Family LOPHOTIDAE.

Genus LOPHOTUS Giorna 1809.

1809—*Lophotus* Giorna, Mem. Acad. Sci. Turin, 1805–8 (publ. 1809), p. 179. Not *Lophotes* and date not 1803, as Agassiz quotes—*fide* Sherborn, Index Animalium. Genotype, *L. cepedianus* of Authors.

1814—*Leptopus* Rafinesque, Specchio delle Scienze i., Palermo, Jan., 1814, p. 16. Genotype, *L. peregrinus* Rafinesque—*fide* Jordan, Gen. Fish, 1917, p. 86. Preoccupied by *Leptopus* Latreille, 1809, Hemiptera.

1815—*Podoleptus* Rafinesque, Anal. Nat. 1815, p. 93, according to Jordan, but Sherborn was unable to find the name in this book. Said to be a substitute for *Leptopus* Raf. 1814.

1817—*Lophotes* Bosc, Nouv. Dict. Hist. Nat. XVIII., 1817, p. 185. Based on Cuvier, Ann. Mus. XX., 1813, fig. 17; no specific name.

1817—*Lophotus* Oken, Isis, 1817, p. 1182. Logotype *Lophotes cepedianus*—*fide* Jordan, Gen. Fish. 1917, p. 101. But Oken's names are *nomina nuda* and have no standing.

1820—*Lophotes* Goldfuss, Man. Zool. ii., 1820 Taeniosom.—*fide* Cuvier and Valenciennes, Hist. Nat. Poiss. i., 1828, p. 225.

1822—*Lophotes* Schinz, Das Theirreich (Cuvier) ii., April, 1822, p. 400. Haplotype *"Lophod. Cepedii"* Schinz, the first latinization of the vernacular specific names of Giorna, Cuvier, etc.

1823—*Lophotus* Cloquet, Dict. Sci. Nat. (ed. Levrault) XXVII., 1823, p. 194. Species called *Lophotus cepedianus.*

1826—*Lophotes* Bory de Saint-Vincent, Dict. Class. Hist. Nat. IX., Feb., 1826, p. 498. Species called *Lophotus Lacepedianus,* based on Giorna and on Cuvier.

1826—*Lophotus* Risso, Hist. Nat. Europe Merid. iii., 1826, p. 292. Species here called *L. lacepede.*

1827—*Lophotes* Berthold, Nat. Fam. Thierreich (Latreille), 1827, p. 138.

1832—*Lophotus* Voigt, Das Thierreich (Cuvier) ii., 1832, p. 306.

1835—*Lophotes* Cuvier and Valenciennes, Hist. Nat. Poiss. X., Sept., 1835, p. 407, pl. ccci.

1846—"*Lophotes* Giorna 1803" (should be *Lophotus* Giorna, 1809) Agassiz, Nomencl. Zool. 1846, Index Universalis.

1861—*Lophotes* Valenciennes, Dict. Univ. Hist. Nat. vii., 1861, p. 442. Not *Lophotes* Lesson, Traite Ornith. (2), May, 1830, p. 96, a genus of birds; *Lophotus* Fischer, Zoognosia ed. 3, ii., 1813, p. 548, mammals; and *Lophotus* Schoenherr, Gen et sp. Curcul. ii., 1, 1834, p. 314, a genus of Coleoptera, the latter equals *Orodinus* Gistel (not Jordan).

1917—*Podoleptus* Jordan, Gen. Fish. i., 1917, p. 92. Attributed to Rafinesque, Ann. Nat. 1814, but not there according to Sherborn, Index. Anim. Substitute for *Leptopus* Rafinesque, 1814.

1919—*Orodinus* Jordan, Pro. Acad. Nat. Sci. Philad. LXX., 1918 (publ. April 10, 1919), p. 339. *Ex* Gistel, Nat. Thier, 1848. Reference to Gistel's work shows that *Orodinus* was proposed for a beetle, *Lophotus* Scheenherr, preocc. by Giorna's name, and not for the fish genus, as Jordan thought.

1933—*Regilophotes* Whitley, Rec. Austr. Mus. xix., Aug. 2, 1933, p. 72. Orthotype, *Lophotes guntheri* Johnston, 1883. New name given under the mistaken impression that the typical *Lophotus* of Giorna was perhaps a *Trachipterus.*

Whitley suggests that *Regilophotes* may stand as a subgenus for the Australian species.

From the foregoing it will be seen that this fish, which has been generically named *Lophotus* or *Lophotes,* was referred to under the vernacular names by the early French writers, and Whitley points out that the earliest spelling and date, according to Sherborn's *Index Animalium* is *Lophotus* Giorna, 1809, which apparently stands for the genus, the type of which is usually called *Lophotes cepedianus,* but this name appears to be a synonym of *L. peregrinus.*

The principal synonymy of the species of the typical Crested Band Fish of Europe, etc., is as follows:—

LOPHOTUS PEREGRINUS (RAFINESQUE).

(Vernacularly named only as a species in Giorna; Cuvier Ann. Mus. XX., 1813, pl. xvii., Bosc; Valenciennes, etc.)

1814—*Leptopus peregrinus* Rafinesque, Specchio delle Scienze i., Palermo, Jan., 1914, p. 16, and Precis Somiol. 1814, wrapper p. 4. Palermo (*fide* Sherborn).

1822—*Lophotes cepedii* Schinz—p. 401. Based on Cuvier, Vernac.

1823—*Lophotus cepedianus* Cloquet, Voigt, etc., not *Gymnetrus cepedianus* Risso, 1810, which is a *Trachipterus.*

1826—*Lophotus lacepedianus* Bory de Saint-Vincent.

1826—*Lophotus lacepede* Risso, Hist. Nat. Eur. Merid. iii., 1826, p. 293. Nice district, Mediterranean.

1835—*Lophotes cepedianus* Cuv. & Val.

1839—*Lophotes siculus* Swainson, Hist. Nat. Fish., etc., ii., 1839, p. 396, fig. 126. Sicily where Rafinesque had observed it.

Other nominal species of *Lophotus* appear to be as follows:—

Lophotes capelli Temminck & Schlegel, Fauna Japon. (Pisces 1845), p. 132, pl. lxxi., fig. 2. Seas of Japan. (Whitley suggests that the Californian Crested Bandfish may be this species.)

Lophotes machadoi Ribeico, Bol. Mus. Nac. Rio de Janeiro iv., 1928, p. 21, Brazil.

Lophotes cristatus Johnson, Pro. Zool. Soc. Lond. April 29, 1863, p. 38, Madeira.

The synonymy for the New Zealand and Australian species of Crested Band Fish is as follows:—

LOPHOTUS GUNTHERI Johnston.

Crested Band Fish (Plate 53).

1883—*Lophotes guntheri* Johnston, Rept. Roy. Soc. Tasm. 1882 (1883), p. 13; Pap. Proc. Roy. Soc. Tasm. 1882 (1883), pp. XLV., 142 and 177; ibid. 1890 (1891), p. 34. Emu Bay, N.W. Tasmania 31.10.1882.

1894—*Lophotes cepedianus* Parker, Trans. N.Z. Inst. xxvi., p. 223. St. Clair Baths, near Dunedin.

Specimen in the Otago Museum. Not *Lophotus cepedianus* Cloquet, and authors.

1897—*Lophotes* sp. Clarke, Trans. N.Z. Inst., xxix., June, 1897, p. 251, pl. xvi. Coast of Taranaki.

1904—*Lophotes fiskei* Hutton. Index Faun. N.Z., p. 47. Not *Lophotes fiskii* Gunther, 1890, which belongs to the genus *Eumecichthys* Regan, Pro. Zool. Soc. Lond., 1907, ii., p. 638.

1907—*Lophotes fiski* Waite, Rec. Cant. Mus. i., 1, p. 33.

1909—*Lophotes cristatus* Kershaw, Vict. Nat. xxvi., p. 78. Apollo Bay, Victoria. Not *L. cristatus* Johnson, 1863, from Madeira.

1914—*Lophotes cepedianus* Waite, Trans. N.Z. Inst. xlvi., June 15, 1914, p. 130, pl. iv., fig. 2, Wellington district.

1924—*Lophotes guntheri* Lord & Scott, Vertebr. Anim. Tasm., p. 47.

1927—*Lophotes cepedianus* Phillipps, Marine Dept. Bull. N.Z. i., p. 52.

1929—*Lophotes cepedianus* Young, Trans. N.Z. Inst. LX., p. 145. Chatham Islands.

1929—*Lophotes guntheri* Whitley, Pap. Proc. Roy. Soc. Tasm. 1928 (1929), p. 50.

1929—*Lophotes guntheri* and *cristatus* McCulloch, Austr. Mus. Mem. V., p. 139.

1933—*Regilophotes guntheri* Whitley, Rec. Austr. Mus. xix., I., p. 72.

Systematic description:—

Br. 5. D. CXCV./XX./VI./XVII./VI. A. XVII./VI.; C. VII.; P. XIV.: V.5.

Greatest depth 5.902 in the total length to base of caudal. Head 6.857 in same and 1.162 in the depth. Eye 2.625 in the head.

Body elongate, compressed, the dorsal and ventral profiles almost subequal, forming a high crest above the head, the anterior margin of which is keel-like. Above the lateral line, the body is covered with quadrangular scales of extreme thinness directed obliquely backwards; when removed distinct pits are left behind. No scales are present below the lateral line, and little or no indication of pits can be seen, but owing to the highly deciduous nature of the scales it is possible these may have all disappeared at the time of capture.

Lateral line commencing at the base of the anterior spine of the dorsal curves downward to the pectoral, and thence follows a long even curve to the caudal.

Head wholly bony, the bones of the operculum and preoperculum heavily striated. Mouth small, oblique, the maxilla reaches backward to about the first quarter of the eye.

Teeth in jaws conical and depressable, those in the upper forming an irregular band with a gap in front, while those in the lower jaw are in a single series. The vomer is toothless, but there is a pair of strongly hooked depressable teeth placed mesially on its posterior margin. A single short depressable tooth is also found on the outer side of the palatine bones, but the palate and tongue are smooth.

Eye large, circular, placed rather nearer the lower than the upper profile. Nostril minute, pore-like, placed above the mouth on the lower margin of the crest.

Gills four, a slit behind the fourth. Gill-rakers rather long and flattened. I count seven on the lower half of the anterior limb. Pseudobranchiae present.

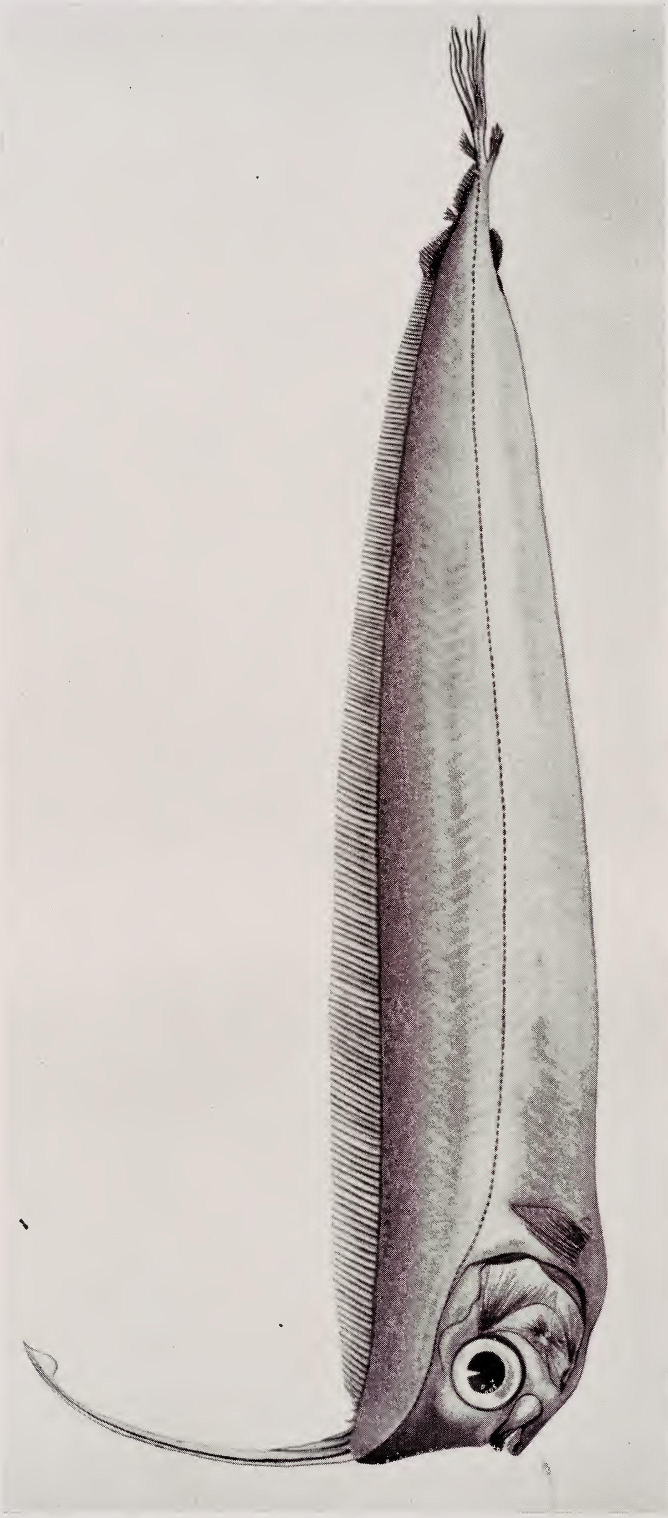
Fins: Anterior dorsal spine exceedingly elongate and having a small leaf-like lobe at the tip; this is followed by two other spines connected by thin membrane to the anterior one. The three next spines are very short and appear to form a distinct notch, but all are connected by membrane to the greater portion of the dorsal along the back. The posterior portion of the dorsal appears to be split up into four parts, and the membrane covering these fins is thicker and roughened, quite different from the clear membrane found in the middle and anterior part of the dorsal. The anal is similar to the posterior dorsal fins. The caudal was reduced to long roughened spines, flattened and bent, and no membrane was found connecting them. Pectoral has a broad base and the rays are directed vertically. Ventral minute, situated below and a little behind the base of the pectoral.

Colour: When first taken, the whole of the body was brilliant silver, with no vestige of spots or other markings. Fins, bright pink, the spines somewhat darker. Anterior dorsal spine dark brown with pale pink membrane, and the leaf-like lobe at the extremity bright red. The small detached posterior fins of the dorsal and anal, including the caudal spines, deep rose colour.

Locality: Waihau Bay, Cape Runaway, East Coast, New Zealand. Captured by Mr. H. F. Kemp on 5th October, 1933, to whom I am greatly indebted for forwarding the specimen in such perfect condition. Mr. Kemp informed me that when this fish was speared it ejected a very large quantity of sepia-like fluid from the anus.

Described and figured from a specimen which is 720 mm. long to the hypural joint. The head is 105 mm., greatest width 122 mm., eye 40 mm.

Specimen in the Auckland Museum.



Lophotus guntheri (Johnston, 1883).

L. T. Griffin del.

The Distribution and Breeding Habits of Petrels in Northern New Zealand.

By R. A. FALLA, M.A., Ornithologist.

The eastern coastal waters of Northern New Zealand, between the parallels of 34° and 38° South Latitude, may be considered as a well-defined feeding and breeding area for petrels. It is characterised by extensive areas of semi-sheltered water along the east coast, and a large number of islands suitable for nesting. Of the species breeding here, a number are resident and apparently restricted to the area, many are transequatorial migrants, and only two truly subantarctic genera (*Pelecanoides* and *Pachyptila*) are represented. An attempt is made in this paper to define the breeding dates accurately, to indicate the range of a species within the area, and put on record all observations to date on the habits of the birds. No discussion of the status or relationships of any of the species has been attempted. The data may not prove to be applicable to such breeding areas further south as Cook Strait, Bank's Peninsula, and Stewart Island. Many of the transequatorial migrants inhabit these areas for breeding in common with the northern area under discussion, but as regards what may be termed resident species the various areas are not contiguous and have their own distinguishable forms and characteristic species.

I am much indebted to Mr. Bernard Sladden, of Taneatua, for permission to quote his reliable records from the Bay of Plenty, and for the many opportunities of visiting islands there in his company; also to Messrs. W. R. B. Oliver and E. F. Stead for permission to quote unpublished records. Where I have not personally observed evidence of a species breeding the authority for the record is quoted.

The assumption that certain species are transequatorial migrants is based on observation of their regular arrival and departure, and on records of their occurrence in the northern hemisphere during the period of absence from these waters. Resident species are so described as the result of observation of their movements in every month of the year. On this basis the thirteen species to be dealt with may be classified as follows:—

Transequatorial Migrants.	Resident Species.	Unclassified for want of definite data.
Puffinus carneipes	*Pterodroma macroptera*	*Pelecanoides urinatrix*
Puffinus bulleri	*Puffinus gavia*	*Pachyptila turtur*
Puffinus griseus	*Puffinus assimilis*	*Procellaria parkinsoni*
Pelagodroma marina (probably)		*Pterodroma inexpectata*
		Pterodroma cooki
		Pterodroma pycrofti

Among the published records dealing with this area, Sandager's paper (1889, p. 286) contains records, from Mokohinau, which can all be confirmed by observation at the present day. On the other hand it should be pointed out, in the interests of accuracy, that Reischek's observations, so extensively quoted, cannot be fully confirmed in the same way. While much of his observational work forms an invaluable field record, a number of his statements regarding the breeding seasons and the habits of some species are completely at variance with contemporary observations, as well as with more recent ones, and some cases in point are quoted below.

Pelecanoides urinatrix (Gmelin).

Breeding stations: Three Kings Islands (Fraser), Cavalli Islands, Poor Knights Islands, Mokohinau and Fanal Island, Bream Rocks, Chickens Islands, Channel Island, Alderman Islands, Karewa Island, Motuotau (Rabbit Island), Plate Island.

Breeding dates: The annual moult of adult birds is usually complete in March, and large flocks are to be seen at sea near the breeding places from April onwards. For the next three months they are engaged in a leisurely cleaning out of burrows, carried on mainly at night. Odd birds, usually males, are sometimes found in the burrows during the day during this period. One male bird taken from a burrow on one of the Chickens Islands in April was in fresh plumage and had enlarged gonads, although in this area actual laying does not commence until July at the earliest. At Karewa Island practically all the birds had laid by the end of August, 1925 (Sladden). An incubation period of at least five weeks is suggested by the fact that on the same island on 5th October of the same year Sladden could find no chicks, although several eggs were just ready to hatch. Most of the young leave the nests on this island at the end of November, but on islands further north the season is more extended and numbers are still leaving throughout December. Nothing has been recorded of their movements and habits from January to March, during which time they are rarely seen at sea in coastal waters. This is the season of moult.

Breeding habits: Throughout the breeding season, diving petrels, which arrive always after dark, fly straight in from the sea without preliminary circling, and land heavily within a few feet of the home burrow. Their courtship is noisy, with both mewing and cooing notes. It often takes place, as does pairing, outside the burrows. For nesting material the most readily available is used, and Sladden mentions the leaves of *Coprosma retusa* as used on Karewa, quantities being knocked off the bushes as the birds hurtle in. After the eggs are laid, the birds coming and going at night, make much less noise. On many of the islands larger species begin to nest before the diving petrels have finished, and there are few places in which the latter have an area to themselves for the whole season. Mr. Sladden is of opinion that on Karewa diving petrels sometimes occupy the larger burrows made by *Puffinus carneipes*, and Buller quotes Captain Fairchild as having found a pair of the latter in November in the same burrow as a fledgling diving petrel.

Development of young: The smaller nestling figured (Pl. 54, fig. 2) is from Mokohinau, on 4th October. It is covered with protoptyle down, silver grey above and white on throat, chest and abdomen. Murphy (1921, p. 210) has described *P. urinatrix* as similar to *P. georgicus* in having dark protoptyle, but this is not so. The next stage figured (Pl. 54, fig. 1) is a bird from Cavalli Islands on 5th November. It is heavily clothed with mesoptyle down, loose and dark brownish grey on the upper parts, and short, dense and sooty grey below. Teleoptyles are already well developed on head and wings, the secondaries being white edged at the tips, and some of the short outer scapulars with pale grey inner webs.

Food: There is very little food in the stomachs of adults early in the nesting season. Later, when feeding the young, and after the post-nuptial moult, they contain quantities of fine paste made up of various pelagic Crustacea. This is the only species of petrel in which I have not yet found remains of cephalopods.

Pelagodroma marina (Latham).

Breeding stations: Cavalli Islands, Mokohinau, Noises, Gannet Rock, Mercury Islands, Alderman Islands (Hongiora).

Breeding dates: After an absence of five months from these waters, the first flocks of white-faced storm petrels appear about the middle of August. The dates given by Sandager for Mokohinau apply exactly to all the other breeding islands listed above. Laying takes place from about the 20th until the end of October, the young are hatched at the end of November, and begin to show feathers during January. At the Noises islets on 3rd March, 1934, two-thirds of the burrows were empty and the youngest bird found was within less than a week of flying.

Breeding habits: During September the birds are very common at sea, and are to be seen engaged in erratic mating flights more often than feeding. They not infrequently lose their way in thick weather during this period, and fly into lighthouses or passing ships, but usually without damaging themselves. The nesting burrows vary in length, some being quite shallow. The large quantity of nesting material used results in the egg being kept dry and usually quite clean. I have found surface laid eggs at most of the breeding places, and on one of the Noises islets a nest of leaves out in the open, under trees, with a male bird sitting closely on a well-incubated egg. This was on 2nd December, and in broad daylight.

At no time during the nesting season do the birds appear to come in until well after dark. At the Mercury Islands on 5th January, 1926, when feeding young, the majority arrived about

9 p.m., an hour after dark. At this time they are not noisy, uttering a low twittering note after alighting, but by 10 p.m. louder squeaking calls are to be heard. I am unable to state whether both parents visit the young on the same night. In marked burrows only one adult was found at any one time.

Development of young: The newly hatched nestling is covered with ash grey down of uniform shade above and below, and very long and bushy on the forehead and crown; chin and throat naked. The distinguishing features of the first teleoptyle plumage succeeding the down are the grey-white edging of the secondaries, and the white tips of the major wing-coverts. At this stage also the webs of the toes are usually buff pink, and not yellow, as in adults.

Food: The stomachs of several sitting adults of both sexes in October were found to be empty except for small pebbles. Food in the stomach of nestlings consists of a fine paste in which the only recognisable remains are of minute crustacea. The stomachs of newly-fledged birds ready to leave the nest were found to be empty, but such birds immediately after death discharge about a fifth of a fluid ounce of clear, reddish orange oil from the mouth. Small cephalopod beaks have been taken from the stomachs of adults at various seasons.

Pachyptila turtur (Kuhl.).

Only one form of the fairy prion is so far recorded from this area. It is not distinguishable from the form breeding in Cook Strait and at the Chatham Islands. It is not common even near the breeding places listed, and appears to be absent from the Bay of Plenty.

Breeding stations: Poor Knights Islands, Chickens Islands (Reischek), off Great Barrier.

Breeding dates: At the Poor Knights I have found new burrows, on 17th November, and Oliver has recorded a heavily incubated egg there on 3rd December. Sladden (in lit.) has found well grown chicks in down on Saddle Island, off Great Barrier, at the end of January, so that the breeding season would seem to be fairly uniform throughout the area.

General: Up to the present time no further facts about prions breeding in this area have been recorded. By February countless numbers of prions of several species reach these waters from further south, and it becomes impossible to trace the movements of the local birds. As their condition on leaving the nest and plumage changes are probably similar to those of the birds inhabiting Cook Strait, I may here give the results of an examination of some Stephen Island material, for which I am indebted to Mrs. Moncrieff, of Nelson. The material consists of the complete heads, with plumage attached, of a number of adult and juvenile birds which had been killed by cats on or about 25th January,

1932. The bill measurements of the various stages represented are as follows:—

No.	Stage of Growth.	Length of Bill.	Width of Bill.
1	Adult.	24 mm.	10.5 mm.
2	Adult.	23	11
3	Adult.	23.5	12
4	Young, almost fully fledged.	20.0	8.5
5	Young, fully fledged, wisps of down on neck.	22.0	9.0

At the time a young prion leaves the nest it is still distinguishable from the adult, not only by a bill of smaller dimensions, which when dry after death presents a shrunken appearance along the top of the culmen, but also plumage of a pale bright blue, which later becomes darker and greyer through wear. Birds in this condition are frequently driven ashore during gales in February, and their immaturity can always be verified by dissection.

Puffinus carneipes (Gould).

Breeding stations: Three Kings Islands (probably), Chickens Islands, Mercury Islands, Alderman Islands, Karewa.

Breeding dates: After an absence of three or four months in the winter, the first of these shearwaters are noticed at sea off the coast early in September, and they remain in the neighbourhood of their nesting islands throughout the summer. A few go ashore at night to work on new burrows or clean out old ones during September, and by the beginning of October about half the burrows have been "claimed." Early in November all the birds seem to come ashore every night, and by the end of the month laying has commenced, continuing until about 10th December. Hatching commences about 12th January. Half-grown nestlings have been found on 24th February (Chickens Islands), and full-grown nestlings still in down on 10th March (Karewa). From this date they begin to feather and are fed less frequently. Most of the burrows are empty by the beginning of May, and the birds are no longer to be seen at sea, at any rate in coastal waters.

Breeding habits: At the nesting places these shearwaters approach the land before dark, and begin to come ashore at dusk. On 5th October at Karewa, Sladden noticed a fair amount of activity at night, but very little noise. Many burrows on that date contained pairs of birds, and in a few, single birds were found during the day. Throughout November, when burrowing and collecting of nesting material is finished, the din at night associated with courtship and mating is considerable. The birds begin to call before alighting, a short mewing note like that of a kitten. Mating displays begin after dark on the ground near the burrows, and it is somewhat difficult on account of the large numbers involved to isolate the participants in any particular display. A high pitch of excitement is reached by many of the birds, and they waddle about with swaying necks thrust forward, uttering a guttural purring note, with sobbing intake. The noisiest part of the demonstration is reached when each pair strikes an ecstatic attitude, with beaks close together, and sets up a duet of loud squeals. During January, when the birds are coming in at night to change guard, they arrive later, and when bringing food for the young often later still. There seems a tendency on windy days for food-gathering birds to work away from the home island in the morning into the wind. On a day when a south-west wind registered a stead force 5 (Beaufort Scale) I have seen many of these shearwaters late in the afternoon still feeding at a point 80 miles to the south-west of the nearest breeding island. The obvious advantage of this habit is that the birds can feed more easily when moving head to wind, and, further, that they have the wind with them when flying back heavily laden with food.

Development of young: A half-grown nestling from the Chickens Islands is covered with sooty grey down, uniform above and below, and has a fleshy purple bill, dark at the tip, and dull fleshy pink feet. The condition of a well-grown nestling on Karewa Island on 10th March is figured by Oliver (1930, p. 117), who reproduces a photograph taken by Mr. Sladden on that date. A young bird from the same island on 30th March, with wing feathers just beginning to show, has long silky mesoptyle down on the back, darker brown than the protoptyle that it has replaced.

Food: Adults captured in December almost invariably have the alimentary tract filled with a substance like bright green mud, of which the nature and origin have not been determined. Cephalopod beaks of various sizes are often found in the stomachs of adults.

An acquired habit, most noticeable in April, is the regular attendance of many shearwaters of this species only on boats engaged in line fishing. In addition to picking up scraps, the birds dive down and follow the bait on a sinking line to a depth of ten or fifteen feet, usually getting it or hooking themselves.

Puffinus bulleri Salvin.

Breeding stations: Three Kings Islands (probably), Poor Knights, off Great Barrier (?), off Mayor Island (?), Whale Island (probably).

Although to date the Poor Knights is the only breeding place definitely recorded, there is no doubt that colonies also breed at the Three Kings and at Whale Island. At both these places I have seen large numbers of birds closing in on the islands at sunset, and also flying out from the shore at daybreak.

Breeding dates: The first Buller shearwaters arrive at the end of August, and others throughout September. Preparation of burrows probably begins in October, and I have found at the Poor Knights on 17th November evidence of fresh burrowing, and collected nesting material, but no birds in the burrows by day, and no eggs. The first week in December seems to be fairly uniformly the laying time, and most of the chicks hatch before the end of the month. By 24th February the chicks are large, but still clothed in down, with no feathers showing. They are fledged and leave the nests about the end of March, and by the end of April very few birds of this species are to be seen at sea.

Breeding habits: No detailed observations have been made other than those recorded by the present writer (1924, p. 37). As the breeding season coincides with that of *Puffinus carneipes,* so also do the habits of this species seem to correspond fairly closely. This applies to the mewing call made when approaching land after dark, and to some of the feeding habits. *Puffinus bulleri,* however, has not been seen to approach the nest just before dark, as *P. carneipes* sometimes does.

Development of young: The only material so far examined are four well grown nestlings in down taken at the Poor Knights on 24th February. These birds, collected from different parts of the island, are fairly uniform in size and colour of down, which is a neutral grey, only slightly darker above than below (Pl. 55, fig. 1). Bill and feet are coloured as in the adult, but more fleshy and with dark parts less pigmented.

Food: The stomachs of adults taken early in December contained cephalopod beaks and small sharp pebbles, and birds on the nests later in the month had an unidentified green substance in the alimentary tract, which is possibly not food, but a secretion like bile.

Puffinus griseus (Gmelin).

Breeding stations: Three Kings, Cavalli Islands, Mokohinau (Sandager), Hen Island (Stead), Alderman Islands, Whale Island, White Island (Sladden).

Although breeding regularly on all the islands named, the sooty shearwater is not common on any of them, and the number of burrows of this species on any of the islands would not be more than a dozen. Consequently only scattered birds are to be seen at sea during the summer in this area, associated with other petrels often, but never seen in flocks composed of their own kind, as at the southern breeding areas.

Breeding dates: These correspond with those of the other two long distance migrant shearwaters. The birds begin to come ashore at the breeding places in October, and on 5th November at the Cavalli Islands Mr. Pycroft has found a male bird with enlarged gonads, occupying a burrow during the day. A nest containing a female bird and egg was found on Whale Island on

11th January, the state of incubation of the egg indicating that it had been laid not earlier than mid-December. A similar season elsewhere in this area is confirmed by the observations of Sandager at Mokohinau (1889, p. 290), Sladden and Falla (1928, p. 283) at Alderman Islands, and Sladden at White Island.

Breeding habits: Published accounts and observations agree that this species in this area burrows in harder ground than the others, and has generally deeper burrows. A burrow at Whale Island went down almost vertically for three feet, and then turned sharply to the left before opening into a roomy breeding chamber, where three or four handfuls of sticks, dry grass and leaves formed the nest. The habit of uttering a monotonous crooning note in the burrows during the day when sitting, especially on the approach of footsteps near the burrow, has been frequently observed. They resist vigorously if disturbed.

Puffinus gavia (Forster).

?**Puffinus gavia byroni** (Mathews).

Birds from northern New Zealand are smaller than the birds from the type locality and Cook Strait, and may prove to be inseparable from the New South Wales birds which Mathews has referred to a subspecies *byroni*. These shearwaters outnumber every other species numerically, and are present all the year. A typical flock, off Three Kings Islands, is shown in Pl. 56, fig. 2.

Breeding stations: Three Kings, islets off Doubtless Bay, Poor Knights, Bream Island, Mokohinau, Chickens, Hen Island, Little Barrier, Saddle Islet, off Great Barrier, Channel Island, Mercury Islands, Alderman Islands, off Slipper Island, Plate Island, Whale Island.

Breeding dates: On all the islands above listed apparently the dates are those given by Sandager for Mokohinau. The moult of adults is protracted, beginning in January and often not complete until June. The majority of adult birds are ashore nightly by September, burrowing and courting. Fresh eggs are to be found at the end of that month and early in October. A nestling about half grown, described below, was taken at one of the Chickens Islands on 11th November, and fully fledged young with patches of down still adhering have been taken on 11th January (Whale Island). A young bird that had just left the nest was taken at Whangarei on 22nd January, a time of departure that observations elsewhere show to be general.

Habits: In March and April, while still in double-feather, these shearwaters frequent inshore and sheltered waters in vast numbers, feeding on the shoals of larval and post-larval fish (*Engraulis* and other species) which are plentiful at that time. When feeding thus on small fish the birds swim on the surface and frequently submerge their heads. They also dive and swim for considerable distances under water. When the fish go down the shearwaters rise and make a straight flight into the wind with the rapid wing beats characteristic of the species, until they gain sufficient momentum to perform controlled gliding. At this stage they all wheel back until the rising fish are sighted again, when they round up once more into the wind and alight.

They are vocally more noisy than any other petrel in this region. Even at sea a flock will sometimes set up a cackling noise after the discharge of a gun. Approaching the nesting islands an hour or more after dark they begin to call when about two hundred yards off shore, and the burst of staccato notes then set up lasts till the bird lands on the ground. The notes when uttered slowly resemble the native name of the bird "pakaha"; their rapid repetition is like a wild burst of laughter. The burrows of this species vary with the kind of surface in which they are made. On Bream Island, for example, in soft soil they are comparatively shallow, close together, and on a bare knoll devoid of vegetation; on Hen Island frequently under large trees, winding under roots and rocks, and five or six feet long. I have not observed the courtship and early stages of nesting.

Development of young: The youngest nestling available for examination (Chicken Island, 11th November) is about half grown and covered, except for the naked chin and fore-neck, with uniformly coloured sooty grey mesoptyle. In specimens almost fully fledged the remnants of this down show no difference in colour. The first teleoptyle plumage resembles that of the adult, but is darker than that of even a fresh moulted adult bird, being on the upper parts a glossy blackish brown. Even at this stage, however, it could hardly be confused with the blue-black of *Puffinus assimilis,* as has been suggested in discussions on the taxonomy of *P. gavia.*

Puffinus assimilis Gould.

Among several resident petrels that commence nesting before winter is over, this species appears to be the earliest to lay. It is not common at any season, and I have never seen it in flocks in coastal waters.

Breeding stations: Mokohinau, Chickens Islands (Reischek), Hen Island.

Breeding dates: On Hen Island A. T. Pycroft found a freshly moulted pair in a burrow during the day on 17th April. At Mokohinau on 5th October burrows of an extensive colony were all empty, except for two belated chicks, one in down, the other half-fledged. Adults in worn plumage and young in fresh first plumage were collected at sea on 17th November, and in the same month R. A. Wilson found odd birds in burrows on Hen Island, probably fully fledged young. These records all agree with Sandager's observations at Mokohinau, except that he describes the young as leaving the burrows fully two months later. Reischek (1885, p. 95), however, records the commencement of burrowing in October, the season ending with the departure of the young in February. If Sandager is correct the season must be irregular and extended, or have altered slightly in fifty years. If Reischek is correct, either the season has changed from winter to summer, or the birds raise two broods in a year. Present day observations indicate *P. assimilis* as a winter breeder only, with season from April till October.

Habits: The period of field work covered by this paper has yielded little information about this species additional to what has been published. Its flight is rapid in still air, but the wing beats are not so rapid as in the heavy-bodied *P. gavia,* and it has more control when changing direction than that species.

An example of the optimism or patience of the male was afforded by a male *P. assimilis* found at Mokohinau on 5th October still sitting closely on an egg in which a well developed chick had been dead probably for a week or two.

Development of young: Reischek has described the down on "the very young of *P. assimilis* as light grey, the throat, breast and abdomen white." This is the protoptyle stage, and a well-grown nestling from Mokohinau still has a patch of white protoptyle adhering to the mesoptyle of the breast (Pl. 54, fig. 4). The full mesoptyle condition, however, is a dark grey both above and below (Pl. 54, fig. 3), the sequence of neossoptyle plumages being thus somewhat similar to that in *Pelecanoides urinatrix.* In its first teleoptyle the young is indistinguishable from a fresh moulted adult, except for its immature bill characters.

Food: Remains of small cephalopods and minute crustacea have been found in the stomachs of several.

Procellaria parkinsoni Gray.

The superficial similarity of this species to *Puffinus carneipes* and *Pterodroma macroptera* introduces an element of uncertainty into all earlier records that are not supported by existing specimens. In view of its apparent restricted breeding area to-day and the infrequency with which it is seen, it must be accounted one of the rarest petrels in the world.

Breeding stations: Little Barrier Island, and possibly inland mountain ranges.

Breeding dates: The black petrel seems to be the latest breeding petrel in the area. Reischek records them as still cleaning out burrows on Little Barrier in November, and the finding of the first egg on 28th of that month. He further mentions very young birds in December, January and "even as late as April." A specimen collected by him on Little Barrier and dated "April, 1885," is in the Auckland Museum collection, and is clothed in dark brown (although possibly somewhat faded in the specimen) mesoptyle. Teleoptyle plumage is well grown on crown, ear-coverts, mantle, scapulars, upper wing coverts and breast.

It seems clear that the young leave the burrows mainly in May, for there is seldom a year when young birds are not picked up in various parts of the Auckland district, having lost themselves in gales and fogs during that month and early June. The last one to reach the Auckland Museum was picked up injured in the city on 19th May, 1931. Its whole plumage is a rich, glossy, blackish brown, relieved by the paler or rather "frosted" edging to the feathers, especially of the mantle and back. The bill was ivory white, stained with black on the culmen, mandibular sulcus, and tip of mandible; feet entirely black, iris brown.

Pterodroma macroptera (Smith).

Of this petrel it may be said that it breeds on every islet where burrows can be made, on all suitable cliffs along the mainland coast, and sometimes a mile or two inland. A full list of breeding places would include two or three hundred islands, islets and capes. It is not gregarious nor a colony-forming bird, like most of the shearwaters, and its abundance on certain islets is due to the suitability of the ground there. Elsewhere a single burrow may be found in some isolated spot. The species appears to be independent of food supply in coastal waters, and its extensive feeding range has been remarked upon in another paper (Sladden and Falla, 1928, p. 284).

Breeding dates: Within a month of the departure of the last of the young from the burrows in January, some few old birds will be found in occupation again, at first only single birds, and usually males. This is so in February and March. From April till June pairs are often found in burrows during the day, but not in all the burrows on any one day. Laying takes place at the end of July and early in August, and a few chicks are hatched before the end of August. Chicks reach their maximum size and condition late in October, and begin to feather. November is the "mutton-bird season" for this species, the only one now collected at all regularly for food by North Island Maoris. Young are fully fledged early in January, and are all away by the end of the month.

Habits: Their habits have been vaguely described by some writers as "nocturnal," apparently because they are often found in burrows by day. The position seems to be that a pair may remain for several days and nights in a burrow, and then spend a similar continuous period at sea. Although not common in coastal waters at any time, when they do appear they are frequently in pairs, especially in May. Their courtship has not been described, and I have not seen it. A large quantity of nesting material is sometimes used, and I have half filled a sugar-bag with the contents of one burrow. Although female birds are sometimes found sitting on quite fresh eggs, in the later stages of incubation only males have been found sitting, at any rate during the day. Males have also been found in attendance during the day on chicks up to ten days old, after which the chick is only visited at night.

Throughout the year, except perhaps in January, old birds may be heard calling at night near the nesting places, and among several notes the predominant one is that represented by the native name "Oii." It is not unusual in January to find fully fledged young emerging from the burrows after dark and ambling about in an aimless fashion over tree stumps and other obstacles. They often return again to the burrow before daylight, but sometimes take wing.

Development of young: Chicks about ten days old collected at Tiri Tiri Island on 1st September were in uniform sooty grey down, and had black bills and fleshy grey feet. Two such specimens weighed respectively $6\frac{3}{4}$ ozs. and $8\frac{1}{2}$ ozs. A chick taken at Cuvier Island on 6th October weighed 12 ozs., and was still in down, with no feathers showing. Half-fledged young from the Cavalli Islands on 5th November weigh 1 lb. 2 ozs., and 1 lb. 6 ozs., the latter being 4 ozs. in excess of the normal adult weight. Before flying the young are reduced to about 3 ozs. less than adult weight. A young bird from Tiri, fully fledged, but still in the burrow on 22nd December, is of adult dimensions, viz., wing 302, tail 120, tarsus 41, toe 64, bill 37. Its plumage is indistinguishable from a fresh moulted adult, except in being perhaps a shade darker. The "frosted edges" of the mantle feathers are noticeable as in the fresh plumage of practically all dark petrels.

Food: In the stomachs of young and old, cephalopod remains are invariably found. Young birds when disturbed throw up considerable quantities, including pieces of flesh, beaks, eyeballs, and purple fluid.

Pterodroma inexpectata (Forster).

This species evidently once nested in great numbers in the inland ranges of the North Island. There is reason to believe that many hearsay records of *P. cookii* from inland refer to this bird, perhaps on account of the native name "titi" being applied to both. There are authentic specimens of *P. inexpectata* taken inland, and none that I can find of *P. cookii.* Most of the extensive breeding areas once known to the natives are now deserted, on account of fire and vermin. Miss L. M. Cranwell informs me that the calls of petrels may still be heard at night on Maungapohatu Mountain, in the Urewera district.

In the area under discussion, *P. inexpectata* has been recorded as nesting only on Cuvier Island. In a letter to me dated 22nd July, 1923, the late Mr. R. S. Sutherland wrote: "At the present time at Cuvier mottled petrels *(P. inexpectata)* are becoming more frequent round the lighthouse at night—evidently congregating —but so far they have not touched the old burrows. Their nesting time, judging by observations I made on the West Coast, South Island, is October onwards." In another letter he wrote: "At Cuvier, *Pterodroma macroptera* seems to have monopolised all nesting sites—the only other petrel breeding in any number being *inexpectata*—and there are only odd ones of these; I mean there is no section of the island of which one can say—this is *inexpectata* —or this is *macroptera.*"

On a visit to Cuvier on 7th October, 1933, I found freshly cleaned burrows under the roots of *pohutukawa* trees, but they were at that date unoccupied during the day. The only specimen I have collected in the area was picked up dead on a beach on Red Mercury Island, ten miles south of Cuvier, on 10th January.

Pterodroma cookii (Gray).

Recent investigations have indicated the possibility of Little Barrier Island being the only known breeding place of *P. cookii,* and the strong probability that Reischek's records from the Chickens Islands refer to *P. pycrofti.* Reischek's observations on Little Barrier are likely to remain the chief source of information about the nesting of *P. cookii,* as no permits are now granted for the collecting or disturbance of any bird on this sanctuary. Such observations as can be made confirm the dates he gives, namely, a fresh egg on 2nd November, and the young full grown in March.

Habits: There are no records by any observer to show definitely whether *P. cookii* leaves these waters at any part of the year, but there is some indication that they do so. I have noted their presence in each month from October till March, their absence in August and late April, and have no record for the winter months. Such evidence is not conclusive, for even in the summer they may be seen at sea in thousands on one day, and then be absent for days at a time, probably feeding a hundred miles off-shore. They still nest in considerable numbers on Little Barrier, in spite of the fact that wild cats are still finding them easy prey. The burrows are mainly on the higher ridges of the island, and wind down deeply beneath roots into a rich black forest mould which is usually sodden with moisture.

Development of young: None of the nestling stages have apparently been described. A photograph of a well-grown bird in down taken by Mr. R. S. Lediard early in February is here reproduced (Pl. 55, fig. 2) and shows pale grey down above and white below. The first teleoptyle plumage of a bird not long from the nest, picked up on 2nd April, 1928, was decribed earlier in this volume (Falla, 1933, p. 178). An exactly similar bird has been found under similar conditions on 1st April this year (1934) near Auckland.

Food: Cephalopod beaks have been found in all the specimens I have examined.

Pterodroma pycrofti Falla.

An opportunity is taken in this paper to present additional field observations on this species which should further help to distinguish it from the closely allied *P. cookii.*

The dimensional differences indicated in my earlier paper in this volume (p. 176) are confirmed by the larger series of both species now available. All the specimens of *P. pycrofti* have shorter wings, bills, and middle toes, but relatively, and in some specimens, absolutely longer tails than *P. cookii.* The average weight of three breeding females of *P. pycrofti* was 5.65 ozs., and of two female *P. cookii* 6.75 ozs. The fresh material indicates that the type and paratype of *P. pycrofti* from Hen Island are darker than normal on account of wear. The fresh plumage of the upper parts is slightly darker than the neutral grey of Ridgway's standards, that of *P. cookii* being slightly lighter than neutral. In *P. pycrofti* the white edging to frontal feathers is confined to the forehead, not extending back over the crown, and the white mark over the eye is more extensive. The scalloped effect at the sides of the neck and breast of *P. cookii,* due to white edging of dark feathers, and grey flecks on some of the white feathers, is absent in *P. pycrofti,* the line of demarkation being more cleanly defined. The flanks axillaries and thighs are white, without the irregular mottling found in *P. cookii.* The inner web of the outer pair of lateral rectrices is pure white in all eight specimens. This is stated by Murphy (1929, p. 3) to be variably marked in *P. cookii,* but it is more or less mottled in all the specimens of *P. cookii* available for this comparison. The feet of *P. pycrofti* are pale lilac blue on the tarsus and the middle and inner toes, brown on the outer toe, webs of a transparent flesh colour, heavily veined with purple. The feet of *P. cookii* have the upper part of the tarsus and most of the inner toes dull purplish blue. The outer toe, patches on the inner toes and lower end of tarsus are brown. The outer two-thirds of the webs are opaquely stained with brownish black. In life *P. pycrofti* appears a shorter bird, with a smaller, more rounded head.

Breeding stations: Hen Island, Chickens Islands.

Breeding dates: The conditions of the earlier discovery of this species, when a pair were found in a burrow on 25th January (Falla, 1933, p. 176) were evidently abnormal, and Mr. E. F. Stead has subsequently determined that laying at both known breeding places commences at the end of November and continues through December, which appears to be some weeks later than that of *P. cookii.* A brief search for young in February this year was unsuccessful, as the only burrows found were either empty or contained punctured egg shells, and in two cases dead birds, perhaps the work of rats.

Habits: Very little information about the range and habits of this species has yet been obtained. The situation of the nesting burrows, however, offer a striking contrast to those usually occupied by *P. cookii* on Little Barrier. The burrows so far discovered are not anywhere close together, but in small groups in dry, well drained ground. Some of them are comparatively shallow, and in many dead leaves have been allowed to accumulate at the entrances in such quantity as almost to block them. Even when the birds are in occupation they present externally the appearance of old disused burrows. The call *tee-tee-tee* has been heard at the Chickens and Hen Island, and as *P. cookii* has not been found at either place, it is apparently made by *P. pycrofti.*

General conclusions:—

The main factor governing the breeding dates of the various species here considered appears to be the extent of the annual migration, if any. Thus none of the species that have been recorded at the equator or north of it are found to lay before November, except *Pelagodroma marina,* which lays at the end of October. Furthermore, there is marked regularity about the laying dates of such species, and the preliminaries of courtship and burrowing occupy a shorter time. On the other hand, the species listed above as resident breed in the winter, at any time from April onwards, and have a more extended season, with some irregularity in the dates of laying. Judging by these criteria and from other indications, the species in the unclassified list given above might tentatively be regarded as probably migratory, with the exception of *Pelecanoides urinatrix,* which is probably resident. Some observations on these lines have recently been published by Major R. A. Wilson in the "Wanganui Chronicle" of 13th March, 1934.

In the matter of food supply there is not the competition that might be expected where such a large number of birds of similar habit are confined to a small breeding area. Examination of stomach contents and observations of the birds at sea show that many species are to some extent specialised in their feeding habits. Thus *Puffinus gavia,* and to a lesser extent *Puffinus carneipes,* seem better able than the others to obtain young fish. An almost exclusive diet of pelagic cephalopods seems to be the rule with the larger species of *Pterodroma,* and of these *P. macroptera* is rarely, and *P. inexpectata* practically never, seen within fifty miles of the coast during the day.

Although conditions of temperature and food supply seem superficially much the same throughout the area, the waters of the Bay of Plenty, from Cuvier Island south, may be regarded as a sub-area in which it will be noted that several species do not breed. Those not so far recorded from there are *Pachyptila turtur, Puffinus assimilis, Procellaria parkinsoni, Pterodroma cookii* and *Pterodroma pycrofti.* The Bay of Plenty sub-area has no species breeding there that are peculiar to it.

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TEXT FIGURE.

Map of North Auckland and Bay of Plenty coast, with off-shore islands.

PLATE 54.

1 2 3 4

Fig. 1. Mesoptyle down of *Pelecanoides urinatrix*.
Fig. 2. Protoptyle down of *Pelecanoides urinatrix*.
Fig. 3. Mesoptyle down of *Puffinus assimilis*.
Fig. 4. *Puffinus assimilis:* younger specimen with patch of white protoptyle still adhering to grey mesoptyle.

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Fig. 1. *Puffinus bulleri* nestling, Poor Knights Islands. Photo by courtesy "The Weekly News."
Fig. 2. *Pterodroma cookii* nestling, Little Barrier Island. Photo by R. S. Lediard.

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Fig. 1. Typical nesting site of *Puffinus bulleri*, Poor Knights Islands.
Fig. 2. Flock of *Puffinus gavia* (with *Larus scopulinus*) off Three Kings Islands.
Photos by courtesy "The Weekly News."

Upper Pliocene Fossils from Cape Runaway.

By A. W. B. POWELL, Conchologist and Palaeontologist.

Recently, as the result of road construction near Cape Runaway, a small but richly fossiliferous bed was exposed for the first time.

The writer is indebted to Mr. and Mrs. A. E. Kemp, of Cape Runaway, for notification of this important discovery, and also for hospitality extended to him last August during a visit of three days, when the collection here described was made.

The main exposure is in one bank of a road cutting, just below Te Piki, upon the Whangaparaoa–Te Araroa main road (Plate 57). In extent it is not more than sixty feet in total length, and the portion exposed above the bottom of the cutting not more than four to twelve feet deep.

About one hundred yards up the road, south of the main bed, there is a smaller exposure identical in character with the first one, except that fossils are fewer and less varied.

The matrix is a soft blue-clay and the fossils are strong and excellently preserved, many of them still retaining their original colour markings.

The fossiliferous blue-clay is overlaid first by a narrow band of pure white fine pumiceous silt, two to three feet in thickness, and above this by some seven or eight feet of Recent soil and humus.

The bed is an important one, as it is the first extensive Castlecliffian fauna to be found outside the Wanganui district. Further, although the Cape Runaway bed is of very different facies, there appears some evidence in support of direct correlation with Landguard Bluff, which is on the eastern bank of the Wanganui, near the mouth, and is separated by that river from the extensive Castlecliff series of beds, upon which the stage name is based.

The Castlecliff beds are mostly blue clays with minor intercalated zones of brown sands, but at Landguard Bluff the blue clay is absent and the fossiliferous layers are of either brownish or yellowish sands, obviously of shallow-water deposition.

The reasons for assuming the Cape Runaway and Landguard faunules to be of contemporary age and yet slightly higher than those of Castlecliff are as follows:—

(a) *Capulus uncinatus* and *Eunaticina cincta* are restricted Landguard fossils, which so far as is known occur nowhere else in the Wanganui district, yet both are present at Cape Runaway.

(b) Typical nodulous examples of the Recent *Alcithoe arabica* are known as fossils only from Landguard Bluff and from Cape Runaway. The respective facies for these localities are: sandy bottom in shallow water down to five or six fathoms for the former, and mud bottom probably between 20 and 30 fathoms for the latter. Cape Runaway and Castlecliff are fairly similar in facies, yet of the numerous examples of *Alcithoe* found at Castlecliff *arabica* is not present, the inference being that it is a later evolutionary product. Recent examples of *arabica* are found living from low water to about 30 fathoms, on a substratum of either sand or mud.

(c) A new subspecies of *Glaphyrina vulpicolor,* described herein from Cape Runaway, has characters intermediate in development between those of the Castlecliff *progenitor* and the Recent *vulpicolor.*

The Cape Runaway specimens of *Austrosipho (Verconella) dilatata* are of a growth form identical with Recent specimens from depths between 20 and 30 fathoms. In any case Recent *dilatata* is not known from less than 20 fathoms.

Although the facies of the Cape Runaway bed is suggestive of deposition at between 20 and 30 fathoms, there occurs a few somewhat worn characteristic littoral specimens, such as *Lepsiella scobina* and *Ischnochiton maorianus,* which indicate proximity to a rocky shore, from which they were no doubt derived.

The most abundant fossils in the Cape Runaway bed are the following: *Maoricolpus rosea, Atrina zelandica, Pecten tainui, Austrosipho (Verconella) edita, Alcithoe arabica, Struthiolaria vermis* and *Pupa alba.*

Fossils were so abundant in one small pocket of about three feet in diameter that it was difficult to remove one without damaging others, so tightly were they packed together.

Although the road passes through many deep cuttings, strangely enough there appears to be no other beds of similar age anywhere else in the Cape Runaway district. Several other sparsely fossiliferous cuttings were examined, one in a gorge near Waihau Bay, another nearer to Te Araroa, but all contain a Miocene fauna probably of Awamoan age, certainly, however, lower than Pliocene.

Unfortunately the richly fossiliferous Landguard Bluff beds are no longer well exposed for collecting, as the construction of tide deflectors in the Wanganui River has caused drift sand to accumulate and obscure the lower and best fossiliferous strata.

Eleven new species and a new subspecies are described herein, and the types of all of them are in the Auckland Museum.

Complete List of Fossils collected at the Te Piki (Cape Runaway) Bed.

PHYLUM COELENTERATA.

*	*Flabellum rugulosum* Tenison-Woods 1880	C.

PHYLUM MOLLUSCA.

Class Pelecypoda.

*	*Nucula nitidula* A. Adams 1856	L, C.
*	*Neilo australis* (Quoy & Gaimard 1835)	C.
*	*Barbatia novaezelandiae* Smith 1915	C.
*	*Modiolaria impacta* (Herrmann 1782)	C.
*	*Trichomusculus barbatus* (Reeve 1858)	
	Pecten (Notovola) tainui (Finlay 1930)	L, C.
*	*Chlamys zelandiae* (Gray 1843)	C.
*	*Chlamys radiatus* (Hutton 1873)	C.
*	*Chlamys imparicostatus* (Bavay 1905)†	
*	*Limatula maoria* Finlay 1926	L, C.
	Mantellum marwicki (Powell 1926)	C.
*	*Ostrea sinuata* Lamarck 1819	L, C.
*	*Atrina zelandica* Gray 1835	C.
*	*Venericardia purpurata* (Deshayes 1854)	L, C.
*	*Venericardia purpurata difficilis* (Deshayes 1854)	C.
*	*Pleuromeris zelandica* (Deshayes 1854)	C.
*	*Zemysia zelandica* (Gray 1835)	L, C.
*	*Chironia suborbicularis* (Montagu 1804)	C.
*	*Arthritica bifurca* (Webster 1908)	C.
*	*Melliteryx parva* (Deshayes 1856)	C.
*	*Rochefortula reniformis* (Suter 1908)	C.
*	*Scintillona zelandica* (Odhner 1924)	
*	*Maoritellina huttoni sterrha* (Suter 1913)	
*	*Leptomya retiaria* Hutton 1885	C.
*	*Mactra ovata* (Gray 1843)	
*	*Zenatia acinaces* (Quoy & Gaimard 1835)	C.
*	*Dosinia lambata* (Gould 1850)	C.
*	*Dosinia (Kereia) greyi* Zittel 1864	C.
*	*Paradione (Notocallista) multistriata* (Sowerby 1851)	C.
*	*Dosinula zelandica* (Gray 1835)	C.
	Tawera wanganuiensis Marwick 1927	C.
*	*Chione (Austrovenus) stutchburyi* (Gray 1828)	L, C.
*	*Paphirus largillierti* (Philippi 1849)	L, C.
*	*Nemocardium (Pratulum) pulchellum* (Gray 1843)	C.
*	*Notocorbula zelandica* (Quoy & Gaimard 1835)	C.
*	*Hiatella australis* (Lamarck 1818)	C.
*	*Cleidothaerus maorianus* Finlay 1926	C.

CLASS GASTEROPODA.

	Tugali superba n.sp.	
*	*Emarginula striatula* Quoy & Gaimard 1834	C.
*	*Trochus (Coelotrochus) tiaratus* Quoy & Gaimard 1834	L, C.
*	*Trochus (Thorista) viridis* (Gmelin 1791)	C.
*	*Cantharidus purpuratus* (Martyn 1784)	
*	*Micrelenchus rufozonus* (A. Adams 1853)	C.
*	*Dolicrossea vesca* Finlay 1926	
*	*Estea semiplicata* Powell 1927	
*	*Nozeba emarginata* (Hutton 1885)	C.
*	*Lyroseila chathamensis* (Suter 1908)	

†In the "Zoological Record," vol. 68, 1932 (Moll.), p. 95, reference is made to a paper by L. G. Hertlein, J. Paleont. Sharon Mass., 1931, pp. 367-369, in which *Pecten zeelandonus* is given as a new name for *P. imparicostatus* Bavay. Hertlein's name is not adopted here, as the writer has been unable to refer to this paper, and find the reasons given for this name change.

	Notosinister tepikiensis n. sp.	
*	*Lilax nucleogranosum* (Verco 1904)	C.
*	*Maoricolpus rosea* (Quoy & Gaimard 1834)	L, C.
*	*Zeacolpus fulminatus* (Hutton 1873)	C.
*	*Struthiolaria papulosa* (Martyn 1786)	C.
*	*Pelicaria vermis* (Martyn 1786)	C.
	Capulus uncinatus (Hutton 1873)	L.
*	*Maoricrypta costata* (Sowerby 1824)	C.
*	*Maoricrypta (Zeacrypta) monoxyla* (Lesson 1830)	C.
*	*Sigapatella novaezelandiae* (Lesson 1830)§	C.
*	*Zegalerus tenuis* (Gray 1867)	L, C.
*	*Tanea zelandica* (Quoy & Gaimard 1832)	C.
	Eunaticina cincta (Hutton 1885)	L.
*	*Trichosirius inornatus* (Hutton 1873)	C.
*	*Charonia capax euclioides* Finlay 1926	
*	*Monoplex parthenopeum* (Von Salis 1793)	
*	*Austrosassia parkinsonianum* (Perry 1811)	
*	*Xenophalium* cf. *pyrum* (Lamarck 1822)	L, C.
*	*Heliacus maorianus* n. sp.	
	Syrnola lawsi n. sp.	
	Syrnola tepikiensis n. sp.	
	Chemnitzia n. sp. aff. *aoteana* Powell 1930‡	C.
*	*Chemnitzia* n. sp. (occurs Recent from 50 fath. off Oamaru)	
	Chemnitzia	
	Pyrgulina n. sp.	
	Odostomia n. sp.	
	Odostomia n. sp.	
*	*Odostomia* n. sp. (occurs Recent in the vicinity of Auckland)	
	Odostomia sherriffi Hutton 1883	C.
*	*Odostomia chordata* Suter 1908	
	Glaphyrina vulpicolor annectens n. subsp.	
	Buccinulum (Evarnula) striatum (Hutton 1875)	C.
	Buccinulum (Evarnula) gracillimum n. sp.	
*	*Buccinulum (Euthrena)* cf. *heteromorphum* Powell 1929	
*	*Austrosipho (Verconella) dilatata* (Quoy & Gaimard 1833)	C.
	Austrosipho (Verconella) edita n. sp.	
*	*Aeneator attenuata* Powell 1927	C.
*	*Austrofusus glans* (Bolten 1798)	C.
*	*Cominella (Cominista) glandiformis* (Reeve 1847)	C.
*	*Cominella (Acominia) adspersa* (Bruguiere 1789)	C.
	Cominella (Cominula) kempi n. sp.	
*	*Nassarius aoteanus* Finlay 1926	
*	*Poirieria zelandica* (Quoy & Gaimard 1833)	C.
	Murexsul tepikiensis n. sp.	
	Zeatrophon bonneti (Cossmann 1903)	C.
*	*Xymenella pusilla* (Suter 1907)	
*	*Lepsiella scobina* (Quoy & Gaimard 1833)	
	Agnewia kempae n. sp.	
	Zemitrella contigua n. sp.	
*	*Alcithoe arabica* (Martyn 1784)	L.
*	*Alcithoe gracilis* (Swainson 1821)	C.
*	*Baryspira mucronata* (Sowerby 1830)	C.
*	*Baryspira (Alocospira) novaezelandiae* (Sowerby 1859)	C.
	Inquisitor wanganuiensis (Hutton 1873)	C.
*	*Melatoma buchanani* (Hutton 1873)	C.
*	*Guraleus sinclairi* (Smith 1884)	C.
	Acteon ambiguus (Hutton 1885)	L, C.
*	*Acteon cratericulatus* Hedley 1906	
*	*Pupa alba* (Hutton 1873)	L.

§Subspecies *inflata* (Hutton 1883) also occurred, but this is possibly only a growth form peculiar to specimens adherent upon the shells of *Maoricolpus rosea*.

‡For the Pyramidellid identifications, the writer is indebted to Mr. C. R. Laws, of Auckland, who has written a monograph of the N.Z. species in which will appear the new genera and species here indicated.

CLASS AMPHINEURA.

* *Ischnochiton maorianus* (Iredale 1914)	
* *Terenochiton inquinatus* (Reeve 1847)	C.
* *Notoplax mariae* (Webster 1908)	C.

PHYLUM BRACHIOPODA.

* *Terebratella inconspicua* (Sowerby 1846)	
* *Terebratella sanguinea* (Leach 1814)	

Species still living are prefixed by an asterisk, and those known to occur at Landguard Bluff or Castlecliff are followed by an "L" or a "C" respectively.

SUMMARY.

Total number of species	112
Number of extinct species	26
Percentage of Recent species	76.78

Fissurellidæ.

Genus Tugali Gray 1843.

Tugali superba n. sp. Pl. 58, figs. 10 and 11.

Shell moderately large, depressed, oblong, not noticeably narrowed in front. Sculptured with a fairly open, crisp reticulation of radial and concentric ribs. Sinus rib distinctly tricarinate, which places the species in the *elegans–pliocenica–opuraensis–navicula* series, although with its rectangular outline the shell simulates the shape of the *bascauda,* bicarinate-ribbed series. Apex at the posterior fifth, low. Sides parallel, broadly rounded at both ends, but very slightly narrowed anteriorly. Radial sculpture at the margin consists of about 88 regularly alternating crisp rounded radials, of which 51 are primaries. The radials are crossed by slightly finer crisp, concentric ridges, which enclose rectangular interspaces that are considerably longer than wide. Interior smooth and polished, margins crenulated, corresponding to the external ribbing.

Length, 23 mm.; width, 12.25 mm.; height, 5.25 mm. (Holotype).

Differs from previously described species in its very depressed shape, extremely slight anterior narrowing, and crisp ribbing, with more open interstices.

Triphoridæ.

Genus Notosinister Finlay 1926.

Type (original designation): Triphora fascelina Suter.

Notosinister tepikiensis n. sp. Pl. 57, fig. 4.

Shell small, subulate. Whorls 14, including a typical polygyrate protoconch of five whorls, having a sharp median carina crossed by closely spaced fine axial threads. Post-nuclear whorls tricarinate, crossed by regular, closely spaced axials; points of intersection raised into rounded gemmules. On the first four post-nuclear whorls the central carina is weakest, but the three are equally developed over the later whorls. The suture is margined above by a very fine spiral thread, and the body-whorl has the addition of two basal spiral keels. There are 21 axial ribs upon the penultimate whorl. Spire tall, a little more than five times the height of the aperture, outline slightly convex. Aperture subquadrate, produced below into a short, open canal which is sharply bent to the right. Outer-lip thin and sharp, sinuated, with a distinct sutural notch. Columella short, vertical.

Height, 5.8 mm.; diameter, 1.7 mm. (Holotype).

Height, 6.35 mm.; diameter, 1.6 mm. (*infelix,* 30 fathoms, Hen and Chicken Islands).

This species appears to be directly ancestral to the Recent *infelix,* from which it differs in being less slender, with a more convex spire outline, evenly tricarinate over all but the early whorls; and in having a more open canal, and in consequence a less sinuous basal lip.

PYRAMIDELLIDÆ.

Genus SYRNOLA A. Adams, 1860.

Type (by monotypy): SYRNOLA GRACILLIMA Adams.

Syrnola lawsi n. sp. Pl. 57, figs. 1 and 2.

Shell very large for the genus, subulate, smooth and polished. Whorls numerous, 11½ showing in the more complete specimen, but probably at least one whorl and the protoconch are missing. Height of each whorl of the spire about half the diameter. Spire very tall, straight sided and about five and one-third times height of aperture. Suture slightly indented, not margined. Surface highly polished, but with dense spiral striae barely visible even under a high magnification. Body-whorl higher than broad, and rounded at periphery. Aperture subrhomboid. Columella oblique, straight, with a weak fold situated very high up, slightly expanded, and free from the base, resulting in a small umbilical chink. Outer-lip sharp, rather straight above and narrowly rounded basally.

Height (actual), 13.5 mm.; (estimated) 14.5 mm.; diameter, 3.4 mm. (Holotype).

Height (actual), 15.25 mm.; (estimated) 18.5 mm.; diameter, 3.9 mm. (Paratype).

This fine species is characterised by its extremely large size, and straight-sided, many-whorled spire. The nuclear whorls are unknown, but Mr. Laws, who has prepared a monograph of this family, has little hesitation in classing it in *Syrnola.*

Syrnola tepikiensis n. sp. Pl. 57, fig. 3.

Shell very large for the genus, subulate, smooth and polished except for a few faint subperipheral spiral striations. Whorls numerous, ten and one-third showing in the holotype, which has the protoconch and several post-nuclear whorls missing. Height of each whorl of the spire about one fourth the diameter. Spire very tall, straight sided, except for deeply impressed V-shaped bevel-sided sutures. The body-whorl is rounded except for the very slight sutural bevel. The aperture is slightly damaged, but is shown to be small, with six sharp spiral ridges upon the inside of the outer lip. Columella vertical, very massive, with a strong plait at the upper two thirds of its height.

Height (actual), 13.6 mm.; (estimated), 15.5 mm.; diameter, 4.5 mm. (Holotype).

Marshall and Murdoch's *S. semiconcava* 1923, Trans. N.Z. Inst., vol. 54, p. 122, from Awamoa is related. It has a similar bevelled suture, massive columella and plait, and evidently crenulations inside the outer lip. This latter feature is not mentioned but the rather sketchy figure seems to indicate it. From *semiconcava* the Cape Runaway species differs in the proportions of the whorls, which are much lower and broader.

The remaining Pyramidellids, indicated near the beginning of this paper, in the list of Cape Runaway species, will be dealt with later in Mr. Laws' monograph.

ARCHITECTONICIDÆ.

Genus HELIACUS d'Orbigny 1842.

Type: SOLARIUM HEBERTI Deshayes.

The genus *Heliacus* has hitherto had a precarious standing in New Zealand literature. Several Tertiary species have been described under the genus name, but Finlay (1926, Trans. N.Z. Inst., vol. 57, p. 401) has shown that all belong to other genera. This pronouncement left only one undoubted record of *Heliacus* in New Zealand; Suter's "*H. variegatus* (Gmel.)," from 37 fathoms off Cuvier Island (1913, Man. N.Z. Moll., p. 317). Suter's description of this shell is obviously composite, for neither the dimensions nor the colour pattern given are in accord with the Cuvier shell. Finlay (1926, Trans. N.Z. Inst., vol. 57, p. 401) suggested that Suter's description and figure were more in accord with *H. stamineus* (Gmelin), but an examination of the actual Cuvier specimen from the Suter collection now in the Wanganui Museum, shows that this shell cannot be referred to either of the above mentioned species.

Most of the earlier figures and descriptions of the species of *Heliacus* are very sketchy, and it is difficult to be definite about details of sculpture. However, the New Zealand species, with its eleven-ribbed spiral sculpture, appears to be distinct from any hitherto described.

A specimen identical with the Cuvier Island shell, but larger and from the Cape Runaway bed, is selected for the holotype of the species, and a description follows.

Heliacus maorianus n. sp. Pl. 58, figs. 5, 6 and 7.

Shell small, depressed, lenticular, radiately and spirally sculptured, solid. Whorls 4¼, plus a typical inverted *"Agadina"* protoconch, with the apex (really the base of the protoconch) slightly obliquely sunken and inrolled. Spire much depressed, broadly conical, half the height of aperture. Spiral sculpture of eleven strong flat-topped ribs, having almost linear, channelled interspaces. A pair of peripheral spirals and that bordering the umbilicus are stronger than the rest. The whole is crossed by numerous radials, similar in size and spacing to the spirals. The deeply channelled interspaces to the radials cross the spirals and cut them into series of small rectangular granules. The spire whorls have five spiral ribs, the fifth one, which is the upper peripheral spiral, being about twice the size of the others. Umbilicus wide, deep, perspective, slightly less than one-fourth major diameter of the base. Aperture subcircular. Outer-lip indented by the external sculpture. Columella vertical, expanded, with a broad spiral rib situated below the middle, which is deeply grooved immediately above and below.

Diameter, 11.75 mm.; height, 6.5 mm. (Holotype).

Diameter, 8.75 mm.; height, 5.0 mm. (off Cuvier Island in 37 fathoms).

CAPULIDÆ.

Genus CAPULUS Montfort 1810.

Type: PATELLA UNGARICA Linn.

Capulus uncinatus (Hutton 1873). Pl. 59, figs. 16 and 17.

1873. *Pilaeopsis uncinatus* Hutton, Cat. Tert. Moll., p. 14.

1886. *Pilaeopsis uncinatus* Hutton. Hector, Outline Geol. N.Z., p. 48, figs. 2, 5.

1893. *Hipponyx uncinatus* Hutton, Macleay Mem. Vol., Plioc. Moll., p. 62.

1914. *Capulus australis* (Lamk.) Suter, not of Lamk. 1819, N.Z. Geol. Surv. Pal. Bull. No. 2, p. 19.

Hutton in describing his species gave the bare locality reference "Wanganui U," the "U" signifying upper part of the Wanganui System. So far as the writer is aware the specimen here figured is the only one known to have been collected since the finding of the type. The writer's specimen was collected by Mr. W. La Roche at Landguard Bluff, the uppermost beds of the Wanganui System, and it would seem that the species is restricted to this horizon, for, although the other Castlecliffian localities have been subjected to intensive collecting, no further specimens of *uncinatus* have been found.

One perfect specimen of *uncinatus* and several broken ones were found in the Cape Runaway bed.

Length, 33 mm.; breadth, 29 mm.; height, 20 mm. (Holotype? Suter, 1914, l.c. p. 19).

Length, 27.75 mm.; breadth, 23.5 mm.; height, 14 mm. (Landguard Bluff specimen.) Pl. 59, figs. 16 and 17.

Length, 30.25 mm.; breadth, 28 mm.; height, 14.5 mm. (Cape Runaway specimen.)

An apparently constant feature of the species is the presence of a deep broad sinus and various irregularities in the basal margin of the aperture. The Recent *C. calcareus* Suter is known to favour for an anchorage the base and canal of *Austrosipho dilatata,* and it is here suggested that the fossil species had a similar habit. In fact, specimens placed upon the constricted region of the base of *Austrosipho* near the neck of the canal fit very well, the deep broad sinus matching the curve of the neck. Further, minor corrugations of the margin of the *capulus* indicate the sculpture of the host to be rather coarse, such as obtains in the common Cape Runaway *Austrosipho* herein described as *edita.*

NATICIDÆ.

Genus EUNATICINA Fischer 1885.

Type: NATICA PAPILLA Gmelin.

Eunaticina cincta (Hutton 1885). Pl. 59, fig. 18.

1885. *Sigaretus (Naticina) cinctus* Hutton, Trans. N.Z. Inst., vol. 17, p. 318, pl. 18, f. 12.

1893. *Sigaretus cinctus* Hutton, Macleay Mem. vol., p. 55.

1915. *Polinices (Euspira) cinctus* (Hutton), Suter, N.Z. Geol. Surv. Pal. Bull. No. 3, p. 9, pl. 4, f. 5.

1918. *Sinum cinctum* (Hutton), Suter Alph. List N.Z. Tert. Moll., p. 25.

1924. *Sinum (Eunaticina) cinctum* (Hutton), Marwick, Trans. N.Z. Inst., vol. 55, p. 572.

Like the previous species, this one also was described with the bare locality reference, "Wanganui." No subsequent collecting brought to light any further specimens, until Mr. W. La Roche found at Landguard Bluff a single specimen of this species, together with his *Capulus uncinatus.* A well preserved specimen of *cinctum* occurred in the Cape Runaway bed.

Height, 16 mm.; diameter, 12.5 mm. (Holotype. Suter 1915 l.c. p. 9.)

Height, 11.75 mm.; diameter, 10 mm. (Landguard Bluff specimen.) Pl. 59, fig. 18.

FASCIOLARIIDÆ.

Genus GLAPHYRINA Finlay 1926.

Type (original designation): FUSUS VULPICOLOR Sowerby.

Glaphyrina vulpicolor annectens n. subsp. Pl. 60, figs. 28 and 29.

This subspecies is intermediate in character between the Castlecliff *G. vulpicolor progenitor* Finlay 1926, and the typical Recent species. It has the more even and less prominent spirals of *progenitor,* but also a more extensive distribution of the axials, which cover all but the last whorl. Also these axials number eleven per whorl in *annectens* instead of the usual twelve or thirteen of Recent shells.

Recent shells from a variety of localities and from depths down to 25 fathoms, show no marked variation in sculpture, so it would seem that the Te Piki fossils represent a definite stage in the evolution of *vulpicolor* rather than a benthic variant approximately contemporary with the Castlecliff *progenitor.*

Height, 33 mm.; diameter, 14.5 mm. (Paratype).

Height, 31 mm.; diameter, 13 mm. (Holotype).

BUCCINULIDÆ.

Genus BUCCINULUM Swainson 1837.

Subgenus EVARNULA Finlay 1926.

Type (original designation): COMINELLA STRIATA Hutton.

Buccinulum (Evarnula) gracillimum n. sp. Pl. 58, figs. 8 and 9.

Shell moderately large, solid, fusiform; sculptured with regularly spaced thin, raised spiral cords, subsidiary crowded spiral striations, and axials upon the upper spire whorls only. Whorls 7½, including typical bluntly dome-shaped protoconch of 2½ whorls (two whorls smooth, last half whorl of close axial ribs). Spire tall, almost equal to height of aperture plus canal; outlines evenly convex except for a slight subsutural concavity. The post-nuclear sculpture consists of fairly strong rounded axials which occur only upon the first 2½ whorls, becoming obsolete upon the antepenultimate, and entirely absent from the last two whorls. The spiral cords are narrow, rounded, and sharply raised, and number four upon the upper spire whorls, but increasing to five upon the penultimate, while there are thirteen upon the body-whorl and base. Between each of these primary cords there is a single weak secondary cord, which divides the still finer microscopic spiral lirations, of which there are five upon each side of each secondary cord, making ten, plus the secondary cord, between each pair of primary cords. The spiral lirations are delicately reticulated by dense microscopic axial growth striae. Aperture pyriform, produced below into a moderately long, narrow, open canal. Outer-lip thin, very slightly thickened and lirate within. Inner-lip callus with about nine irregularly shaped denticles and the usual parietal tubercle. The colour pattern, which is wonderfully well preserved, is of narrow reddish-brown lines upon a white or buff coloured ground. The colour-lines coincide exactly with the primary cords.

Height, 35 mm.; diameter, 15 mm. (Holotype).

This species is closely allied to Hutton's *striatum* from the Upper Pliocene of Wanganui, but differs in being more narrowly fusiform and more distinctively sculptured, the primary cords being fewer and more sharply raised. Also the primary cords in *gracillimum* are coloured, whereas *striatum* is presumed to have been without colour-bands. This supposition is based upon the occurrence of banded *gracillimum* and plain *striatum*, both in the Te Piki bed. In this bed colour markings have been preserved in practically every instance.

Genus Austrosipho Cossmann 1906.

Subgenus Verconella Iredale 1914.

Type (original designation): Fusus dilatatus Quoy and Gaimard.

Austrosipho (Verconella) edita n. sp. Pl. 60, figs. 24 and 25.

Shell close to the Recent *adusta,* but much more slender, with a proportionately higher spire, and more deeply incised sculpture. Whorls 10, including typical *"adusta"* type of protoconch of 3 whorls. Spire tall, about five-sixths height of aperture, plus canal. In *adusta* the spire height varies between three-fourths and two-thirds that of the aperture, plus canal. Shoulder only slightly concave, sharply descending, forming an angle of 35° with the vertical axis of the shell. In *adusta* this angle is mostly about 50°, although occasional deep-water specimens are near to 35°. Compared with the fossil species these slender deep-water Recent *adusta* specimens are always finer in sculpture and have the canal instead of the spire disproportionately long. The spiral sculpture consists of ten primary rounded scabrous cords and one to three interstital spiral threads. On the early spire whorls there is only one interstital thread, but as the whorls increase a still smaller thread appears in each interspace between a primary cord and a secondary thread. Closely spaced axial growth lines cut the surface of the spirals into blunt scales. The axials are weak upon the early whorls, but increase rapidly in size over the penultimate and body-whorls, where they number ten per whorl. These axials are nodulous where they cross the peripheral carina, which is a blunt ridge made up of two primary spirals and the intermediate threads. Aperture small. Canal long and slightly twisted. Peripheral keel below the middle.

Height, 134 mm.; diameter, 58 mm.; height of spire, 62 mm. (Holotype).

Height, 116 mm.; diameter, 50 mm.; height of spire, 54 mm. (Paratype).

Height, 135 mm.; diameter, 68 mm.; height of spire, 55 mm. (*adusta* from 25 fathoms).

COMINELLIDÆ.

Genus COMINELLA Gray 1850.

Subgenus COMINULA Finlay 1926.

Type (original designation): COMINELLA QUOYANA A. Adams.

Cominella (Cominula) kempi n. sp. Pl. 58, figs. 12 and 13.

Shell small, fusiform, solid, sculptured with prominent axial costae and fine spiral striations. Whorls 8, including a moderately large dome-shaped protoconch of 2½ whorls, followed by a brephic stage of a half whorl of closely spaced, vertical, axial costae. Post-nuclear whorls sculptured with strong, regularly spaced, slightly obliquely-flexuous, axial costae, which number ten on the early whorls and twelve on the penultimate. Spire tall, one and one-third times height of aperture; outline turreted by a deeply concave shoulder. The axials diminish as they cross the shoulder and become obsolete over the lower half of the body-whorl. Spiral sculpture of very fine, numerous, flattened threads, with linear interspaces, and more distant and more deeply incised lines, five upon spire-whorls and about nine upon the body-whorl and base. Aperture vertical, narrowly-ovate, with a short, widely open and deeply notched anterior canal. Columella vertical arcuate, smooth, with a "*Phos*"-like plait at its base. Fasciole prominent, keeled. When wet, specimens show the original colour pattern, which is identical with that of the Recent genotype, being marbled with reddish brown, spiral grooves dark brown, and aperture and columella white.

Height, 21.5 mm.; diameter, 9.4 mm. (Holotype).

Height, 21 mm.; diameter, 10.2 mm. (*quoyana*).

Height, 21.5 mm.; diameter, 10.8 mm. (*quoyana*).

Compared with *quoyana*, the Cape Runaway species is narrower, having a taller spire and more oblique and fewer axials. In these respects it is shown to be a species intermediate between the Nukumaruan (Mid-Pliocene) *hamiltoni* Hutton, and the Recent *quoyana*.

MURICIDÆ.

Genus MUREXSUL Iredale 1915.

Type (original designation): MUREX OCTOGONUS (Quoy and Gaimard 1833).

Murexsul tepikiensis n. sp. Pl. 59, figs. 14 and 15.

Shell rather small and squat, with a tumid body-whorl, which is sub-angular above the middle. Apex eroded; post-nuclear whorls five. Spire moderate, about two-thirds height of aperture, plus canal. Aperture invert-pyriform, full above, but rapidly contracted to a rather short, narrowly open, recurved canal. Fasciole keeled by a sharp scaly ridge which bounds an open umbilical chink. Spiral sculpture of evenly developed, prominent, raised ridges, which are crowded with sharp imbricating scales. These spirals number ten upon the penultimate whorl and twenty upon the body-whorl. The axials are broadly rounded, not prominent, and become obsolete over the entire body-whorl.

Height, 26 mm.; diameter, 14.5 mm. (Holotype).

Height, 25 mm.; diameter, 13 mm. (Topotype of *mariae).*

Height, 17 mm.; diameter, 9 mm. (Holotype of *mariae).*

Height, 34.5 mm.; diameter, 16 mm. (Topotype of *espinosus* Hutton).

The Nukumaruan *M. espinosus* Hutton, of which the writer collected topotypes from Petane, Hawke's Bay, is far nearer to the Recent *octogonus* than it is to the Cape Runaway species, which is apparently directly ancestral to the Recent Cape Maria van Diemen, *M. mariae* Finlay 1930 (Trans. N.Z. Inst., vol. 61, p. 237). From *mariae,* the new species differs in being still more tumid, in having subobsolete axials, and the spirals regular and closely imbricated.

THAISIDÆ.

Genus AGNEWIA Tenison-Woods 1878.

Type (original designation): PURPURA TRITONIFORMIS Blainville = ADAMSIA Dunker 1856 (same type): not ADAMSIA Forbes 1840.

Agnewia kempae n. sp. Pl. 59, figs. 19 and 20.

Shell small, fusiform rather thin. Whorls 8, including a typical four-whorled *"sinusigera"** protoconch. Sculpture consisting of broad, low, obscure axial folds crossed by fine, crisp, sharply-raised spiral cords. These cords number five on the first post-nuclear whorl, eight upon the third post-nuclear, twelve upon the penultimate, and about forty upon the body-whorl and base. The interspaces are mostly from one and a-half times to twice the width of the cords. The axials number thirteen per whorl and are most distinct upon the earlier whorls. Spire elevated, conic, about same height as aperture; outline sinuous, generally arcuate, but slightly concave just below suture. Aperture subvertical, narrowly ovate, with a very short, straight and open shallowly notched anterior canal. Parietal and columella callus polished, slightly countersunk. Fasciole defined by a strong rounded ridge and sculptured with fine, closely spaced spiral threads. Outer lip thin and sharp.

Height, 18 mm.; diameter, 8.5 mm. (Holotype).

Compared with the Recent genotype, the fossil species has less prominent axials and more widely spaced and sharply raised spirals. It adds a genus to the New Zealand Tertiary fauna.

The species is named after Mrs. A. E. Kemp, of Cape Runaway.

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*Iredale (1911, Proc. Malac. Soc., vol. 9, pp. 319-323), in a paper "on the Value of the Gastropod Apex in Classification," has described the *Sinusigera* protoconch and given an interesting account of its significance. This type of apex is always associated with species of wide distribution, its presence indicating a lengthy, free-swimming larval stage.

Genus ZEMITRELLA Finlay 1926.

Type (original designation): LACHESIS SULCATA Hutton.

Zemitrella contigua n. sp. Pl. 59, figs. 21 and 22.

Shell moderately large for the genus, smooth and polished except for about eight evenly spaced weak spirals upon the neck of the base, and another eight much more closely spaced and less prominent upon the fasciole. Spire about equal to height of aperture, outlines only slightly convex. Whorls $5\frac{1}{2}$, plus smooth papillate protoconch of $1\frac{1}{2}$ whorls. Suture linear, false margined below, by the base of the upper-whorl showing through. Body-whorl evenly rounded, but not bulging. Aperture long and narrow, sides parallel medially. Outer-lip vertical above, rounded and contracted basally; without a distinct canal, but there is a shallow anterior sinus. Within the outer-lip there are about ten weak denticles. Columella straight and vertical medially, and with a distinct oblique plait at the base.

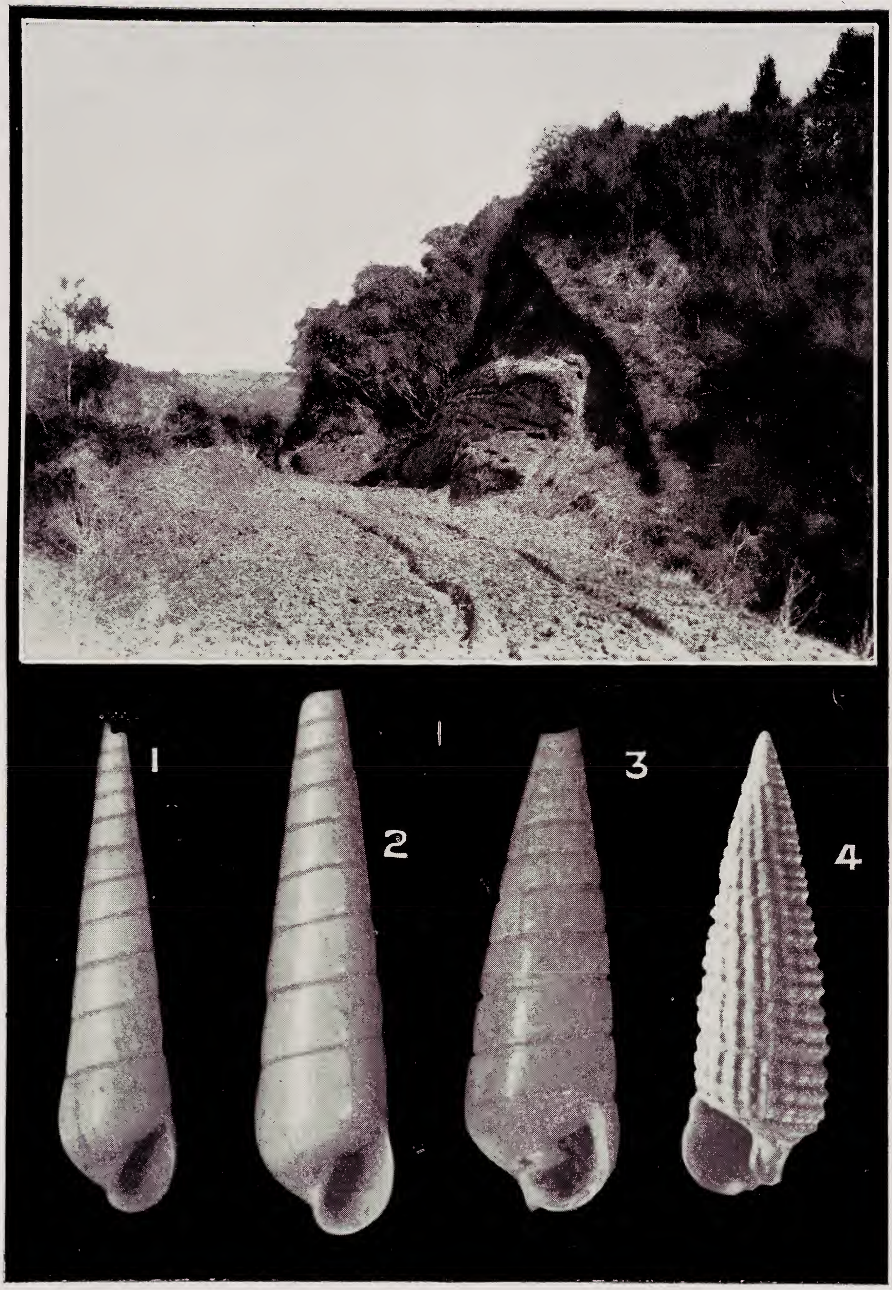
Height, 7 mm.; diameter, 2.95 mm. (Holotype).

Height, 5.5 mm.; diameter, 2.4 mm. (large specimen of *chaova*).

Suter's record for *chaova* (1913, Man. N.Z. Moll., p. 432) of 6.5 mm. x 3 mm. is larger than any the writer has seen.

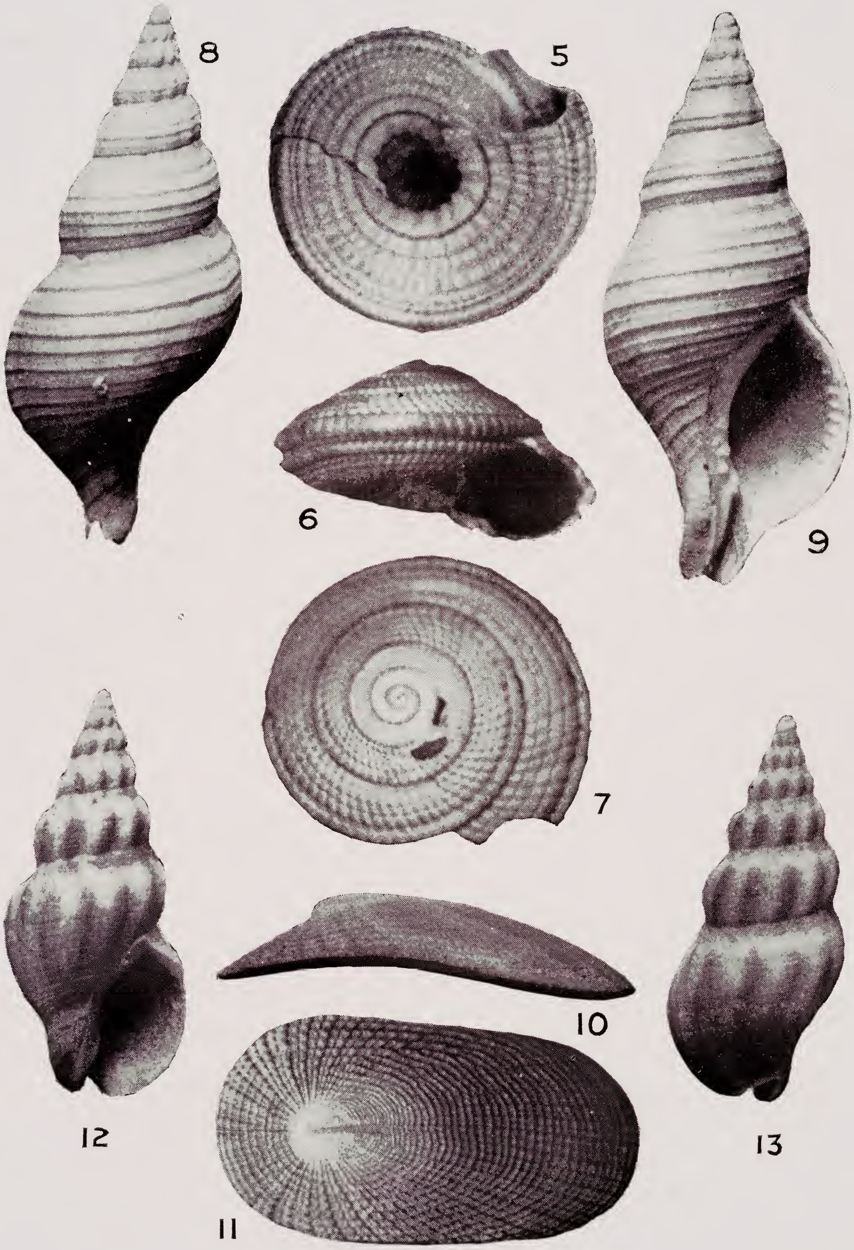
Compared with *chaova,* the fossil species is slightly larger and less massive, the outer lip is thin and very little thickened within, the aperture is relatively longer and narrower, and the neck of the base more deeply contracted. Otherwise the species is closer to *chaova* than it is to any other of the described species.

Plate 57.

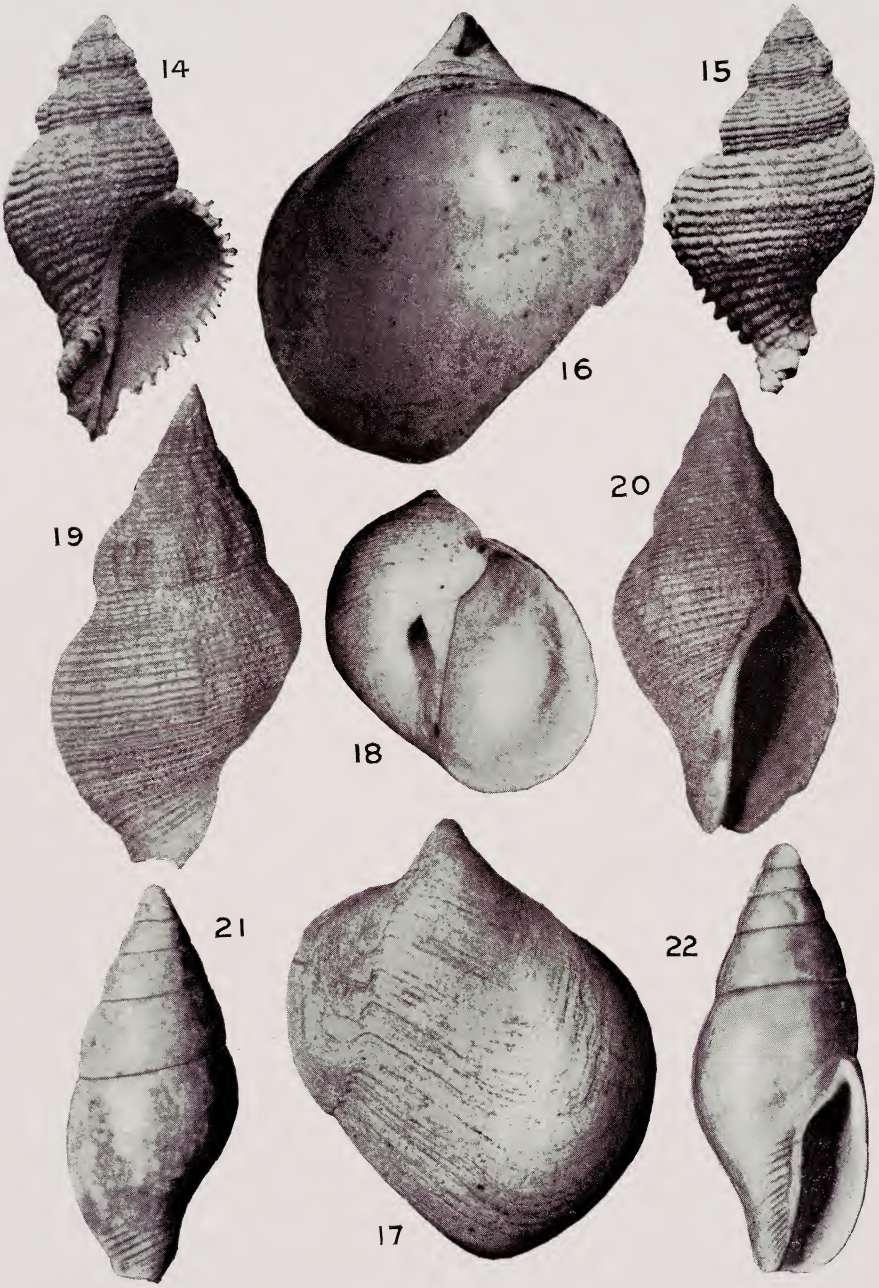


The recently discovered fossiliferous bed of Upper Pliocene (Castlecliffian) age, on the Whangaparaoa-Te Araroa main road, near Cape Runaway.

Fig. 1. *Syrnola lawsi* n. sp. (Holotype).
Fig. 2. *Syrnola lawsi* n. sp. (Paratype).
Fig. 3. *Syrnola tepikiensis* n. sp. (Holotype).
Fig. 4. *Notosinister tepikiensis* n. sp. (Holotype).



Figs. 5-7. *Heliacus maorianus* n. sp. (Holotype).
Figs. 8 & 9. *Buccinulum (Evarnula) gracillimum* n. sp. (Holotype).
Figs. 10 & 11. *Tugali superba* n. sp. (Holotype).
Figs. 12 & 13. *Cominella (Cominula) kempi* n. sp. (Holotype).



Figs. 14 & 15. *Murexsul tepikiensis* n. sp. (Holotype).
Figs. 16 & 17. *Capulus uncinatus* (Hutton 1873). Landguard Bluff (Topotype?)
Fig. 18. *Eunaticina cincta* (Hutton 1885). Landguard Bluff. (Topotype?)
Figs. 19 & 20. *Agnewia kempae* n. sp. (Holotype).
Figs. 21 & 22. *Zemitrella contigua* n. sp. (Holotype).

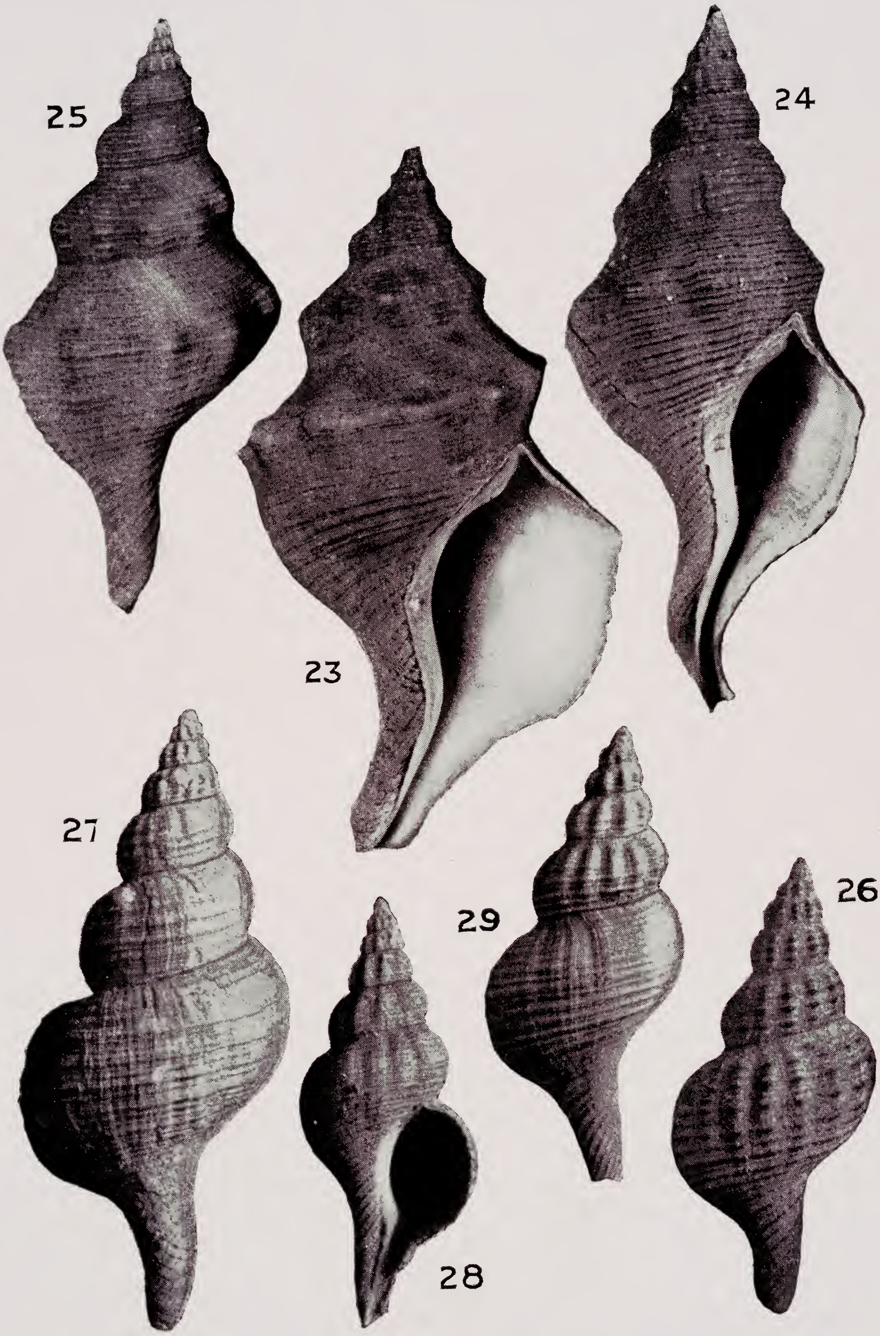


Fig. 23. *Austrosipho (Verconella) adusta* (Phil.) 25 fathoms off Coromandel, Hauraki Gulf.
Fig. 24. *Austrosipho (Verconella) edita* n. sp. (Holotype).
Fig. 25. *Austrosipho (Verconella) edita* n. sp. (Paratype).
Fig. 26. *Glaphyrina vulpicolor* (Sowerby) Recent, Foveaux Strait.
Fig. 27. *Glaphyrina vulpicolor progenitor* Finlay. Castlecliff (Up. Pliocene).
Fig. 28. *Glaphyrina vulpicolor annectens* n. subsp. (Holotype).
Fig. 29. *Glaphyrina vulpicolor annectens* n. subsp. (Paratype).

The Material Culture of Oruarangi, Matatoki, Thames.

1. Bone Ornaments and Implements.

By V. F. FISHER, Assistant Ethnologist.

Oruarangi is an old *pa* site, about three acres in extent, lying to the east of the Waihou River, some six miles south of Thames. At present the area consists of about four feet depth of sand, ash and shell middens raised above the surrounding swamp, and contained implements and other articles at all levels.

The site was dug over by a private collector, who obtained an extensive series of adzes, fishing sinkers, tops and numerous other stone articles, a few specimens made of shell, and very many bone implements, some of which are complete, others being in various stages of manufacture.

Unfortunately systematic stratigraphical details were not kept, and it is only possible now to give descriptions of the articles recovered. The present paper will deal only with the bone articles, the remainder being reserved for a future contribution.

Methods of Working Bone.

The collection contains so many partly fashioned articles that it is possible to give an outline of the methods employed in their manufacture. The bones used at Oruarangi were from human remains, the native dog, various cetaceans, certain large sea birds, and, occasionally, fish such as the snapper. Moa bones were apparently not used.

Whether it was intended to cut the bone longitudinally or transversely, the methods employed were much the same. A reference to Plate 61, figs. 1, 2, will show the steps mentioned fairly clearly. First a cut was made with a piece of sharp chert or obsidian, as in fig. 1. This was deepened with further cuts, followed by a sawing process, fig. 2, performed with the aid of a sandstone rubber. The sandstone rubber shown here (fig. 3) is 112 mm. in length, 38 mm. across at the widest part, and varies in thickness from 3-5 mm. It is worn smooth on all the edges, a sure proof of continual use. Usually the cutting and sawing were done from both sides until the two cuts nearly met, when perhaps pressure was exerted with the hands until the cleavage was completed.

The specimens chosen to illustrate the various stages of the manufacturing process are all lower jaw bones of the native dog. Final shaping was secured either by carefully rubbing the bone on a piece of sandstone, or else using the sandstone as a rubber.

How constant a use was made of the drill is indicated by the many perforated needles, toggles and pendants, and by the numerous stone drill points found throughout the site.

By way of further illustration, several objects showing evidence of cutting are mentioned here (figs. 4-8). Fig. 4 is a piece of human skull with two grooves cut therein, the wider of the two being 5 mm. in width. Human bone has been also used in fig. 5, where we have a piece of femur sawn through and then broken off, and again in fig. 6, showing a portion of a lower jaw, really waste material thrown away after a strip of bone had been cut from it. The lower jaw of a native dog, fig. 7, shows a section of bone in process of removal.

ORNAMENTS AND ARTICLES OF PERSONAL ADORNMENT.

A wide variety of ornaments manufactured in bone was procured from the site. These included a *rei puta,* and pendants of various shapes, some carefully made and decorated, others fashioned in a somewhat crude manner. Ornaments of human and dogs' teeth were also found.

Rei Puta.

Neck pendants of this type, sometimes called *rei paraoa,* are rare. In the Auckland Museum collection we now have seven. Skinner (1923, p. 32) gives details of *rei puta* in other collections. This particular specimen, 19558 (Plate 62, fig. 8), differs somewhat from the recognised type in that it is thin in section throughout. In all typical examples, the *rei puta* is thin in section at the top, becoming suddenly thicker towards the bottom. Two eyes set obliquely at the lower end of the pendant definitely determine its classification as a *rei puta.* Made from a whale's tooth split longitudinally, it has two holes drilled at the top, one in each corner, to allow of suspension by a flax cord from the neck.

The dimensions are as follows: Length 122 mm., width at proximal end 34 mm., gradually tapers to 19 mm. at a point 20 mm. from the distal end.

Human Teeth.

Twenty-two human teeth, all perforated at the fang end, have been classified by Dr. H. A. Chatfield as follows: 9 Cuspid, 2 Central, 6 Molar and 4 Pre-molar. One had been worked down to such an extent that identification was impossible. In almost every case the hole was drilled as close as possible to the end of the fang. One of the molars has had both fangs drilled, while two have had the second fang removed.

Best (1924, Vol. 2, p. 537 and p. 543) mentions human teeth being used as ear pendants, or strung to form a necklace. As comparatively few were found at Oruarangi, they may perhaps have been intended for ear pendants, but on that point we cannot dogmatise.

Dogs' Teeth.

Twenty-nine specimens of the canine teeth of the native dog, or *kuri,* have been drilled, but show no other signs of working except in the case of three, to be mentioned later. Evidently these teeth were intended for use either as ear pendants or to form a necklace. In one tooth the hole has not been completed, but it is of interest, for it shows clearly the method of drilling, first from one side and then from the other, giving rise to a crater shaped hole in each case.

Three of the pendants differ from the remainder. Two have a tiny rounded knob cut at the fang end, with the hole drilled immediately below it (Plate 62, figs. 13, 14). The third (fig. 15) has been squared and flattened for a short distance at the fang end. Through this flattened portion the hole has been drilled. The longest specimen in the series is 41 mm. in length. Ninety canine teeth, lacking any trace of working, indicate that at one period the *kuri* was reasonably plentiful at Oruarangi. Mention will be made of those used for barbed fish hook points when treating of the barbed points and articles used for fishing.

Pigs' Tusks.

This seems to be the appropriate place to mention two fragments of pigs' tusks (Plate 62, figs. 16, 17) that were apparently worn as pendants. The longer of the two is 37 mm., the shorter 30 mm. Both have a hole drilled in true Maori style, and both have been fractured unevenly. They are of special interest, because they give an indication as to the period during which some at least of the material was manufactured. However, for the present we merely note the fact, and shall have occasion to refer to it later.

Sharks' Teeth.

Only two teeth of the *mako* shark (19151.1, .2), (Plate 62, figs. 18, 19) are in the collection. Both are drilled for suspension. Two eyes are clearly cut out at the fang end on one specimen, while the other has only one. Probably small pieces of *paua* shell were inserted to give the eyes a more realistic appearance.

Miscellaneous Pendants.

The specimens dealt with in this subsection may have been pendants worn singly, or they may have been strung with other perforated specimens to form a necklace of assorted pieces of bone.

Specimen 19592.1 (Plate 62, fig. 20) is the largest of four pendants made from the supra-occipital bone of the snapper. It is 81 mm. long and at one time had a hole at the back, but this has broken away. Carved in front is a human face, the most noticeable features being the large eyes and mouth.

Its companion, 19592.2, is 68 mm. in length, lacks a perforation, yet shows some signs of a crude attempt at carving. The smallest complete specimen, 19592.3, is only 63 mm. long and shows no evidence of any carving whatever. A portion of a snapper supra-occipital bone has been drilled and decorated with narrow grooves. Such bones, either carved or drilled, are sometimes found in other parts of the Auckland Province.

An interesting specimen is 19588 (fig. 21), made from a piece of a human skull. This pendant is 47 mm. long and has been carved to represent the eye and mouth of a human being. The execution is very fine; in fact the whole design is effective and pleasing. I know of no other specimen like it. It will be noted that a second hole has been drilled, the first having carried away. The drilling of the second hole has resulted in the pendant being worn upside down, that is to say, on its head. Two interesting pendants are illustrated in figs. 22, 23, an ankle and toe bone respectively, both perforated.

Combs or Heru.

In addition to perfect combs, there are some fifteen fragments and a number of detached teeth. The most perfect and also an unusually large example is 19640 (Plate 63, fig. 24). It is typical of Maori combs, having the rounded top and the design carved at the side. It is 240 mm. in length and 84 mm. wide at the widest part. It possesses seven broad teeth, of an average width of 6 mm., the longest tooth being 94 mm. in length. Like most of the bone combs, it is made from the lower jaw of a species of whale. This fact would account for the gradual tapering, usually a noticeable feature of Maori bone combs.

In contrast to this large comb is a small one, 19638 (fig. 25), 72 mm. long and 30 mm. wide at the widest part. The teeth, which are about half the length of the comb, are six in number, one of which has been broken. At one side is a crude piece of carving that does not display the artistry usually seen in such work.

Although the next specimen, 19639 (fig. 26) is only a fragment, it is of great interest. In its perfect state the comb was obviously a large one, but unfortunately was broken, so the owner drilled five holes along the fractured edge, from which perhaps feathers were hung by way of ornamentation. Five teeth were left intact, though they, too, have suffered damage at a later stage.

Toggles or Poro toroa.

Of toggles there were found 36 perfect specimens and 12 fragments, but several of the latter showed "secondary working," i.e., they had been converted into *uhi,* or tattooing implements.

They are mostly made from the wing bones, or, more precisely, the humerus or ulna of sea birds, such as the gannet or albatross.

Of the perfect specimens, only 8 show signs of decorative work. These are decorated at one, or in some cases both ends, with short, deeply cut notches. One, 19565.36, is also decorated with chevroned lines cut into the bone. A broken toggle exhibits a series of chevrons, while another fragment shows lines criss-crossing in such a way as to form diamond-shaped areas of unequal size.

There are 29 pieces of varying lengths cut from the humerus or ulna of a sea bird, the majority of which must have been intended for toggles, though some may have been cut with a view to making flutes or short sections to form a necklace. The longest piece measures 156 mm.

Of these lengths many illustrate stages in the making of a toggle. Perhaps the best of this series is 19617.10 (Plate 66, fig. 27), a piece of the humerus of a sea bird, 113 mm. in length, with a secondary transverse cut 34 mm. from the end. Possibly the craftsman intended to obtain several toggles from this piece. Several, cut to the required length, have been decorated or partially decorated with notches, although no attempt at drilling the hole has been made. Of interest is a short specimen, 19565.44, showing the first stage in the drilling of the hole.

Cloak Pins.

Four perfect specimens and five fragments of cloak pins are included in the collection. The two best specimens, Nos. 19568.2 and 19568.4, are both made of whale ivory, and measure 119 mm. and 86 mm. respectively. Both have been carefully worked and show a neatly executed perforation at the top.

Implements.

Several hundred implements, some only partially finished, are included in the collection. The comparative shortage of bone implements discovered in the Auckland Province in the past, adds importance to their consideration.

Needles.

In the manufacture of bone needles, the material from which the needle was obtained varied according to the material at hand. In the majority of cases it is not possible to give an opinion owing to the working and polishing of the bone.

Of special interest are two pieces of the lower jaw of the native dog, both showing a needle in process of manufacture. In each case the shape of the needle is clearly indicated. Plate 64, figs. 29-32, shows a series arranged to illustrate the various stages in the manufacture of a needle from the lower jaw of the native dog. The top specimen (fig. 29) shows an untouched jawbone, below that is a jawbone (fig. 30) with the first cut or groove shown, below that again a specimen (fig. 31) with the needle almost cut out, while the final specimen (fig. 32) shows the finished article.

The Quennels (1921, p. 81) illustrate very carefully the Solutrean method of needle-making. The raw material was reindeer horn, but the method of cutting out the needle by forming a groove on either side of the piece of horn, was the same as is illustrated here with the native dog's jaw.

Needles in this collection are represented by some 57 perfect specimens, in addition to many fragments, a good proportion of which are only slightly damaged, as, for instance, where the point is broken or the eye damaged. The collection of needles is extremely interesting, for in almost every case they are tangible evidence of the great skill and care exercised by the Maori craftsman. Some of the needles are only splinters of bone, yet they are highly polished, and the eye or hole drilled very carefully. When drilling a needle the strictest care was necessary to prevent the hole encroaching on the side. A careful examination of the 57 perfect specimens fails to reveal a single instance where a second hole had to be drilled. With one exception, 19568.5, the holes were always drilled without a preliminary cut.

The needles are of three main types, (a) those that are flattened and broad on the face and flat in section, (b) those that are rounded on the face and round in section, and (c) a curved type; but the three groups are connected by intermediate types. For instance under type (a) are some that are very broad and could almost be placed in a sub-section. They resemble perhaps bodkins rather than needles.

Naturally it is not possible to give details of the whole of this interesting group, but the table below gives particulars of the type and certain dimensions of those illustrated in Plate 64, figs. 33-58, and is followed by some mention of particular specimens where necessary.

Museum No.	Fig.	Type.	Length mm.	Greatest Width mm.
19569. 3	33	a	109	4
„ .26	34	a	101	5
„ .24	35	a	92	5
„ .11	36	a	91	3
„ .28	37	c	97	4
„ .51	38	c	70	3
„ .61	39	c	68	3
„ . 9	40	b	63	5
„ .22	41	b	65	3
„ .69	42	a	60	4
„ .64	43	a	50	3
„ .71	44	a	52	3
„ .31	45	b	49	3
„ .19	46	b	45	2
„ .38	47	b	43	2
„ .72	48	b	43	1
„ .40	49	a	44	5
„ .41	50	a	44	5
„ . 6	51	a	37	5
„ .54	52	a	33	4
„ .58	53	a	26	3
„ .45	54	a	35	3
„ .36	55	a	48	4
„ .29	56	b	55	3
„ .35	57	b	53	3
„ .39	58	b	85	4

Actually the longest specimen, No. 19568.5, is not illustrated. It belongs to type (c), is 141 mm. in length, and 4 mm. greatest width. Of the specimens illustrated the most perfect specimen of the larger needles is 19569.3 (fig. 33). It tapers very gradually to a sharp point, is highly polished and has the eye carefully placed in the middle of the needle. One can quite imagine that the maker was very proud of his workmanship.

No. 19569.9 (fig. 40) differs from all the others owing to its thick, stumpy appearance and the abrupt, blunt point. It suggests a pendant rather than an implement. Possibly it is a broken tooth from a comb, though combs with round teeth were not common.

Three fine specimens illustrated together are Nos. 19569.19, .38, .72 (figs. 46-48). All three are very slender, have carefully drilled eyes, sharp points and highly polished surfaces. Perhaps fig. 48 stands out as the finest needle in the collection. The eye is less than 1 mm. in diameter, and reminds one more of a European housewife's needle.

The shortest needle is 19569.58, a rather crude specimen with a large eye (fig. 53). No. 19569.36 (fig. 55) is a well polished needle cut from a longitudinal section of the ulna bone of a sea bird. Three others (figs. 56-58) are also from a bird's wing bone, in this case the radius.

Steele (1930, p. 313) mentions that in Otago needles "appear to be cut out, ground and shaped before the hole is cut or drilled." This was also the method followed at Oruarangi. Two needles, neither of them illustrated, both shaped and finished, show the commencement of the perforation. In one the hole has been started on one side only, while in the other a hole has been commenced from both sides, but a junction has not been effected.

The most outstanding specimen, 19569.80 (fig. 59) is notched on both sides. The notches appear to be human handwork, and must have been made for some definite purpose, though what that purpose was we cannot say. Neither amongst the Oruarangi material nor in the Auckland Museum collection is there another specimen of this kind. Its dimensions are, length 41 mm., greatest with 2 mm. This needle is highly polished and tapers to a very sharp point.

Thatching Needles.

The next implement to be described is one that we have called, for want of a better term, a thatching needle (No. 19574, Plate 66, fig. 60). It is a very fine specimen made from whalebone, round in section, slightly curved throughout its length, and tapering gradually to a fairly sharp point. The dimensions of this implement are as follows: Length 347 mm., greatest width 15 mm. Some 7 mm. from the top, which is flattened, is a perforation 5 mm. in diameter.

Though the above mentioned is the only perfect specimen, there are also four fragments obviously belonging to a similar type of implement. They are all about the same diameter, and one, about one third of the length of the described specimen, has a hole drilled at the top, while another, the longest fragment of the four, is broken off 175 mm. above the point. This last specimen, when compared with the perfect specimen, might be a "spare part," for what there is of it tallies very closely as regards dimensions, and the same gradual tapering is a noticeable feature.

Pickers.

The number of pickers (14) in the collection is small. They are mostly made from a length of wing bone of a large sea bird, such as a gannet or albatross. Two such specimens from the radius of a sea bird show a perforation at the top, and may have been threaders. Apart from the two specimens mentioned, none of the other specimens shows any signs of working, except at the point. In most cases the point is of considerable length, and tapers very gradually. The strongest specimen is 19570.2, the dimensions of which are given in the table below. It is made from a piece of a human radius.

Museum No.	Fig.	Length.	Greatest Width mm.	Length of Point mm.	Material.
19570. 4	63	85	6	22	Ulna of a sea bird
,, . 5	62	149	7	13	Radius of a sea bird
,, . 8	61	149	7	7	Radius of a sea bird
,, . 2	—	192	21	21	Human radius
,, . 9	—	222	4	8	Radius of a sea bird
,, . 3	—	125	15	21	Humerus of a sea bird
,, .15	—	119	5	20	Radius of a sea bird

Chisels.

A fine range of chisels is included in the collection. For lack of space it has only been possible to figure seven, so we shall commence with a detailed description of those figured (Plate 65, figs. 64-70).

Museum No.	Fig.	Length mm.	Greatest Width mm.	Length of Point or Bevel. mm.	Material.
19575.24	64	136	29	39	Human femur.
,, . 5	65	134	25	42	Human femur.
,, .12	66	120	17	20	Human fibula.
,, .31	67	97	18	18	Human bone.
,, .23	68	76	7	37	Proximal end of a sea bird's ulna.
,, . 6	69	88	12	26	Distal end of humerus of gannet or gull.
,, . 2	70	112	23	58	Human femur.

Fig. 64 is fractured at the proximal end. It would still be possible to use this implement, though probably it was originally squared across. It is a strong implement, capable of giving much service.

In fig. 65 a fine specimen is illustrated. The bevel has been carefully worked down and culminates in a keen edge, that is, a cutting edge. The proximal end is squared across. A broad groove is noticeable 55 mm. from the proximal end, indicating perhaps that the former owner had intended to use the bone for some other purpose.

A slender, well made specimen is shown in fig. 66. The most interesting feature is the bevel worked on both faces. On the back the bevel is very pronounced, while at the front it commences 4 mm. from the edge, which is somewhat blunt.

The finest bone chisel in the collection, or for that matter, in the Auckland Museum, is seen in fig. 67. Unfortunately, the photograph does not do it justice. Manufactured from human bone, it resembles in shape a well made stone chisel. It has been highly polished on all its surfaces, except part of the back, where it still shows cancellous tissue. The bevel has been carefully shaped, and the edge is very keen. Such a chisel would appear to be quite suitable for working wood.

Of the remaining chisels that are illustrated, the main points of interest can be gleaned by examining the illustrations, figs. 68-70, and consulting the table published earlier in this section.

In addition to those illustrated there are in the collection some 28 specimens, varying in length from 63-131 mm., some being fragments only. Five are perforated at the proximal end. The material from which they are made is chiefly human or bird bone.

We have no record as to how bone chisels were used. It is possible that those with a keen edge were used for carving wood, while the duller edged specimens may have been used for chipping away charred wood, for we know that the Maori made use of fire when reducing wood to the required size.

Bird Spear Points, or Makoi.

There is only one perfect specimen, No. 19571.14 (Plate 65, fig. 74) in the series, though quite a number of the imperfect specimens have only a small portion of the point or base broken. Apart from the specimens illustrated, there are twenty fragments, some showing interesting features. In most the barbs are placed singly, with practically an equal distance between the barbs, but 19571.21 has the barbs set in pairs. This fragment shows three sets of pairs.

One fragment is decorated with a human head crudely carved between the last barb and the butt.

Noticeable features common to all the specimens in this series are (a) the barbs are all on one side, (b) the butt is worked down or flattened where it fitted on to the wooden shaft, and (c) none of the barbs is notched or serrated. A number of sting ray barbs in the collection may have been used as points for bird spears, as several have been worked down at the butt, and one is notched on both sides near the butt, apparently so that the lashing would hold more firmly.

The table below gives dimensions and details of the points illustrated.

Museum No.	Fig.	Length mm.	No. of Barbs.	Remarks.
19571.12	71	89	4	Short piece of point broken off. Butt flattened and perforated twice.
" .10	72	107	6	Point broken. Butt broken. Barbs are equal distance apart.
" . 1	73	164	14	Point sharp. Butt flattened, broken.
" .14	74	167	7	Point exceedingly sharp. Butt flattened and squared.
" .11	75	110	4	Point broken. Butt flattened and perforated.
" . 7	76	107	3	Point broken. Butt notched.

Tattooing Instruments, or Uhi.

In this collection there are 75 fairly perfect specimens of tattooing instruments, or *uhi.* Hamilton (1897, p. 308) quotes Cook's remarks that at the Thames and Mercury Bay districts the natives were much more tattooed and had different patterns from those lower down the coast. It would seem that the former occupants of Oruarangi either tattooed extensively, or were in the habit of making the implements and exchanging them with other tribes.

The tattooing instrument, commonly known as *uhi,* may be best described as a piece of bone, sometimes plain, but more frequently toothed like a comb, lashed after the manner of an adze to a wooden handle.

The majority are made from the wing bones of a large sea bird, such as the gannet or albatross *(toroa).* It is interesting to note that Williams (1921, p. 515) gives the word *toroa* as also referring to a tattooing needle made of albatross bone.

Actually our survey refers only to the blade of the instrument, as in every case the handle is missing. The blades are divisible into three types, irrespective of whether they are plain or toothed, as follows: (a) notched at the butt end to facilitate lashing (Plate 66, figs. 77-79), (b) with a hole drilled close to the butt (figs. 80-83), and (c) with the butt plain, that is, lacking either of the above features (figs. 84-86).

This last type (c) constitutes by far the greatest number, as the respective numbers of each type indicate. The numbers are (a) seven, (b) fourteen, (c) fifty-four.

The following table gives details of the blades illustrated.

Museum No.	Fig.	Type.	Length mm.	Width mm.	Edge.	No. of Teeth.
19567.14	77	a	53	7	Toothed	6
„ .57	78	a	41	6	Plain	—
„ .67	79	a	35	8	Toothed	10
„ .31	80	b	65	12	Toothed	14, mostly broken.
„ .65	81	b	38	10	Toothed	8
„ . 2	82	b	51	12	Toothed	10, 2 or 3 broken.
„ .62	83	b	34	13	Toothed	8, several broken.
„ .19	84	c	48	9	Finely toothed	11
„ .45	85	c	55	7	Teeth marked but not cut	—
„ .60	86	c	43	6	Toothed	7

The fact that the blades vary considerably is probably due to the fact that any tattooing expert engaged on a subject would have at hand blades of different types, according to the lines to be cut. Thus the blade may be broad or narrow, the edge plain or toothed, the teeth fine or coarse, and so on.

Possibly some of the plain specimens are in an unfinished state, and would have been cut later. Fig. 85 is interesting, for it shows lines lightly marked, but not cut sufficiently to form teeth. Quite a number of split toggles were made into tattooing blades. Two blades, figs. 80, 81, show this feature very clearly. In both the central hole is apparent, and particularly in fig. 81 the notching frequently seen on toggles is to be seen at the top end above the perforation. In fig. 81 the lines decorating a toggle can be seen faintly.

Calabash Stoppers.

A curious mushroom-shaped specimen (No. 19559) is figured on Plate 66, fig. 88. It is 51 mm. in length. The stem is 31 mm. in length and 22 mm. greatest width, and round in section. Its use must be left to conjecture, but the suggestion that it was intended for a calabash stopper or plug seems feasible. For comparison a stone example (No. 19560), also from Oruarangi, is shown in fig. 87. It is 51 mm. in length, while the stem is 25 mm. in length, greatest width 24 mm., and round in section. Unlike the bone specimen, which has a plain head, fig. 87 is carved with grooves similar to those found on the top of the butt of a *patu onewa*. In fact, at first sight one would say it was broken off from that weapon, but apparently it was intended for the same purpose as the bone specimen.

Flutes.

Bone flutes are rare in the collection. Plate 66, fig. 89, illustrates the only perfect specimen. Made from the humerus of a sea bird, it is 110 mm. long and has two stops drilled 18 mm. apart. Another specimen of the same material is 92 mm. in length, with only one stop, and is evidently unfinished. Probably some of the long lengths of wing bone were intended for manufacture into flutes.

In a future paper it is proposed to describe the bone fishing material, of which there is a fine collection, to describe the stone specimens and to summarise conclusions drawn from a study of the material, together with some remarks respecting the site from which this fine collection was obtained.

In conclusion, I have to thank Mr. A. G. Stevenson for his assistance in photographing the specimens illustrating this paper.

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For cultural reasons, these images have been removed. Please contact Auckland Museum for more information.

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Figs. 1, 2. Stages employed in cutting bone.
Fig. 3. Implement used for cutting or sawing bone.
Fig. 4. Fragment of human skull, showing grooves cut deeply.
Fig. 5. Portion of a human femur, showing method of cutting.
Fig. 6. Piece of human jaw, from which bone for implements has been cut.
Fig. 7. Lower jaw of native dog, showing piece of bone cut for removal.

Fig. 8. *Rei-puta.*

Figs. 9-15. Canine teeth of native dog, perforated for necklaces or pendants.

Figs. 16, 17. Pieces of pigs' tusks, drilled and worn as pendants.

Figs. 18, 19. Ear pendants, made from the teeth of the *mako* shark.

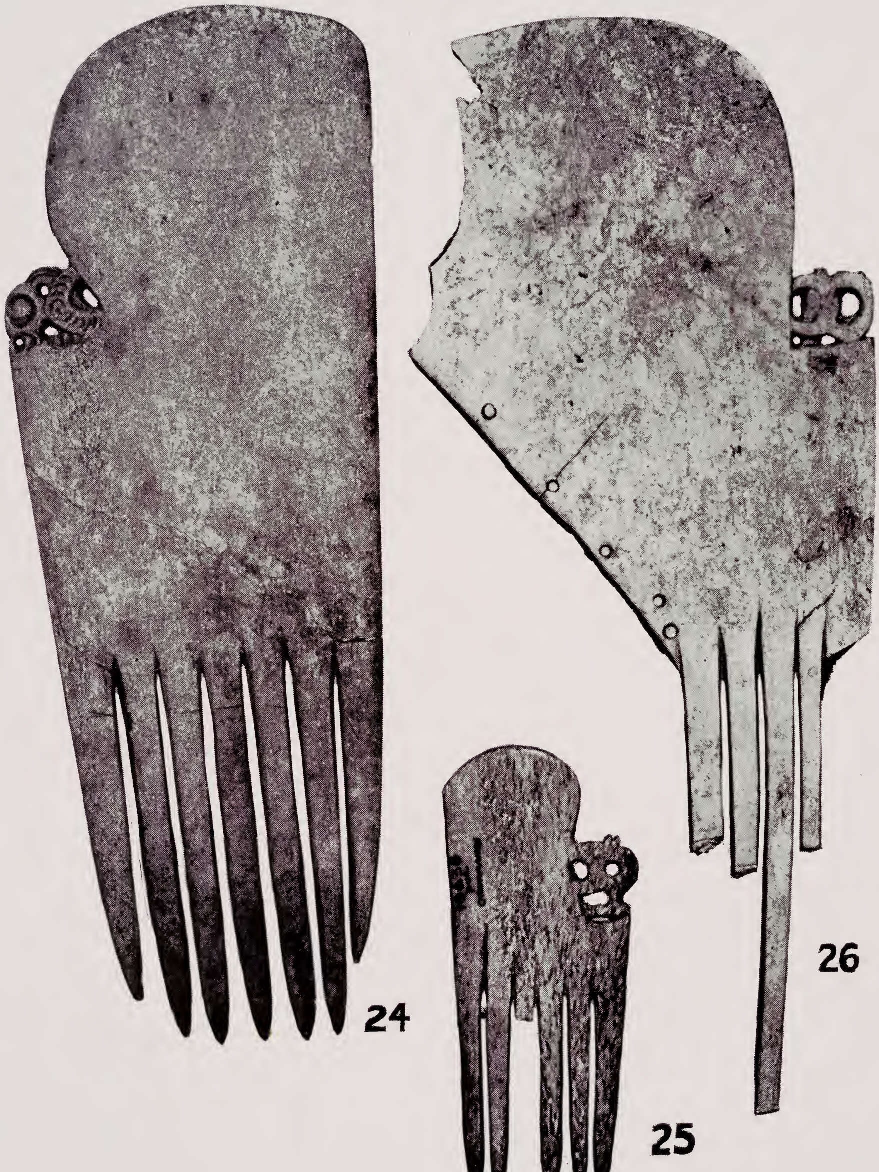
Fig. 20. Pendant, decorated with carved human face.

Fig. 21. Pendant, made from a fragment of human skull.

Fig. 22. Ankle bone pendant.

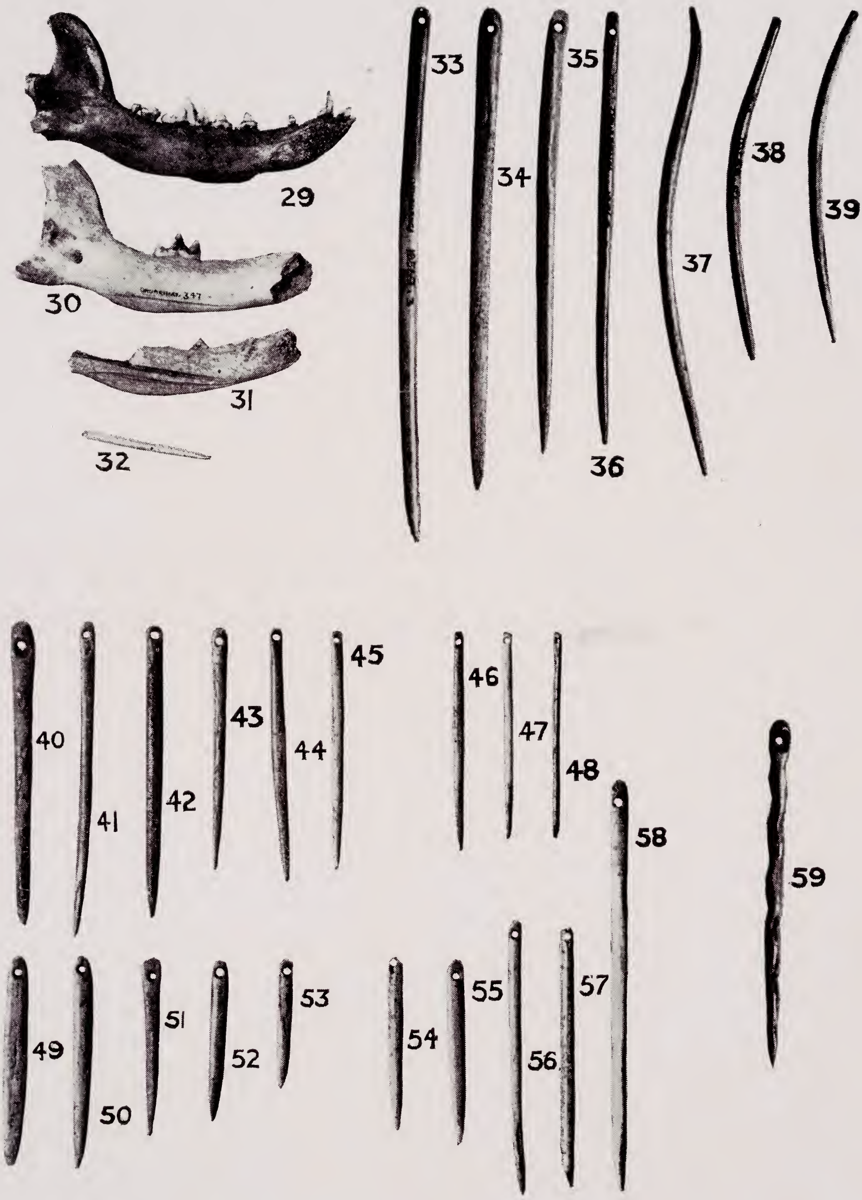
Fig. 23. Toe bone pendant.

PLATE 63.



Figs. 24, 25, 26. Bone combs or *heru*.

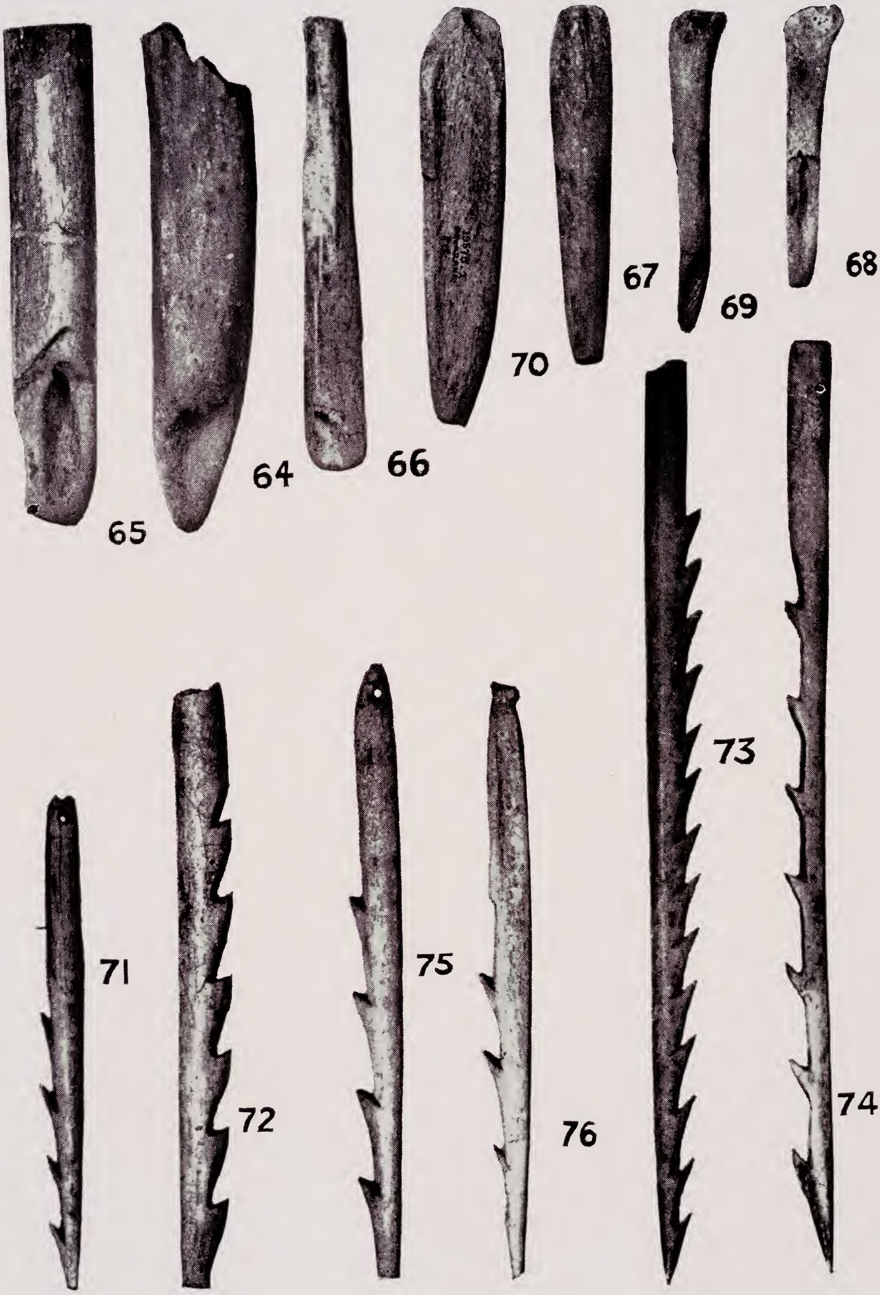
Plate 64.



Figs. *29-32*. A series arranged to show the manufacture of a needle from the lower jaw of a native dog.

Figs. 33-58. Bone needles. Full details of each needle are given in a table in the text.

Fig. 59. A notched needle.



Figs. 64-70. Bone chisels.

Figs. 71-76. Bone points, or *makoi,* for bird spears.

PLATE 66.

Figs. 27, 28. Toggle in process of manufacture, and finished specimen.
Fig. 60. Bone thatching needle.
Figs. 61-63. Bone pickers.
Figs. 77-86. Tattooing blades, or *uhi.* Figs. 77, 78 made from broken toggles.
Fig. 87. Stone "calabash stopper," shown for comparison with fig. 88.
Fig. 88. Bone "calabash stopper."
Fig. 89. Bone flute.

The Material Culture of Oruarangi, Matatoki, Thames.

2. Fish Hooks.

By V. F. FISHER, Assistant Ethnologist.

Under the above heading many interesting specimens were secured, the majority being fish-hook points. In this section, the terminology used for describing the parts of a hook, follows that used by Te Rangi Hiroa (Dr. P. H. Buck), as recorded in recent Bulletins of the Bernice Pauahi Bishop Museum. (See References.)

In the Oruarangi collection there are only two one-piece hooks, as against over one hundred and ninety-two points of composite hooks, besides numerous fragments. The scarcity of one-piece hooks is all the more remarkable when we consider the fact that such hooks were formerly made in great numbers at Mercury Bay, Waihi Beach and other adjacent localities. It seems clearly established, then, that the composite hook was the favourite type at Oruarangi.

Shanks.

Although comparatively few shanks were found, they showed a great divergence in type. With the exception of two specimens, one of shell, and the other of stone, all were of bone. The dearth of bone shanks can possibly be accounted for by the fact that the majority of shanks had probably been made of wood which would quickly decay.

At the end of this section will be found a table giving dimensions and details of the individual shanks. The table in question is based on a similar one drawn up by Teviotdale (1929, p. 280).

It is perhaps appropriate to deal first with an already well-known type, represented by Nos. 19566.6 and .7 (Plate 67, figs. 90, 91), a type commonly found in various parts of New Zealand. The first is a crudely fashioned specimen, quadrangular in section, with neither the shank knob, nor the tail grooves well developed. Its companion .7 is a fine example of a straight shank, round in section, with the shank modified owing to the drilling of a hole for the attachment of the snood. A conspicuous feature on each side of the hole is an eye carved in high relief. The illustration does not show this very clearly, but a careful scrutiny will disclose the eye on the left-hand side. Teviotdale (1929, p. 276) mentions that the Otago University Museum has two specimens which "have very neatly-cut spirals on each side of the head." There are three other specimens in the Auckland Museum, which are decorated at the head with either spiral carving or concentric circles. The best of the three is a fine example from Otumoetai, near Tauranga, the second is from Mahia Peninsula, and the third, which is in the Sir George Grey Collection, has no recorded locality.

In the British Museum is a hook figured by Beasley (1928, p. 7), the shank of which has what he terms a "boss" on either side. He says, referring to this feature, that it is "a fairly common occurrence with hooks of this type." Presumably he has in mind hooks from other areas besides New Zealand, where this particular type with the "boss" is rare. He suggests with a good deal of probability that the bosses were intended to represent the eyes of a fish.

Fig. 92 is a curiously shaped shank quite unlike anything else in the Auckland Museum collection. It appears to be made from whalebone and has a hole at the top of the shank, much larger than is usual. At the tail end there is a big projection, and between this projection and the end of the tail is a wide indentation which measures 16 mm. Judging from the size and strength of the shank it must have been used when angling for a large fish.

An examination of fig. 93 discloses a type quite different from any other in the collection. The greater part of the shank is straight, but near the tail it takes a decided bend at a sharp angle. All the specimens that are recorded from Otago appear to be either straight or evenly curved throughout their length, and none has such a sharp bend. The groove at the knob is very deeply cut, evidently to allow the snood to be securely fastened. The two tail grooves display excellent workmanship, and are of about equal width, while the end of the tail has been squared off and not bevelled. It is in every way a strongly made shank capable of giving extremely good service.

There are five specimens made from a portion of the lower jaw-bone of the native dog, or *kuri*. In two of these the ingenious Maori who fashioned them has left the inferior border of the body of the jaw intact and has cut away a piece of bone of about 3 mm. in width at the front of the bone. This piece increases to about 7 mm. in width towards the back. The natural curve of the inferior border has thus been made to serve the very useful purpose of keeping the tip of the point well away from the shank, when lashed in position. Although the dental groove is still apparent, it does not impair its efficiency. This type is seen to advantage in fig. 94, a specimen which impels admiration for the careful workmanship of the Maori craftsman. The six notches, three on either side of the part that corresponds to the knob of most shanks, have been deeply cut, with the top terminating in a sharp point. The base has two carefully cut tail grooves, and is bevelled on the inside in order to receive the base of the point, which we infer was also bevelled so that a neat join could be effected.

The knob notches of its companion (fig. 95) are not quite finished, but the base shows both the tail grooves and the bevel carefully executed. On the edge, which is not shown in the illustration, there are nineteen shallow cuts made at irregular intervals, but not extending along the entire edge. These are applied solely for decorative purposes. The back has been slightly reduced, as it appears a trifle flattened when compared with an untouched jaw-bone.

Although the next specimen (fig. 96) is broken, it is of great interest owing to the fact that it has been cut from the superior border of the lower jaw-bone, with the result that the sockets for the teeth are a noticeable feature. These sockets have weakened the shank, for the break has occurred at the socket usually filled by the front fang of the first molar. The tail of the shank has been carved out of the anterior border of the ramus, thus producing a curved specimen. The three tail notches and the bevel are neatly finished. The author does not remember seeing any previous reference to the fashioning of shanks from the lower jaw-bone of the native dog.

The next two specimens for review are somewhat similar in many respects. The longer of the two, fig. 97, is a slender, curved shank, 8 mm. in length, with a small, well cut knob, a feature which it shares with its companion, fig. 98. The tails of the two differ; in fig. 97 there are three notches and a bevelled edge, while in fig. 98 no attempt at either of these features is noticeable, though perhaps some further work was intended.

So far all the shanks described have been manufactured from bone. There are, in fact, only two examples made from other material, one of stone and one of shell.

The stone shank, fig. 99, is a poor specimen 61 mm. in length and would not be considered here but for the rarity of stone shanks from this site. At the top of the shank is a faintly cut line, but there is no sign displayed of the careful treatment often given to stone shanks. At the tail a slight bevel is discernible, but, apart from these two features, it is devoid of other marks. The stone itself is rather rough, though this may be due, in part, to weathering.

The scarcity of shell shanks in collections adds interest to this specimen (fig. 100) from Oruarangi. In the Dominion Museum there are several shell shanks in the Bollons Collection, and there are also a few perfect specimens, and many fragments, in the Auckland Museum, most of which came from the North Cape and surrounding districts.

The present specimen is made from the columella of the *paua, Haliotis iris,* and is in a fair state of preservation. The natural shape of the columella supplied a well curved shank, while the irridescence of the shell probably acted as a lure. The shank knob, which is not very pronounced, is rounded at the top, notched in two places on the one side, and on the other, though slightly damaged, still shows one notch. The tail notches, two in number, are clearly marked on the right hand side, but they were apparently not finished on the left hand side. At the base a wide V-shaped notch is a conspicuous feature in the illustration owing to the angle at which the photograph was taken. The shank measures 85 mm. from the top to the base of the tail.

In the Auckland Museum is a *paua* shell shank, from Cape Maria van Diemen, which is decorated with notches along both edges. This shank is mentioned by Hamilton (1908, p. 32) and illustrated in the same work in fig. 21. The Oruarangi specimen shows no sign of such decoration.

The following table gives details of the shanks mentioned in the text:—

Museum No.	Fig.	Length. mm.	Greatest Width, mm.	Depth. mm.	No. of Tail Grooves or Notches.	Material.
19566. 6	90	84	14	5	1 groove	Bone.
„ . 7	91	91	16	14	1 groove	Bone.
„ . 4	92	103	5	17	—	Whalebone.
„ . 2	93	91	6	8	2 grooves	Whalebone.
„ .11	94	89	9	6	2 grooves	Lower jaw of native dog.
„ . 8	95	92	9	7	2 grooves	Lower jaw of native dog.
„ . 5	96	Broken 52	9	7	3 notches	Lower jaw of native dog.
„ .13	98	57	5	6	—	Lower jaw of native dog.
19573	99	61	11	10	—	Stone.
19586	100	85	13	9	2, plus a terminal notch	Columella of *paua* shell (*Haliotis iris*).
19566.10	97	88	6	8	3 grooves	Lower jaw of native dog.

Fish-Hook Points.

The collection of points from this area is especially interesting, both in the numbers found and in the variations in the individual points. It will be shown at a later stage that a special type predominated. Another feature of interest is the fact that, with few exceptions, most of the points were barbed.

The barbed point in New Zealand is of great interest, owing to the fact that, while it was present in parts of Polynesia, such as Tonga and Hawaii, it was apparently lacking in the Society Islands and the Cook Islands. Seeing that it was from those areas that the ancestors of the Maori migrated to New Zealand on the last stage of their meanderings, one is forced to the conclusion that the barbed point as used by the Maori probably originated in New Zealand.

Te Rangi Hiroa (1927, p. 316) has already referred to this matter when he writes: "If there are no barbed hooks in the part of Polynesia from whence the Maori came, it becomes an interesting speculation as to where the Maori and Moriori of the Chatham Islands obtained the barb."

Beasley (1928, Plates LXII. and LXIII.) figures five hooks with barbed points said to be from Tahiti, but personally the writer agrees with Skinner (1930, p. 311) that these hooks are not even Polynesian, let alone Tahitian.

The barbed point is, of course, commonly distributed throughout New Zealand. Possibly the fact that fishing with the line was more suited to New Zealand conditions, would lead to the invention of the barbed point, supposing that the knowledge of such a device had been lost earlier in the history of the race.

Dog Jaw Points.

The points of greatest interest, owing to their rarity, are undoubtedly those made from the lower jaw-bone of the native dog. Seven of this type are included in the collection, five of which are figured here. A complete jaw-bone is also figured (101a) for comparison with the points. In order to fashion the distal end of the point, part of the ramus was cut away, leaving a portion of the coronoid process, to form the tip of the point. In most of the specimens the body of the jaw-bone was treated differently, as is described below.

The choicest specimen is fig. 101, which has been carefully fashioned throughout. The outer curve has five barbs and two notches. The first notch is on the mandibular symphysis. As a result of this notching and barbing, only a short length of the inferior border remains unworked. Of exceptional interest is the fact that most of the teeth are still in the sockets, but they have been cut or filed down, level with the superior border. The only exception is a part of the first molar, which has been left uncut to serve as a barb on the inner curve, a contrivance which has been recorded only twice previously. Beasley (1928, Plate XXIV.) figures a hook, the point of which is made from the jaw-bone of the *kuri*. On the inner curve a "molar tooth ground to a point serves as a secondary barb." Skinner (1924, p. 20) mentions a point of a barracouta hook, "which is made from the lower jaw of the dog, and has the canine tooth as part of it."

Another fine specimen, shown in fig. 102, has a slight barb on the inner curve, but lacks the tooth shown in the previous specimen. The ramus has been cut well away, leaving a slender, but very strong point. The notches at the base are deeply cut; this is necessary with a large point of this type, in order to make certain that the point when lashed to the shank is securely held.

A small, well made specimen is seen in fig. 103. In this specimen the inferior border has been reduced to such an extent that the outer edge of the point almost reaches the dental groove. No barbs have been formed on this point, but the natural undulations of the mouths of the sockets may have served that purpose. In fact, it seems likely that for practical reasons they were left untouched.

A great deal of material was carved away from the jaw-bone to make this point, fig. 104. Thus the inferior border has been worked down to the dental groove, most of the ramus cut away, and the teeth either removed or filed down level with the superior border.

Unfortunately fig. 105 was broken. It has every sign of being carefully finished. There are seven barbs on the outer curve, the greatest number the writer has observed on a point of this type. Beasley (1928, p. 13) has referred to the scarcity of this type of point as follows: "This hook must surely be unexampled, in that the barb [point] is formed from the jaw-bone of a dog; the ramus forms the point, while a molar tooth ground to a point serves as a secondary barb. I have met with no other similar example, excepting perhaps . . . . where portions of a human jaw-bone are used."

Though these points are not so scarce as Beasley thought, they are certainly far from common. In addition to the seven mentioned as belonging to Oruarangi there are in the Museum collection three other perfect specimens, obtained from North Cape, D'Urville Island and one unknown locality; there is also a broken specimen from Murdering Beach.

Both the Dominion Museum and the Otago University Museum possess a number. The latter institution has three from Oruarangi. The writer is of the opinion that when their distribution is worked out it will be found that they are not restricted to particular areas, but are general throughout New Zealand.

Details of the specimens figured are given in the following table:—

Museum No.	Fig.	Length. mm.	Barbs on Outer Curve.	Notches at Base.
19562. 1	101	102	5	2
„ . 2	102	87	1	3
„ . 5	103	77	0	0
„ . 6	104	74	0	4
„ . 7	105	Broken	7	Broken

Dog Tooth Points.

From our survey of fish-hook material from Oruarangi, we have noted that the lower jaw-bone of the native dog supplied the Maori with material wherewith to carve out shanks and points. Even then the possibilities were not exhausted, as canine teeth, both upper and lower, were used for making barbed points. With one exception they are all barbed points, but the number of barbs is not constant, varying from one to five. Thus there may be one, two, three, four or five barbs, while only one lacks a barb. On the inner curve the majority of specimens show only one barb, while a few lack barbs, and in one instance two barbs are noted.

The preparation of the base of the point for attachment to the shank has been carried out in three ways. In some cases notches, varying in number from one to four, have been cut out on the outer curve. In other cases a bevel has been cut on the inner curve, and in one instance, in addition to these features, a hole has been drilled.

Fuller information relating to these points is given in detail in the following table:—

Museum No.	Fig.	Length. mm.	Barbs on Outer Curve.	Barbs on Inner Curve.	Notches at Base.	Bevelled or Drilled.
19585. 1	106	38	—	—	—	—
„ . 2	107	31	2	—	2	—
„ . 3	108	37	4	1	2	Bevelled.
„ . 6	109	35	3	1	2	Bevelled.
„ . 7	110	34	3	1	Wide groove	Bevelled & Drilled.
„ . 8	111	37	2	—	—	Bevelled.
„ . 9	112	36	3	1	2	Bevelled.
„ .11	113	36	2	1	3	Bevelled.
„ .12	114	41	5	1	3	Bevelled.
„ .15	115	30	—	1	2	Bevelled.
„ .16	116	36	1	1	3	—
21596. 2	117	40	5	2	4	Bevelled.
370 (Liggins Coll.)	118	36	2	1	2	Drilled.

Much interest is attached to fig. 106, which shows a tooth cut in three places. The top cut on the outer curve is evidently the first stage in the making of a barb. Similarly the lower incision paves the way for a notch used for purposes of lashing. It is difficult to ascertain the reason for the cut on the inner curve, because if the craftsman intended to bevel it, as was done in other examples, the cut appears to be set rather high.

The use of hooks mounted with a canine tooth must be to some extent a matter for conjecture. Best (1929, p. 37) writes: "Dogs' teeth are said to have been sometimes used in the manufacture of hooks for taking the barracouta." In the same work (p. 44) appears the statement that "another early writer states that barracouta-hooks had a number of dogs' teeth secured to them so that they resembled a saw."

From our knowledge of points that were definitely lashed to wooden shanks to form barracouta-hooks *(pohau manga)*, all of which are much larger than the canine teeth of the *kuri*, the writer is inclined to doubt whether the teeth were large enough to be used for the purpose suggested by Best's informants.

Imitation Dog Tooth Points.

A series fairly well represented at Oruarangi is that which contains a number of small points, which in size and general shape, resemble very closely the canine tooth of a native dog. If this resemblance has any significance—and the writer thinks it has—one of two things may have happened. The canine tooth may have been used as a point, and then at some stage copied in bone, or the process was reversed, that is to say, a point of a certain recognised shape being in use some resourceful person, observing the general resemblance of this bone point to a tooth, utilised the latter as a point. It is impossible to be certain which was the earlier form.

Whether any copying took place or not, a comparison of the two forms has led the writer to conclude that both were used for catching the same kind of fish.

The barbing and notching of the points is not consistent, except in the case of the barb on the inner curve, which in twenty-six of the thirty-one specimens there is only one barb.

The following table gives details of the specimens figured:—

Museum No.	Fig.	Length. mm.	Barbs on Outer Curve.	Barbs on Inner Curve.	Notches at Base.	Remarks.
19572.22	119	39	0	1	2	Bevelled at tail.
„ . 1	120	42	4	1	4	Bevelled and perforated.
„ .30	121	41	4	1	2	Bevelled; material = wing bone of a seabird.
21596. 8	122	45	3	1	2	—
19572.31	123	43	2	1	4	—
„ .12	124	41	4	2	2	Bevelled.
224 (Liggins Coll.)	125	38	3	1	3	Bevelled.

The Oruarangi Point.

For want of a good descriptive term, the writer proposes to name the next type the Oruarangi point, not, however, because it is confined to Oruarangi (it is found in other areas), but because it was the predominant type there.

An analysis of the number of points in this collection shows this very clearly. Thus, out of a total number of 192 points, 116 are of the Oruarangi type. Other types are represented as follows: Dog tooth points, 21; imitation dog tooth, 34; dog jaw-bone points, 7; miscellaneous points, 14. There were, of course, many broken points, but these are not included in the analysis recorded here.

The Oruarangi type is well illustrated in figs. 130-145, and may be defined as follows: The point limb is almost straight or slightly curved and tapers gradually towards the barb. In the vicinity of the barb, usually just beyond, the point takes a pronounced curve inwards. This type receives its characteristic appearance from the single barb on the outer surface; there may, however, occasionally be one or more additional outer barbs which are usually merely decorative. In no instance is there an inner barb. The majority of specimens have two notches at the base, but this is not a constant feature, as some lack notches altogether, while others have one, three or four. In every case the notches are on the outer surface. Taking the point as a whole, there is a decided resemblance to a human leg and foot. This is merely mentioned as a convenient way to summarise the detailed description already given.

As reference has already been made to the distribution of the point, it is appropriate at this juncture to note one or two other localities from which it has been recorded. It is significant that all are from the Auckland District. In the Auckland Museum there are specimens from Kapowairua, North Auckland; Amodeo Bay, Coromandel Peninsula; and Tauranga. It will be noted that two of these localities, namely, Amodeo Bay and Tauranga, are not so very far distant from Oruarangi. Doubtless, further research will extend the range of the type. Beasley (1928, Plate XVII., fig. 2; Plate XVIIa., top specimen; Plate XVIII, specimen on right) figures several composite hooks, the points of which may belong to this type, but as no localities are recorded it does not prove of much assistance.

Considerable difficulty was experienced in determining the bone from which many of these points were manufactured; this difficulty was increased owing to the reducing and polishing necessary for their manufacture. Evidence was obtained, however, which showed that in over half of the specimens the material used was the lower jaw-bone of the native dog.

To achieve this, the interior or exterior surfaces of each jawbone were utilised. Excellent examples illustrating this method are shown in figs. 126-129. Two wide cuts are noticeable on the interior surface of a left jaw-bone. These extend from near the ramus, along the body, and cease at the mandibular symphysis. The length of the strip of bone, which is in process of removal, is 55 mm. Apparently it was originally slightly longer, as at the free end the strip is broken and not cut. The width of this strip varies somewhat, a feature of some importance, which supports the conclusion that it is a point in process of manufacture.

Commencing at the free end the width is 6 mm., it then tapers very gradually until it reaches the natural depression, where it measures 5 mm., and then widens suddenly, until just at the mandibular symphysis it is 7 mm. Judging from this specimen, the incisions were made with due regard to the ultimate shape of the point, that is to say, the point limb was tapered as it approached the barb.

In this collection there are thirty-five lower jaw-bones, which bear evidence of having been cut. Out of these there are thirty-two specimens which have been worked on both the interior and the exterior surfaces. In these cases either a piece of bone has been removed, or preliminary cutting has been carried out. In three specimens, only one surface of each has been worked. Of the points made from dog's jaw-bone the majority were from the interior surface. This may be explained by the fact that it is easier to identify points made from the inner surface, owing to the natural depression near the mandibular symphysis. In many cases four points were probably obtained from the lower jaw-bones of any one dog.

It must be borne in mind, however, that the dog's jaw-bone was not exclusively used for making points of the Oruarangi type. Earlier in this paper (p. 291) we have described the conversion of the proximal part of a mandible into a large point and the making of shanks, and needles (Fisher, 1934, p. 279) from this bone. No doubt further work will reveal additional uses.

Human bone was also used, but, owing to the shaping of the bone, it is not easy to identify many specimens as originating from that source.

Some attention must now be bestowed upon individual points. Fig. 131 is interesting, as it illustrates the manufacture of a barb. Two incisions have been made preparatory to cutting away the bone from the side.

The longest specimen of the series is figured (fig. 141), but details are given in the table below. This specimen is excellently finishd throughout, especially the notches at the base, which are deeply cut.

A table is added giving details of the Oruarangi points which are figured.

Museum No.	Fig.	Length. mm.	Barbs on Outer Surface.	Notches at Base.	Material.
19566. 3	130	55	1	1	Exterior surface of right jaw-bone of native dog.
19572. 4	131	46	—	1	Bone.
„ . 5	132	72	1	2	Interior surface of right jaw-bone of native dog.
„ . 6	133	37	1	2	Jaw-bone of native dog.
„ .10	134	60	1	3	Interior surface of right jaw-bone of native dog.
„ .11	135	44	1	1	Human bone (?)
„ .13	136	50	1	2	Interior surface of right jaw-bone of native dog.
„ .20	137	57	1	2	Interior surface of right jaw-bone of native dog.
„ .23	138	63	1	3	Interior surface of left jaw-bone of native dog.
„ .25	139	56	1	1	Interior surface of right jaw-bone of native dog.
„ . 3	140	52	1	2	Bone.
21969	141	102	1	3	Bone.
19572.29	142	85	7	4	Bone.
„ . 8	143	60	6	1	Interior edge of right jaw-bone of native dog.
„ .24	144	58	10	2	Bone.
„ .16	145	42	2	2	Human bone (?)

Specimens of the Oruarangi type which display more than one barb are very rare. Only nine are noted, four of which are illustrated (figs. 142-145). Two (figs. 143, 144) possess fine barbs extending from the main barb almost to the tip of the point. These, as hinted earlier, may perhaps be purely decorative. Fig. 145 has two distinct barbs, obviously for use.

The most unusual specimen is fig. 142, which certainly belongs to the type, but it has six deeply cut barbs set some distance away from the main barb. There is not another like it in the collection.

Miscellaneous Points.

A statement concerning the number of points of miscellaneous types was made earlier in this paper. As shown from that number (14), the proportion is small, when the fact is realised that there were 192 points of all types. Only four will be described here. Fig. 146 portrays a bone specimen 49 mm. in length. A certain resemblance is borne to the Oruarangi point, but it is readily separated therefrom by the barbs and notches on the outer surface. There are three major barbs at the distal end and a wide groove at the proximal end. Between these there are a series of ten secondary notches, which extend along the remainder of the outer curve. The inner surface of the base is bevelled.

A small point (fig. 147), devoid of a barb, which appears to be finished, measures 33 mm. in length. In place of a notch at the base, a small projection was left to assist the firm attachment of the point to a shank.

An interesting point made from a cetacean tooth is illustrated (fig. 148), as there are no other examples of this in the Oruarangi collection. It is 71 mm. in length, and 14 mm. in width at the widest part. One barb is placed on the inner curve and three on the outer. The base has two wide, deep grooves which suggest that it was lashed to a large shank.

The only shell point is No. 18927 (fig. 149). It is cut from the periphery of *Cookia sulcata, (toitoi),* a shell often used by the Maori in former times for making one-piece hooks and also points. Probably the shiny, irridescent piece of shell served the same purpose as the *paua* shell of other hooks, in providing an excellent lure. It is 53 mm. in length; greatest width 11 mm. The point is without a barb and is incurved; there are three notches at the base on the inner surface.

No typical *kahawai* points were included in the collection; neither were there any fish-gorges. The popularity of bone specimens from this site, especially in view of the fact that bone pickers were common, would have led us to expect to find some evidence of the gorge.

One-Piece Hooks.

Mention has previously been made of the scarcity of one-piece hooks from Oruarangi. This may, perhaps, be accounted for by the absence of *moa* bone, a material greatly favoured in many districts for the manufacture of one-piece hooks.

In the Museum collection there are two perfect hooks, and one in process of manufacture. A fourth specimen was kindly lent by Dr. J. B. Liggins, of Thames. These are all illustrated in figs. 150-153.

A small, neatly finished specimen made of bone is illustrated in fig. 150 (No. 19643). The shank limb and the point limb are both 29 mm. in length, while the bend is 7 mm. in width. The shank limb is practically straight, but the point limb curves gently and terminates in an unbarbed, incurved point; three small notches are carved on the shank knob.

In the Otago University Museum there is a hook from Oruarangi which is very similar to the above specimen, but unfortunately the shank limb is broken. Hooks similar to fig. 150 are commonly found on coastal areas between Tauranga and Mercury Bay.

A hook in process of manufacture is shown in fig. 151. It consists of a piece of bone 28 mm. in length, 24 mm. in width and 7 mm. in thickness. It was obtained from a human femur, the nutrient foramen of which is seen on the right-hand side. A hole has been rasped out near the centre, but much work remains to be done ere the hook is completed.

Possibly this was the method adopted in fashioning the bone hook to be next described, fig. 152. This hook differs substantially from that in fig. 150. It is wider in all its parts, the greatest width of the hook being 25 mm., and its total length is 36 mm., while at the bend it is 10 mm. in width. The shank knob is carefully fashioned and notched at the front and back. Considerable attention is focussed on the point, the barb of which is on the inner curve. Facing this barb is another barb emanating from the shank limb, 7 mm. below the top of the shank knob. The points of these two barbs are only 3 mm. apart. The outer curve of this hook is decorated with twenty-two faint cuts spaced on an average of 3 mm. apart.

In the Bollons Collection in the Dominion Museum are numerous specimens, similar in type to the hook mentioned above, but these differ chiefly in the shape of the shank knob; they were found on Mahia Peninsula and on Portland Island.

I am indebted to Dr. W. R. B. Oliver and Mr. W. J. Phillips, of the Dominion Museum, for the opportunity afforded during a recent visit to Wellington, of inspecting these and other specimens referred to in this article. Interesting comparisons were thus made possible.

To the best of my knowledge the following specimen (fig. 153) is unique, and it says much for the ingenuity of the Maori hook maker. It is made from the molar tooth of a native dog, a perfect specimen of which (fig. 154) is shown for comparison. The shank limb is cut from one fang, while the point limb is carved out of the other. The shank knob has one notch on the outer surface and the point is sharp and incurved. The distance between the tip of the point and the shank knob is 9 mm. A factor controlling this matter is the fact that the average distance between the inner surfaces of the fang is 8 mm. Perhaps the most noteworthy feature of this hook is the clever manner in which the bend has been cut from the crown of the tooth. When a fish was caught on a one-piece hook of this shape, the strain would naturally be at the bend. The maker has probably taken this into account, with the result that the bend was naturally reinforced by the crown of the tooth. To Dr. J. B. Liggins, of Thames, my grateful thanks are due for lending this and other valuable specimens for purposes of study. The length of the specimen is 20 mm., and at the bend it is 5 mm. in width. None of the one-piece hooks features either holes or notches for a bait string.

A broad, general survey of the fish-hooks from Oruarangi has now been completed, and it is hoped will prove of value and interest for comparative purposes, particularly so when other areas in the vicinity yield up their quota of specimens illustrative of this phase of Maori industry.

It was originally the intention of the writer to complete the record of the Oruarangi material in this paper, but it was early found advisable to confine this article to fish-hooks, because of the wealth of specimens awaiting description. A less detailed treatment would not have done justice to the subject. However, at the present stage, the writer can only say that there will be at least one other section of this paper containing some general remarks relating to the area and, possibly, a supplementary article describing the many interesting Oruarangi specimens in private collections.

In addition to those mentioned in the text, acknowledgments must be made to the following persons: To Dr. Doris Berry and Dr. J. Allan Berry, of Napier, for anatomical help; to Dr. H. A. Chatfield for information concerning jaws and teeth; to Mr. S. M. Hovell for permission to visit and excavate on the site, where the material was found; and to Mr. A. G. Stevenson for once again undertaking the photographing of the specimens, the results of which are a tribute to his skill.

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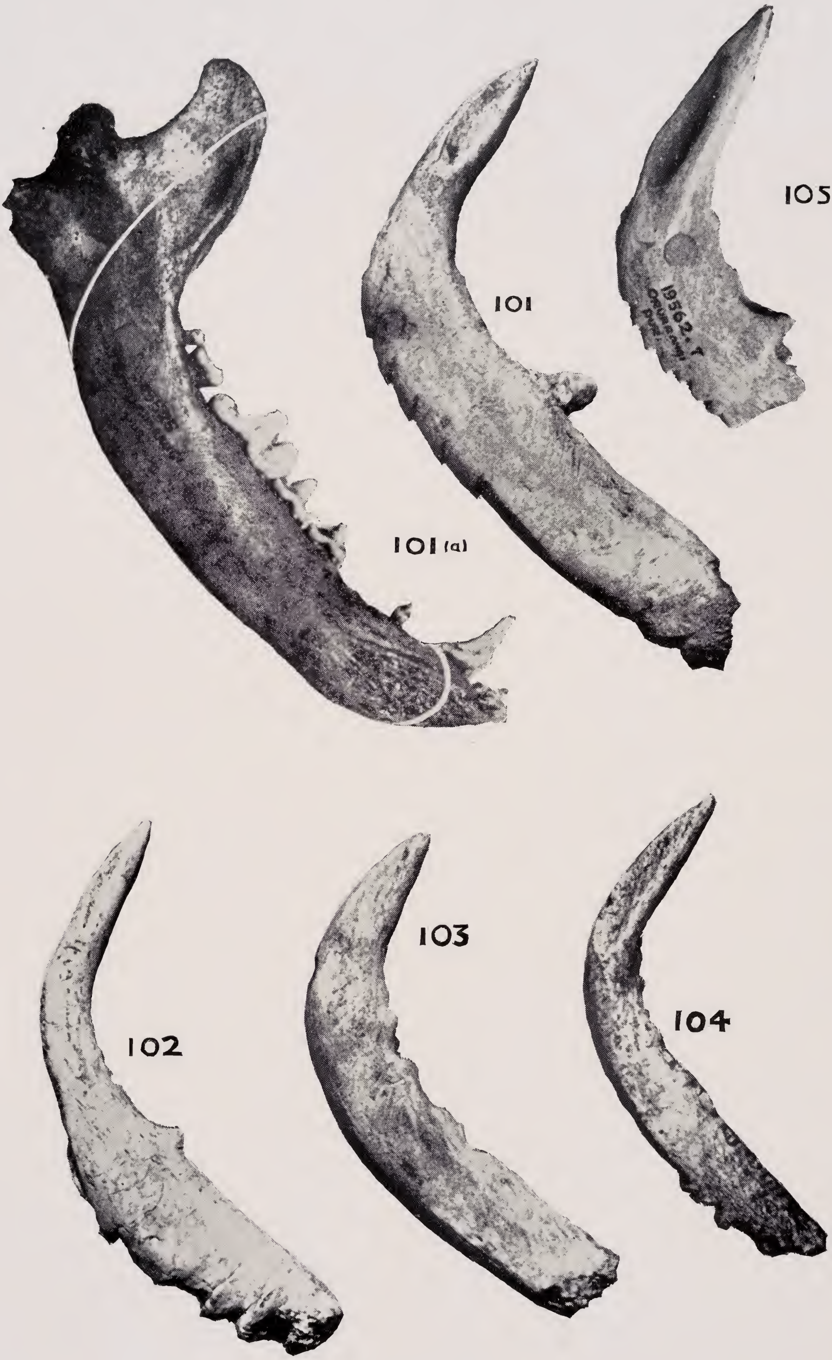
Figs. 90-93. Bone shanks.
Figs. 94-98. Shanks made from the lower jaw-bone of the native dog.
Fig. 99. Stone shank.
Fig. 100. *Paua* shell shank.



Figs. 101-105. Dog jaw-bone points.

Fig. 101A. Lower jaw-bone of native dog, marked to illustrate portion used for dog jaw points.

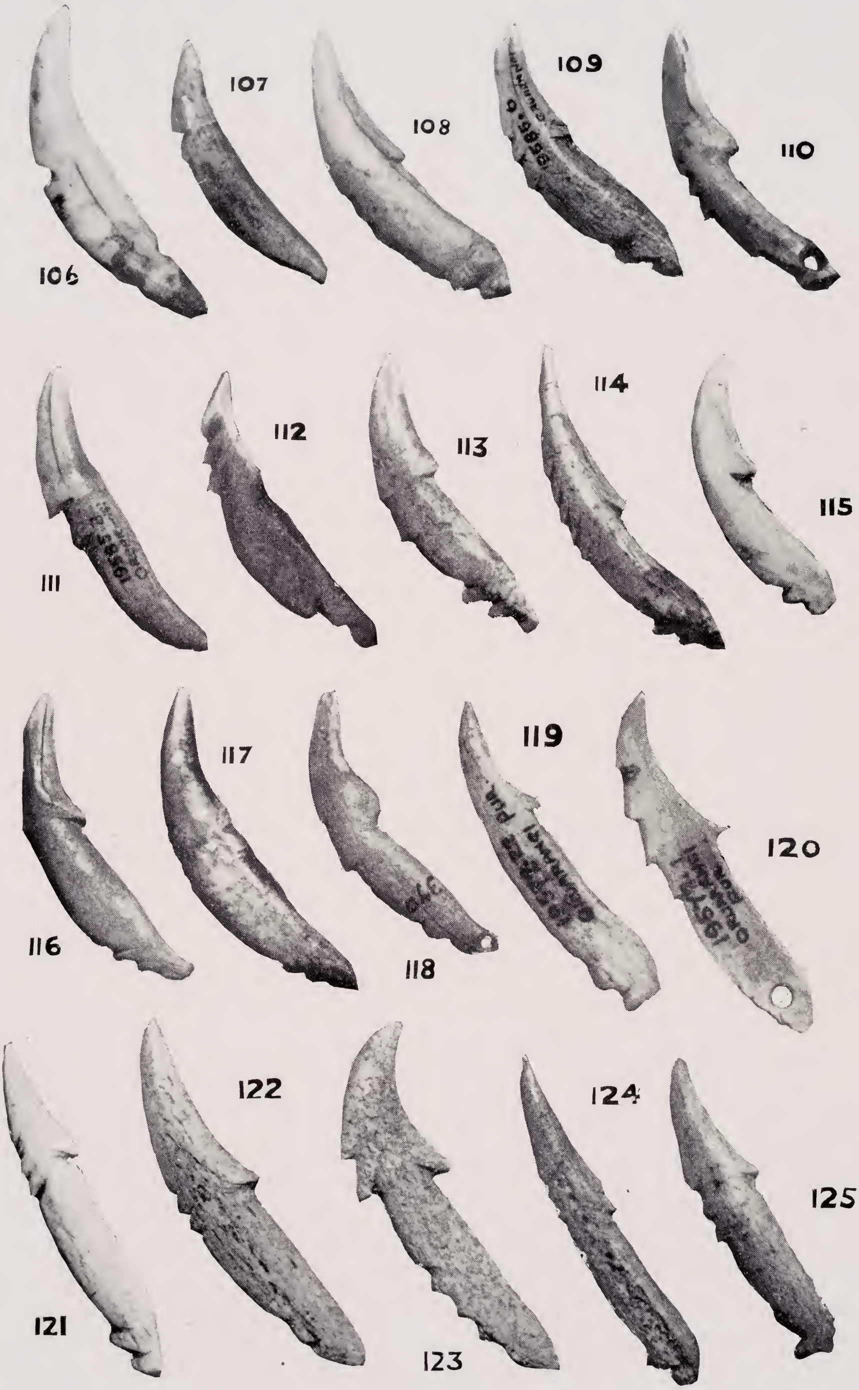


Fig. 106. Dog tooth point in process of manufacture.
Figs. 107-118. Dog tooth barbed points.
Figs. 119-125. Imitation dog tooth barbed points.

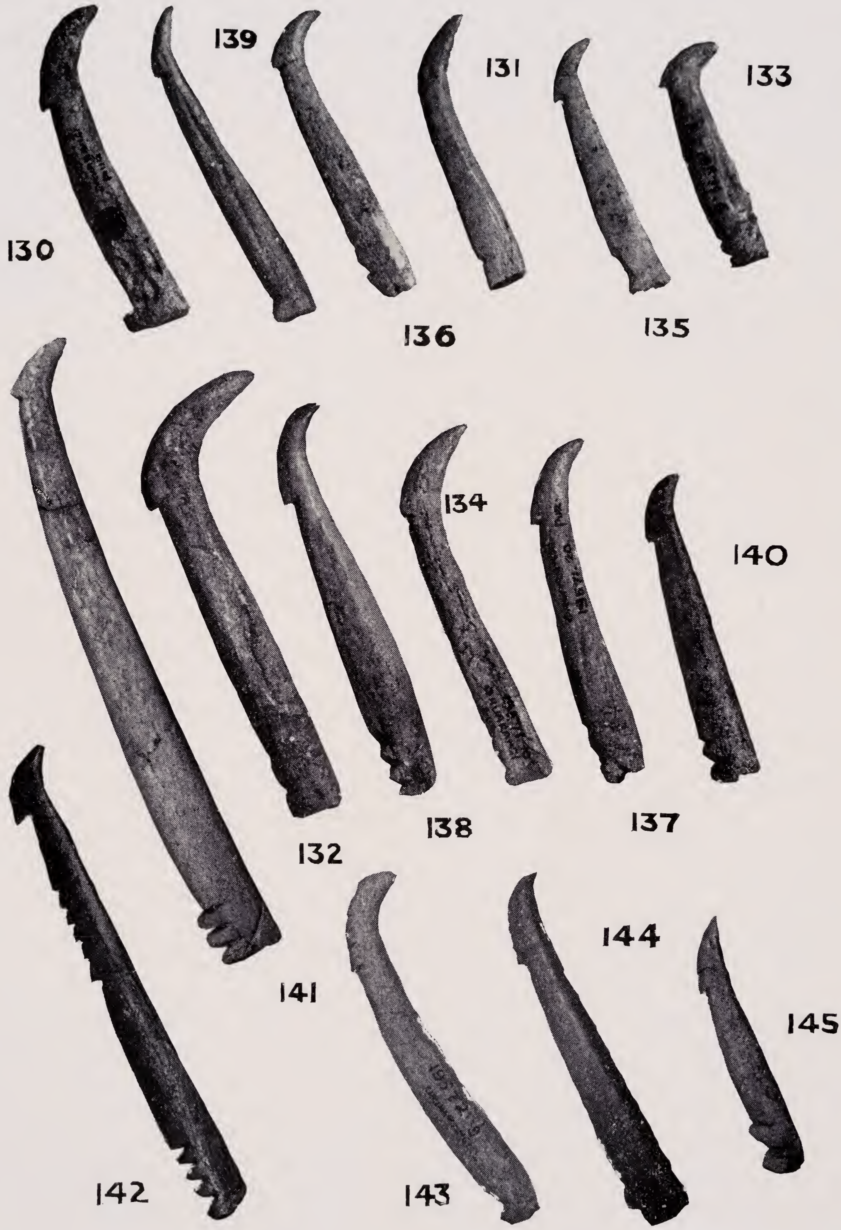
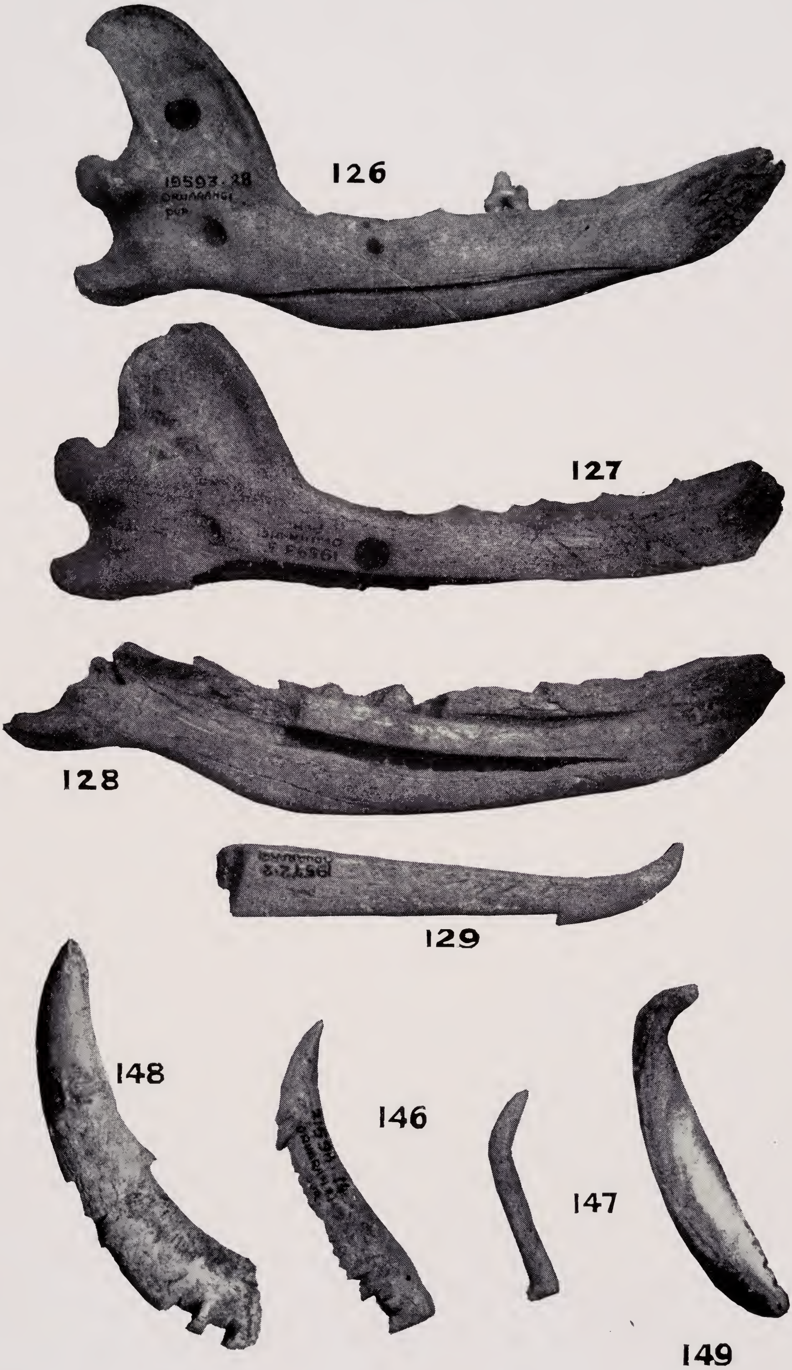


Fig. 131. Oruarangi barbed point in process of manufacture.
Figs. 130, 132-141. Oruarangi barbed points.
Figs. 142-145. Oruarangi points, displaying secondary barbs.

PLATE 71.



Figs. 126-129. A series illustrating the manufacture of an Oruarangi point from the lower jaw-bone of the native dog.

Figs. 146, 147. Bone points.

Fig. 148. Barbed point made from a cetacean tooth.

Fig. 149. *Toitoi* shell point.

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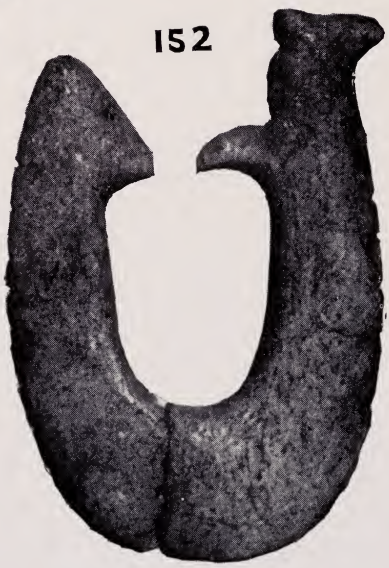
153

150

151

152



Figs. 150, 152. Bone one-piece hooks.
Fig. 151. One-piece hook in process of manufacture, from a piece of a human femur.
Fig. 153. One-piece hook made from a molar tooth of a native dog.
Fig. 154. Molar tooth of a native dog. Portion used in fig. 153 shown by white line.

Botanical Notes on the Hen and Chickens Islands.

(By L. M. CRANWELL, M.A., Botanist, and L. B. MOORE, M.Sc., Auckland University College.)

I. INTRODUCTION.

The Hen and Chickens Group consists of eight islands or islets off the East Coast of North Auckland, by far the biggest and most impressive being Taranga (the Hen), while the Chickens lie strung out in a chain about 6 km. to the north. Sighted and named by Captain Cook on the 29th November, 1769, the islands were, according to Mr. George Graham, in Maori occupation long before the Great Migration, being abandoned in 1821. Little authentic information about the legends or economics of the Maori owners is now available. Signs of occupation are seen in many long, straight, carefully built rock-wall wind-breaks, in piles of stones and boulders collected from land required for cultivation, and in fortifications on high ground.

The islands have been visited by many naturalists, the occurrence of several rare plants being recorded by Cheeseman, Kirk, and Hutton. The present is the first description of the plant-cover, based on two weeks' field work in the early summers of 1933 and 1934. The species list, though obviously incomplete in certain groups, should be of value in ascertaining floristic relations with the mainland, and with the other islands off the East Coast.

1. **Topography:** The islands are obviously remnants of the highland system persisting in the Whangarei Heads, Little and Great Barrier Islands, and the Coromandel Peninsula. All these are notable for great masses of volcanic rock weathered to form precipitous and sometimes overhanging strangely sculptured cliffs.

From the mainland the smaller islands appear rounded or conical, but Taranga is a tall blue mountain rising steeply from the sea. Gentler slopes above lead the eye to the three major peaks, which hide a median ridge sweeping to the north-east to form the backbone of the narrow island. At its extremity this dwindles to a knife edge 100-120 m. above the sea. Nearer the centre and to the north-west is a series of shallow valleys separated by rounded spurs, all truncated by high sea-cliffs. Elsewhere, both on the ridge and the summit pinnacles, the flanks are steep with numerous rock faces. These slopes become more concave at lower levels, and in a very few places occur almost flat areas of about 2 ha., behind boulder beaches. Though V-shaped watercourses, filled with great rocks and flood debris, are numerous, running or other surface water is remarkably rare on the island. (1) The whole coastline is rough, short boulder beaches alternating with wave-cut platforms or fissured cliffs running into deep water. On the biggest Chicken is a crescentic sandy beach. Mud bottom is shown on the chart, in deeper water, but there is no muddy shore and therefore no mangrove or *Zostera.*

2. **Geology:** Taranga and the Chickens are of different geological origin. We thank Professor J. A. Bartrum, of Auckland University College, for permission to quote the following notes made on a brief visit in 1934. "The island (Taranga) consists of coarse volcanic fragmentals of andesitic nature—mainly breccia—penetrated by fairly common dykes of andesite, and containing occasionally what appear to be flows of the same material." Of the biggest Chicken he says, "It is of greywacke, interlaminated in places with hard blackish shale; quite a number of dykes, which appear to be of porphyrite—though I have not yet sectioned their rocks—appear here and there."

The remaining islets are similar in nature, often weathered above the spray-zone to dry plates or crumbling chips. (2).

3. **Climate:** No statistics are available, but the vegetation points to milder temperatures than those of the mainland opposite, where the mean is 16.2°C., with mean daily range of 8.6°. The poor showing of filmy ferns and bryophytes may be taken as an indicator of lower precipitation and humidity, the Waipu mainland figures being 100-125 cm. per annum. Winter is decidedly the rainy season. Wind seems to strike from all angles, but its effect is not marked except on sharp ridges and towards the tops of funnel-like valleys that run down to the sea on the colder southern coast. Elsewhere it is shot upwards by sheer cliffs, which thus protect the basins above from its direct force. Wind is important, too, as a carrier of spray, often preventing any but halophilous species from growing for a hundred metres or so up the cliff face. In closed communities penetration is slight, owing to density of canopy, especially where severely pruned.

4. **Animal Life:** Birds are very abundant; tuataras occasionally rustle over the dead leaves, and skinks abound both on boulder-beaches and under cover of trees and shrubs. Rats (numerous, and with a taste for bird-life) are the only mammals. No trampling or grazing animals have been deliberately introduced, but some years ago a few bullocks swam ashore from a scow in heavy weather off the biggest Chicken, causing much disturbance till their death. In the absence of such beasts broken bark, boughs or saplings are rarely seen.

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(1) This is emphasised by the number of birds that flock to the few available pools. Three shallow squared pits, each about 4 m. by 3 m., constructed (possibly for water storage) on a flat part of the main ridge, contained a layer of some 20 cm. of water above a fine black accumulation of peaty matter. Here at one time a dozen or so birds of three species were seen bathing.

(2) *Soils:* Representative samples were taken on Taranga and on one of the Chickens, but the analyses are not yet available.

II. PLANT-COVER OF TARANGA.

The vegetation falls into three major groups. The coastline communities, depending on the presence of salt water and spray, include sub-littoral and littoral algal associations, open and closed salt-meadows, the vegetation of cliffs and boulder beaches, and coastal scrub. The communities of interior rocks are often similar to those of the sea-cliffs, but are less affected by proximity to salt-laden air. Most of Taranga and portions of the Chickens are forested, though large areas no longer bear their primitive cover. Throughout we treat as fully as possible for Taranga (and for the four Chickens visited) not only the phanerogams and pteridophytes, but also the lower cryptogams, usually neglected in accounts of New Zealand vegetation.

A. COMMUNITIES OF THE COASTLINE.

1. Marine Algal Communities: All belong to the open-coast formation and the flora, though rather richer than that of the greywacke of Waiheke and of the Noises Islands in the Hauraki Gulf, is much poorer than that of the Poor Knights or the more sheltered Waipu coves. The absence of cordlike *Mesogloiaceae* and tufted and foliose gigartinas in the littoral, and of *Lessonia variegata* in the sub-littoral, distinguishes them from others more typical of this northern coastline, the affinities in species content and zoning being with small portions of the mainland (a) opposite Bream Island on the Whangarei coastline, and (b) at Harriet King's on the eastern Coromandel coast.

The substratum is rocky throughout, occasionally with a cover of clean sand visible beyond the boulder-beaches, whose movement eliminates many species above low-tide mark. On stable rock, particularly where shaded or exposed to strong surf-action, certain species reach right up through the *Lichina pygmaea* belt. Where anchored boulders form a pavement they are capped at about low-tide mark by *Xiphophora chondrophylla* var. *minima,* followed by .5 m. to 1.5 m. tresses of *Carpophyllum phyllanthus, C. maschalocarpum* or *C. elongatum,* often as pure dominants, according to the degree of exposure of the coast itself. Slightly above *Xiphophora* on gentle slopes *Hormosira Banksii* is sometimes present, occasionally covering the whole surface of a low wave-cut platform with its buff fronds. Small pools in pitted conglomerate are lined with *Champia novae-zelandiae, Corallina officinalis, Microdictyon umbilicatum* and *Pterocladia capillacea,* the richness of representatives from the sub-littoral being augmented when the pools are fairly deep and shaded by the thalli of coarse brown species —often with *Xiphophora* again dominant on the margins.

Low tides revealed an abundance of the summer species. *Liagora Harveyana* in Old Woman's Cove, associated with a luxuriant growth of *Glossophora Harveyi, Carpophyllum maschalocarpum, Sargassum Sinclairii, Cystophora* spp., and *Ecklonia radiata* var. *Richardiana,* most of these running into deeper water where great buoyant plants were clearly visible against a sandy bottom for a depth of some metres. *Laurencia* was very abundant as an epiphyte in the sub-littoral, but no sign was seen of *Lessonia variegata,* though it may have escaped our notice below the dense *Carpophyllum elongatum* belt on the northern coastline of Taranga.

High salinity is maintained owing to the small flow of fresh water, trickles of which on cliffs sometimes support a growth of *Enteromorpha intestinalis. Catenella opuntia* and various *Myxophyceae* tolerate these conditions at the same or a lower level. There is no brackish water flora, and the extreme richness of *Ralfsia sp.* towards the lower littoral possibly reflects this scarcity of fresh water. With the clear water, the many sunny days and long spells of poor surf, the effect of insolation is seen in (a) the paucity and dwarfing of species between the tide marks, (b) the masking of typical colours. *Carpophyllum, Cystophora, Hormosira, Sargassum* and *Xiphophora* are sometimes so stunted as to be almost unrecognisable. Blackening of apices is common, and killing by long exposure frequent. Species of *Melanthalia, Nemastoma* and *Pterocladia* become yellowish or olive, and *Catenella* a dull greenish purple, but all retain their bright colours when screened in any way.

A number of interesting new records were made amongst the smaller species, and some found here for the first time cannot yet be identified.

2. **Spray-zone Communities:** These differ little from those of long stretches of the North Auckland coastline. Lichens extend from the inconspicuous *Arthopyrenia* sp. (on *Mitella mitella), Verrucaria aucklandica, V. maura* and *Lichina pygmaea* var. *intermedia* of the lower limits to a 2 to 8 m. deep greyish-white belt of *Ochrolechia parella* and *Ramalina leiodea,* among which grow spp. of *Buellia, Caloplaca, Lecanora, Lecidea,* and *Cladonia aggregata.* There is in places on the cliffs a sombre cover, largely of *Caloplaca* and *Lecidea* spp., up to 50 m. in maximum exposure.

Aira caryophyllea, Asplenium flaccidum, A. lucidum, Astelia Banksii, Coprosma retusa, Linum monogynum, Samolus repens, Salicornia australis, Senecio lautus, Trisetum antarcticum,* cling to salt-drenched pockets. Neither *Myoporum laetum* nor *Stipa teretifolia* occur on open rock as they do on the Chickens.

3. **Coastal Scrub:** This is common on cliffs and forms dense masses, tending to bind and encroach on boulder beaches. Beginning in the tight tangles of *Muehlenbeckia complexa* and *Coprosma retusa* on loose rocks, it rises to a height of about 3 m., often merging into wind-pruned forest behind. *Phormium tenax* is associated with a number of woody species of very twiggy habit, the whole interlaced with vines of *Muehlenbeckia, Calystegia* spp., or *Sicyos angulata.* The last-named, together with abundant *Hymenanthera novaezelandiae, Hebe Bollonsii, H. parviflora* and *Paratrophis opaca* at once distinguish this community from any comparable mainland one.

B. COMMUNITIES OF THE INTERIOR ROCKS.

Everywhere surface rock is abundant; even in heavy forest, besides boulders on the floor, vertical rock faces are very frequent, either wholly or partly concealed by tall trees. In their shaded parts these are fairly densely covered by climbers and species, including most of the filmy ferns and many bryophytes, that are here confined to rock, though elsewhere usually epiphytic. Niches in the conglomerate are occupied by *Poa anceps* and *Anthropodium cirrhatum.* Where a little more foothold is available on small, sunny ledges or on tops of columns *Astelia Banksii* and *A. Solanderi* dominate, accompanied in places by *Xeronema Callistemon,* and often with *Dendrobium Cunninghamii* pendent from their exposed bases.

Shrubby species *(Edwardsia microphylla, Entelea arborescens, Hebe parviflora, Leptospermum ericoides* and *Solanum aviculare)* on wider ledges shade masses knee to thigh deep of *Microlaena polynoda, Poa anceps* and *Uncinia australis,* and often lush *Arthropodium.* Where dry rock-dust and fragments accumulate occur *Angelica rosaefolia, Hymenanthera* and *Mesembryanthemum australe.* Sunny slopes at an angle of only 15° to 20°, where well sheltered from wind action, have extensive mats 10 to 15 cm. deep of *Oplismenus undulatifolius* with other herbaceous species, some exotic. The most exposed places have only occasional patches of moss or *Scleranthus biflorus* amongst lichens, but the tops of knobs and peaks carry a sturdier vegetation, often of two or more layers, dominated by *Metrosideros excelsa* 2 to 3 m. high, draped with bright wisps of *Teloschistes flavicans* and spreading thalli of *Sticta* spp. Frequent are *Coprosma* spp., *Leptospermum ericoides, Nothopanax arboreum, Suttonia australis, Senecia Kirkii, Griselinia lucida* and *Pittosporum umbellatum*—the last two confined to this habitat. Between, under, and usually girdling these are dense colonies of *Astelia Solanderi.*

On the more fiercely insolated aspects *Pomaderris phylicaefolia* and *Haloragis depressa* hug the rock, separated by golden green carpets of *Triquetrella papillata, Leptodontium interruptum, Hypnum cupressiforme* and *Bryum truncorum.* Where fruticose and foliose lichens become dominant (notably *Cladonia aggregata, Sticta Mougeotiana) Polytrichum junipernum, Tillaea Sieberiana, Cheilanthes Sieberi* and *Notochlaena distans* form dry brittle tufts. Lichens of varied life-form cover all rock not occupied by larger plants. Several of the encrusting species are white; grey-greens or greenish-yellows are contributed by species of *Cladonia, Parmelia, Stereocaulon, Sticta* and *Usnea;* brightest of all are the golden *Teloschistes* and splashes of *Xanthoria parietina* visible even from the sea.

C. FOREST COMMUNITIES.

1. Coastal Forest: True coastal forest may reach to the very tide, and this, or semi-coastal forest, forms the greater part of the unmodified vegetation of the island. Pohutukawa *(Metrosideros excelsa)* forest is confined to the more rocky slopes and ridges, but the species extends on rocks right to the summit. Elsewhere *Beilschmiedia tarairi* 6 to 12 m. high, is often a pure dominant forming a very uniform brownish-green canopy, as when filling a gently sloping valley. Or a score of species may be almost equally represented, presenting a rich mosaic of greens, broken here and there, especially near rocks, by tall spires of *Knightia excelsa.* Many of these species (e.g., *Cordyline australis, Entelea arborescens, Melicytus ramiflorus, Nothopanax arboreum)* would not reach the roof of a taller forest. The only important local dominants are *Dysoxylum spectabile* (over fairly wide areas), and *Meryta Sinclairii* or *Vitex lucens* in occasional groves with *Paratrophis opaca* and *Sideroxylon novo-zelandicum* co-dominant on windy ridges. Tree ferns are rare. *Rhipogonum scandens* and *Rubus australis* are the only important lianes, while epiphytes are negligible except where an occasional old *Vitex* carries *Astelia Solanderi* on partly dead branches.

The internal characteristics depend on (1) the rocky substratum, (2) the dryness of the ground, (3) the almost complete absence of disturbance by wind or animals, (4) the density of the canopy, and (5) the great size of individual leaves of the majority of the trees. Using Cockayne's (1928) criteria for size of leaves, an analysis of the 30 shrub and tree species occasional to abundant on Taranga in coastal forest shows the percentages: Very small 2.5, small 5, medium 25, large 35, very large 32.5. Of the dominants, *Beilschmiedia tarairi* is *medium* in bright sunlight and wind, and *large* to *very large* where shaded; *Dysoxylum spectabile* always *very large; Metrosideros excelsa* is the only really abundant species in which the leaves are never *very large* even in sheltered places. The result is a dimly lit interior where between the clean straight trunks few species of middle height maintain themselves. Saplings are slender, and though fairly numerous, are well spaced. *Corynocarpus laevigatus, Melicytus ramiflorus* and *Pisonia brunoniana* produce crowded erect shoots from their trunk bases. *Rhopalostylis sapida* is abundant either as large isolated specimens or in groves, where, short-trunked and uniform in size, the leaves of adjacent plants just meeting, it forms the chief undergrowth in forest of low stature. *Macropiper excelsum* occurs freely throughout, often with *Rhabdothamnus Solanderi,* especially amongst rocks. *Coprosma grandifolia* is frequent and *Urtica ferox* occasional by stream-beds.

Probably because of the unstable substratum the common floor-cover is of ferns, usually about 0.6 m. high, perched on boulders of all sizes. *Asplenium lamprophyllum* is usually dominant, with *Polystichum Richardi* very frequent, *Asplenium lucidum* frequent. Scattered under the palms and laxly branching shrubs, but closely packed where this intermediate layer is absent, the tufts of soft fronds often hide the ground for decametres at a time. Though seedlings (especially *Corynocarpus laevigatus, Beilschmiedia tawa* and *B. tarairi)* 10 to 20 cm. high are in places very abundant, few occur where the fern-cover is dense, or, at the other extreme, where the floor is covered in a litter up to 15 cm. deep of harsh fallen, slowly decaying leaves, antagonistic to the establishment of small plants of any kind. Filmy ferns and bryophytes are absent from the actual floor, though thin dark mosses (e.g., *Echinodium* spp., *Camptochaete pulvinata, Hypopterygium novae-zelandiae* var. *nudicaule)* cover fixed boulders between the trees, especially in the dry stream beds. Well shaded rock faces have a fair range of species, with *Leucobryum candidum* and *Rhyncostegium tenuifolium* dominant where dry, and *Eriopus Brownii* where moist. Epiphytic mosses are rare, almost invariably small and appressed to bark; *Dicranoloma Menziesii,* the most conspicuous, is confined to surface roots and trunk-bases.

2. **Leptospermum Communities:** Much of the island (fig. 2) bears pure stands of Kanuka *(L. ericoides),* its dense canopy smoothly following the contours of the shallow valleys along the northern side of the median ridge. These were the largest areas of gently sloping land available to the Maori. Elaborate fortifications on vantage points, and other stonework scattered throughout, indicate that this land was worked intensively, and except in a few cases, the extent of *Leptospermum* to-day is a measure of the interference with the primitive cover.

Over maturity is characteristic of big stretches, the senescent kanuka being remarkable for its great height, its large furrowed trunks (40 cm. diam.), its great proportion of standing dead wood, its unusual undergrowth of *Coprosma grandifolia,* and its burden of epiphytic *Astelia Solanderi.* This last, falling from or with the kanuka, establishes itself on the floor in great masses bound together by *Clematis parviflora,* and often bedded in pale cushions of *Leucobryum candidum.* The abundance of *Astelia* points to the efficiency of bird-dispersal in this genus and to the great age of the kanuka in which it has been able to establish so remarkably. The creeping *Polypodium diversifolium* on the dry soil is as abundant as is the tufted *Asplenium lamprophyllum* on the loose rocks of the coastal forest. These two ferns are practically confined to their respective communities, whereas *Asplenium lucidum* is more adaptable.

Regeneration of forest species occurs freely where odd trees or wedges of forest remain in damp or rocky hollows, but where this source of seed supply is distant a few species of rather low stature, principally *Coprosma* spp., form a large-leaved shrub-layer, conspicuous when a break occurs above. *Nothopanax arboreum* is less abundant than in the coastal forest, while *Phormium tenax* and a little *Pteridium esculentum* grow where light is sufficient, the former rarely persisting long, though it may re-enter the community when the old kanuka begins to fall.‡

In a few small areas the growth of manuka *(L. scoparium)* rather than kanuka has recently been favoured by burning, frequent (shown by the different ages of the clumps) and irregular (shown by ragged junctions with surviving forest), rather different in its effects from the systematic clearing of the Maori.

‡Groves of *Cordyline australis* are a feature of the eastern gullies, most showing comparable signs of old age in much-branched hollow trunks arising from a litter of dead leaves.

Forest species regenerate more freely, and there are thickets of *Phormium tenax* or *Hebe* (2 spp.) with, in one western valley, an admixture of *Dactylis glomerata.* Where wanton firing has destroyed all the humus, dry crumbling rock is sparsely covered with stunted shrubs, or a growth of *Aira caryophyllea,* Dichelachne crinita, Gnaphalium* spp., *Oxalis* spp., *Polycarpon tetraphyllum*‡ and *Sporobolus capensis* Kunth.*

3. Kauri Forest once on Taranga? Just as surely as one could reconstruct the existing forest communities from a study of the seedling and shrub layers of the kanuka, so can we infer that kauri *(Agathis australis)* once played an important part on the higher slopes, as it still does on the bigger Barrier Islands to the south. Three trees of different ages were seen, the largest (18 m. high and 50 cm. d.b.h.) sufficiently old to show that the species is not of recent introduction, and the other two young enough to show continued vigour in regeneration. With them, and scattered through the kanuka, are *Astelia Cunninghamii, A. trinervia, Coprosma grandifolia, C. lucida, C. rhamnoides, Gahnia setifolia, Lepidosperma laterale, Leucopogon fasciculatum, Lygodium articulatum, Pterostylis Banksii* and an *Alseuosmia* indeterminable in the absence of flowers and fruit. Such an assemblage of kauri forest constituents, together with the fact that kauri is normally gregarious, provides our strongest evidence that these few trees are of great significance as survivors after burning, clearing, or even cutting for spars long ago (though this last is but a surmise). Waipu settlers who have known and visited Taranga during the last 70 years know nothing of such changes in this particular area, and had not heard of the presence of kauri until our discovery in December, 1934.

Though kauri forest is gone, these trees and their associates are plainly, we consider, a relic of a higher altitude vegetation, surviving the gradual sinking of the land mass, accompanied by the penetration of salt-tolerant species to the highest points, with the subsequent development of an almost purely maritime vegetation.

III. VEGETATION OF THE CHICKENS.

Though the vegetation of these smaller islands is very similar to that of the lower slopes of Taranga, there are certain striking differences correlated with (a) **physical factors:** altitude lower (225 m. max.), contours rounded without interior bluffs, rock sedimentary (greywacke slipping in plates or small chips), soil usually compact, dry; (b) **biotic factors:** clearing more widespread (due to repeated burning), concentration of burrowing sea-birds very high, sometimes affecting a whole island.

Marine algae are poor except where heavy swell strikes continuously, but salt-meadow and coastal scrub are better represented, and are sometimes induced by bird activities.

In least modified parts *Metrosideros excelsa* is dominant, *Dysoxylum spectabile, Olea apetala,*‡ and *Meryta Sinclairii* are abundant to locally dominant. On the whole, tree species are fewer. *Beilschmiedia* forest is absent (though odd trees of both species may have been missed). *Agathis australis* and *Xeronema Callistemon* do not occur, though a battered tussock of the latter, weighing about 15 kg., was found on the shore of the biggest island, probably sea-carried (like the *Durvillea* fronds) from the Poor Knights.

IV. INFLUENCE OF BIRDS.

1. **Fruit-eating birds:** Certain fruit-eating and nectar-sipping birds tear their food to pieces, so it is common to follow a whole foreshore without seeing seed of *Phormium,* and other fruits are eagerly sought. This may explain the small spread of coastal forest into the old kanuka, apart from Astelias and Coprosmas, the seed of which passes unharmed through the birds.

2. **Perching birds:** Though everywhere numerous, perching birds are on the whole not sufficiently concentrated to have any marked local effect. We noted, however, two cases of detrimental influence. On the smallest Chicken visited the death, apparently through suffocation, of a number of very fine specimens of *Meryta* may almost certainly be attributed to the roosting of starlings migrating from the mainland. The upturned leaves of other sickening trees and of most of the scrub below are plastered on both sides with offensive droppings. Whatever their relation to the dispersal of indigenous species, there is little doubt that they are responsible also for the incoming of *Phytolacca octandra,** an important member of the "bird-scrub" here.‡

The effect of shag colonies was especially noted at Old Woman Cove (Taranga). A pohutukawa living in 1933 was dead and whitened with droppings a year later. Beneath it only nitrophilous species thrive, e.g.,*Coprosma retusa, Hymenanthera novae-zelandiae, Parietaria debilis, Solanum aviculare* on the cliffs, with yellow sheets of *Xanthoria parietina* on flat slabs on the wave-cut platforms below.

3. **Burrowing sea-birds:** The combined activities of blue penguins and petrels, of the latter Falla (1934) lists 5 spp. on Taranga and 7 on the Chickens, last over many months. Thousands hurtle in after dark, trampling down low plants until the ground is bare about the mouths of their burrows. They tunnel in hard or soft soil and vegetable debris (often under astelias), or amongst tree-roots and boulders, and up to 2 m. into the ground. This breaks up and aerates whatever soil is available, besides enriching it with excreta and nesting material. Everywhere an ephemeral growth of tall weak *Parietaria debilis, Stellaria parviflora* and *Solanum nigrum* springs rapidly into prominence as soon as nesting is over.

‡Male flowers, hitherto undescribed, were found here and on Taranga. The inflorescence is fugacious, bearing small, delicate leaves and two or three pairs of simple flowers. The only open flower found had three sepals and two large-anthered stamens, one abnormally lobed.

The maximum effect is seen on some of the smaller islands, where steep greywacke slopes are so riddled with burrows, and the rock fragments so loose, even when found by a tangle of *Muehlenbeckia,* that no tall growth can remain anchored, and even tussocks of *Agropyron multiflorum* and *Stipa teretifolia* eventually fall with their own weight. Vegetation that receives drainage from these slopes is remarkably rank, *Dichondra repens, Mesembryanthemum australe, Salicornia australis* and *Senecio lautus,* all rather plastic species, being especially luxuriant. Several such islets (e.g., D of list) are capped by a growth of coastal scrub species *(Hymenanthera novaezelandiae, Coprosma retusa),* with scattered trees or groves of *Meryta Sinclairii, Pittosporum crassifolium* and *Sideroxylon novozelandicum.* The soil is a softly compacted brown mass of recognisable leaf remains, through which one's feet sink 20 to 30 cm. into the labyrinths of the burrows. It is generally bare except for *Corynocarpus* seedlings and an occasional tussock of *Asplenium lucidum* or the *A. flaccidum* epharmone that is so much more abundant under similar conditions on some of the Noises Islands. Over-disturbance of the roots or manuring far beyond the optimum may account for the remarkably small leaves of *Coprosma retusa* where steep slope merges into flat top.

V. LEAF BEHAVIOUR.

Macropiper excelsum and *Myoporum laetum* have already given rise to much speculation as to the significance of leaves of great dimensions and thick texture on several coastal islands, but on Taranga, even under the forest conditions that affect other species strongly, *Macropiper* does not behave abnormally. Leaf dimensions averaged out at 6.4 by 8.4 cm., as compared with 13.75 by 13.75 cm. for leaves on the southern island of the Poor Knights. The large-leaved, coarse-textured form was found only on one small Chicken with a cover of bird-burrows and manured soil, which, from its warmth and richness must face the growth of the few species that can tolerate these conditions.

Myoporum shows diversity not only in leaf size and texture, but also in the toothing of the margins and in the stature of the plant. Taranga specimens differ little from mainland ones, but on greywacke ledges on two of the smaller islands, caught by spray and dwarfed by wind and probably washed by seepage from bird colonies around, the plants are low and sprawling, with large leaves, the succulence of which obscures the oil-glands.

In both these instances we see a fairly definite correlation with environment. A measure of this can be obtained only by controlled transplant experiments, preferably in two directions and especially from the mainland to the islands. Certainly the few plants we have seen grow in gardens retain their vigour, but may not this be a result of the care bestowed by keen horticulturists on rare and attractive forms?

‡*c.f.* The very similar conical Maria Island of the Noises Group. There also a few tall trees have been killed, while just above the deep spray-zone is a fearsome thicket of *Lycium horridum!**

Rhabdothamnus Solanderi, though not obviously affected by birds, is also remarkable for size of leaf (up to 9.5 by 8 cm. in shade as compared with "½-1 in. long, but sometimes over 2 ins." of Cheeseman's Manual (1925). From the series of specimens obtained (in forest) on Taranga and (in manuka scrub) on one of the Chickens we rank this also as probably a case of epharmony, the effective factors being very favourable soil, combined with exceptional stillness of air, dim lighting and mild temperatures. The same phenomenon is exhibited though in a lesser degree by many species, notably *Corynocarpus laevigatus, Melicytus ramiflorus, Rhipogonum scandens* and *Suttonia australis,* all of which have greater average leaf area than on the mainland.

A large-leaved form of *Beilschmiedia tawa* presents rather a different problem. Though habitat conditions affect it considerably, as instanced by range of leaf-size on a single tree (5 by 2 cm. in sun and 15 by 6.5 cm. in shade), a comparative study of the species on the mainland and on a number of islands off the Auckland East coast has led us to suspect that some genetical difference is involved. Field observations on Taranga giving considerable support to this view will be detailed later.

VI. FLORISTIC RELATIONS.

Though the relatively small number of species of phanerogams and pteridophytes (263, cf. 630 for North Auckland Botanical District) is a natural result of the limited range of habitats available, many important constituents of comparable adjacent mainland communities are absent. Striking examples are (a) *genera: Acaena, Aristotelia, Carpodetus, Cyathodes, Dracophyllum, Elaeocarpus, Freycinetia, Gaultheria, Nothofagus, Phebalium, Tmesipteris, Weinmannia,* and all conifers except *Agathis;* (b) *species: Lycopodium volubile, L. densum, Metrosideras robusta, Pseudopanax crassifolium.*

Lat. 36° S., which falls just south of the group, is the southern boundary of the North Auckland Botanical District (Cockayne, 1928). The Barrier Islands to the south-east are included in the Thames Sub-district of the South Auckland Botanical District. Though affinity with the vegetation of the former rather than of the latter district is shown in the dominance of *Beilschmiedia tarairi* over *B. tawa* in dicotylous forest, the characteristic features are on the whole, as might be expected, those common to the coastal strip of both Cape Colville and the east coast of North Auckland. The only northern local endemics are *Meryta Sinclairii, Hebe Bollonsii, Olea apetala* and *Xeronema Callistemon.* Of these the first is otherwise confined to the Three Kings, a separate district, in which it forms an important part of the vegetation; the second is common to all adjacent islands, while the third links with Whangarei Heads, and the fourth only with the Poor Knights (which show interesting floristic differences in the presence of *Suttonia divaricata?* (large-leaved form), *Carmichaelia Williamsii, Blechnum norfolkianum,* and *Danthonia bromoides.* The Hen and Chickens may, then, reasonably be retained in the North Auckland Botanical District to which they were tentatively referred by Cockayne.

VII. LIST OF SPECIES.

Unless authorities are given these are: for Algae as in Laing's (1926, 1930) lists; for Musci, as in Dixon's (1913-1929) Bulletin; for the rest as in Cheeseman's (1925) Manual, except that *Hebe* is used instead of *Veronica*.

Fungi were few, apart from dry *Hirneola polytricha,* but winter collecting should be richer. *Aseroe rubra* was seen, the others collected have not yet been worked up.

The lichens have in part been identified by Hofrat Dr. A. Zahlbruckner, who has generously worked over large collections sent him by Dr. H. H. Allan, in part after critical comparison with other specimens named by him. A number of species still await examination, but the list is sufficient to give a good idea of the lichen florula, and to serve as a basis for further ecological work. A set of specimens is being deposited in the Auckland Memorial Museum.

Liverworts were collected, but have not been listed, as no comprehensive modern revision of the group is available. In most cases only provisional names could be given, and unless accompanied by detailed descriptions or sketches, would be of little value. Species are probably fewer than those of mosses. Most are small, foliose and appressed to the substratum, which is occasionally bark, but most often rock, where, in dampest places *Radula* is the most important genus. Thallose types are represented only by very small quantities of *Aneura* (in a wide sense) and frondose ones by one small species on rough, vertical, sunny faces. Large forms like *Schistochila,* often abundant in kauri forest, are absent. *Lepidoziae* are rare and small (collected only on *Astelia* bases). *Trichocolea australis* with stems barely 1 cm. long is indicative also of a dry habitat.

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Abbreviations: T. Taranga; A, B, C, D, the islands marked in fig. 1; R, rock; S, scrub; E, epiphytic; P, pools; d, dominant; a, abundant; f, frequent; l, local; o, occasional; r, rare; +, occurs; v, very.

Algae.

1 = upper littoral, 2 = mid littoral, 3 = lower littoral, 4 = sublittoral, † = important records.

CHLOPOPHYCEAE: *Bryopsis plumosa* 2 P o, 3 o. *Caulerpa Brownii* 4 + (dredged at 8 fathoms on A). *Codium adhaerens* 3 r (shaded by *Xiphophora*). *Cladophora prolifera?* 2 P o, 3 P a, 4 + (short harsh branches). *Chaetomorpha aerea* 1 P a, 2 P a, 3 + (spray-zone also). *Rhizoclonium Hookeri* (spray-zone on T, C). *Ulva rigida* 2 +, 3 +. *Enteromorpha intestinalis* 1 o–a, 2 o–a, 3 o. *Microdictyon umbilicatum* (Velley) zanard †, 2 P o (shaded by *Zonaria*).

PHAEOPHYCEAE: *Ectocarpus* n. sp.?, 2 E o, 3 E a, 4 E o (on *Xiphophora* mainly). *Colponemia sinuosa* 2 O f, 3 E o (small specimens). *Scytothamnus australis* 1 r, 2 o (very stunted). *Leathesia difformis* 2 +, 3 o, 4 +. *Splachnidium rugosum* 2 +, 3 r (very stunted). *Perithalia capillaris* (drift only). *Ecklonia radiata* var. *Richardiana* 1 P o, 2 P f, 3 a, 4 a–d. *D'Urvillea antarctica* (drift from living plants: Poor Knights—new record). *Hormosira Banksii* 1 P o, 2 va–d, 3 o–a (mudless-shore form; no parasitic *Notheia!*). *Xiphophora chondrophylla* 1 P r, 2 P o–f, 3 f–d (forms distinct belt). *Cystophora retroflexa* 3 P f, 4 a. *C. torulosa* 2 P o, 3 p f, 4 a. *Carpophyllum elongatum* 2 P o, 3 d (forms distinct belt in rough water). *C. maschalocarpum* 1 P r, 2 P o, 3 a–d, 4 o–a (forms distinct belt). *C. phyllanthus* 1 P r, 2 P o, 3 o–a, 4 va. *C. plumosum* 1 P +, 2 P o, 3 a, 4 va. *Sargassum Sinclairii* 2 P o, 3 P a, 4 a. *Zonaria Sinclairii* 2 P o, 3 P a, 4 a. *Taonia australasica* (Kuetz.) J. Ag. †, 3 r, 4 o (recorded previously from Kermadecs and Little Barrier. Collected by L.M.C. at Whangarei Heads and Harriet Kings, 1931). *Dictyota dichotoma* 3 r, 4 o. *Glossophora Harveyi* 2 P o, 3 P f, 4 a (conspicuous even growth; flat sexual form associated?). *Ralfsia* sp. †, 2 o, 3 o–d, 4 f (often wide belt below *Apophlaea*).

RHODOPHYCEAE: *Bangia fusco-purpurea* 1 +. *Porphyra columbina* 1 + (no continuous belt). *P. subtumens* †, 3 E o, 4 E o (on *C. maschalocarpum*, new host). *Nemalion* sp. 2 f, 3 f (short, sterile). *Liagora Harveyana* Zeh. †, 3 ld, 4 f (whitish tufts on boulders; collected also at Crusoe, Motuihi and Noises Islands, L.M.C.). *Pseudo-scinaia australis?* †, 2 P a, 3 P a, 4 + (C only; drift on T). *Caulacanthu's spinellus* 1 r, 2 +. *Gelidium caulacanthemum* 2 o, 3 o. *Pterocladia capillacea* 2 P o, 3 P a, 4 +. *P. lucida* 2 P +, 3 P r, 4 o. *Catenella opuntia* 1 o–a (ld. in spray-zone). *Melanthalia abscissa* 2 P o, 3 P a, 4 o. *Apophlaea Sinclairii* 1 r–f, 2 o–d, 3 o (forms wide belt). *Rhodymenia leptophylla* 3 P o. *Champia novae-zelandiae* 2 P o, 3 P f, 4 o. *Plocamium brachiocarpum* 3 P r, 4 o. *Abroteia sub-orbicularis* 2 E o, 3 E a, 4 E a (on *Carpophyllum* spp.). *Caloglossa Leprieuri* 1 vr. *Acrosorium decumbens* 3 P o, 4 o. *Laurencia distichophylla* 3 E o, 4 E a. *L. pinnatifida* 3 P +. *L. virgata* †, 2 P o, 3 o–f. *Polysiphonia* sp. 2 P +, 3 P +. *Aphanocladia delicatula* †, 3 P o. *Dipterosiphonia heteroclada* 2 +, 3 + (on *Xiphophora*). *Bostrychia Harveyi* (freshwater, A). *B. mixta* 1 o–f. *Euzoniella incisa* 3 E a, 4 E o. *Vidalia Colensoi* 2 P r, 3 o, 4 o. *Griffithsia antarctica* 2 P a, 3 P o. *Ceramium clavulatum* 1 P a–d, 2 P a. *Ceramium* spp. 2 +, 3 +, 4 +. *Grateloupia* sp. 2 P r, 3 P o. *Nemastoma (Catenella) oligarthra* (J. Ag.) Kylin †, 2 o–d (forms narrow belt: recorded from Bay of Islands and Harriet Kings by Kylin; collected since on Poor Knights and at Whangarei Heads by L.M.C.). *Melobesia leptura* Fosl. 3 E +, 4 E +. *Melobesia* spp. 1 P o, 2 P a, 3 a, 4 a. *Lithophyllum (Dermatolithon) Carpophylli* 3 E +, 4 E +. *Lithothamnion* spp. 3 +, 4 +. *Amphiroa elegans* Harv., 2 P o, 3 P a. *Corallina Cuvieri* 2 a, 3 a. *C. officinalis* 1 P f, 2 a–d, 3 a–d (associated with *Hormosira*). *C. (Jania) micrathrodia* 2 P o, 3 f. *Hildenbrandia rivularis* † (fresh-water stream). *H. Crouani* J. Ag. 1 r–f, 2 o–d, 3 o–d, 4 a (identified by H. Skuja).

Families 28, genera 61, species 78.

Lichenes.

cr = coastal rocks, r = rocks in general, b = bark of shrubs and trees, or on twigs.

Verrucaria aucklandica cr, *V. maura* cr. *Arthopyrenia* sp. cr. *Microthelia magnifica* b. *Pyrenula nitida* b, *P. subpunctella* b. *Graphis tenella* b. *Thelotrema periphysatum* b. *Lichina pygmaea* var. *intermedia* cr. *Collema leucocarpum* b, *C. vespertilio* b. *Leptogium aucklandicum* b, *L. chloromelum* b. *Heppia spectabilis* r. *Pannaria rubignosa* var. *lanuginosa* b. *Psoroma sphinctrinum* b. *Lobaria verrucosa* b. *Sticta aurata* b, *S. carpoloma* b, r, *S. cellulifera* b, *S. coronata* b, *S. dissimilis* r (in forest), *S. filix* b, *S. fragillima* on moss, *S. fuliginosa* r, *S. impressa* b, *S. latifrons* b, *S. Mougeotiana* r, b, *S. subcaperata* b. *Peltigera dolichorrhiza* on moss. *Bacidia viridis* b. *Lecidea albopraetexta* b, *L. albocoerulescens* cr, *L. aucklandica* b, *L. circumdiluens* r. *Cladonia aggregata* r, etc., *C. capitellata* f. *degenerata* r, *C. Floerkeana* on dead wood, *C. pycnoclada* r, etc. *Stereocaulon denudatum* r, *S. ramulosum* r. *Pertusaria aucklandica* cr. *Lecanora atra* f. *americana* b, *L. atrynea* var. *melacarpa* cr, *L. dispersa* cr, *L. perrugosa* r, *L. subfusca* b. *Ochrolechia parella* cr. *Myxodictyon chrysostictum* b. *Parmelia cetrata* f. *sorediifera* r, b, *P. constrictans* r. *P. molliuscula* cr, *P. prolixa* cr, *P. saxatilis* var. *Aitoni* r, *P. subphysodes* b, r, *P. tenuirimis* var. *erimis* r, *P. trichotera* var. *typica* b, *P. pertusa* b. *Ramalina leiodea* r, *R. linearis* b, r. *Usnea arida* b, *U. florida* b, *U. rubescens* b, r. *Caloplaca acheila* f. *rubentior* cr, *C. Allanii* cr, *C. elegans* var. *tenuis* r, *C. pyracea* cr. *Teloschistes chrysophthalmus* b, *T. flavicans* f. *glaber* b, r. *Xanthoria parietina* r, *Buellia canescens* cr, *B. Cranwelliae* cr, *B. myriocarpa* b, *B. stellulata* cr, *B. subdisciformis* var. *meiospora* r. *Rinodina exigua* r. *Anaptychia leucomelaena* var. *angustifolia* b, r. *Physcia stellaris* b.

Families 20, genera 33, species 79.

MUSCI.

1 = coastal rocks and scrub, 2 = interior exposed rocks, 3 = climax coastal forest, 4 = modified areas.

Dicranoloma Menziesii 2 o, 3 R E f. *D. Billardieri* 4, r. *Ceratodon purpureus* 2 vr. *Holomitrium perichaetiale* 2 R E r. *Dicnemoloma Sieberianum* 2 o, 3 R r. *Campylopus introflexus* 2 f, 4 r. *Leucobryum candidum* 2 o, 3 R o, 4 f. *Fissidens leptocladus* 4 R r (wet places). *F. anisophyllus* 1 + (flat, damp rock). *Weisia viridula* var. *gymnostoma* 1 a?, 2 a? (mostly sterile, may be some *Hymenostomum patulum*). *Barbula australasiae* 1 + (shaded rock). *Triquetrella papillata* 2 a. *Leptodontium interruptum* 2 a. *Tortella rubripes* 1 + (noted on A, C). *T. calycina* 2 o. *T. princeps* 1 + (on C). *Ptychomitrium australe,* 1 o, 2 o (shaded rocks down to spray zone. Previous N.Z. records—Mt. Torlesse, R. Brown; Tauranga, Berggren; Cape Colville, L.B.M. The last, like the Taranga one, a small form). *Grimmia pulvinata* var. *obtusata* 1 o. *Macromitrium* sp. (*prorepens* group 2 E +. *M.* nov. sp.? 1 o (as from similar habitat at Stony Bay, Cape Colville (L.B.M.) and Spirits' Bay (I. H. Millener). "I should think quite distinct from any N.Z. sp. and quite possibly new; but in absence of fruit must be left for present unnamed." H. N. Dixon). *Funaria hygrometrica* 4 +. *Bryum argenteum* 2 r. *B. dichotomum* 2 r. *B. truncorum* 1 o, 2 v a, 3 R +, 4 a. *B. campylothecium* 1 + (on C). A sterile, unidentifiable bryoid 1 f. *Leptostomum macrocarpum* 2 o, 3 E r. *Philonotis tenuis* 4 + (on T, damp rock and small slip). *Polytrichum juniperinum* 2 a. *P. commune* 2 r. *Cryphaea dilatata* 3 E + (on T). *Cyrtopus setosus* 4 E o. *Echinodium umbrosum* 3 R a. *E. hispidum* 3 R a. *Ptychomnion aciculare* 3 E o, 4 1 f. *Trachyloma planifolius* 3 R o. *Weymouthia cochlearifolia* 3 E +, 4 E o. *W. mollis* 2 E o. *Papillaria crocea* 2 E r. *Orthorrhynchium elegans* 4 E r. *Homalia falcifolia* 3 R r. *H. pulchella* 3 R f E +. *Thamnium pandum* 3 R o. *Camptochaete pulvinata* 3 R E a. *C. arbuscula* 3 R o. *C. ramulosa* 3 E +. *C. angustata* 4 E +. *Eriopus Brownii* 2 +, 3 R f. *Pterygophyllum dentatum* 3 R r. *Cyathophorum bulbosum* 2 o, 3 R E 1 a, 4 o. *Hypopterygium novae-seelandiae* var. *nudicaule* 3 R f. *Rhacopilum strumiferum* 3 R E f, 4 o. *Pseudoleskea imbricata* 4 R + (first record north of Mahia Peninsula, where it grows on edge of sea beach). *Thuidium furfurosum* 2 o–a, 3 E o, 4 o. *Acanthocladium extenuatum* E o. *Raphidostegium amoenum* 3 E f. *R. homomallum* 1 1 a, 3 E o (only near sea). *Brachythecium albicans* 1 + (has been considered as introduced, *e.g.*, at Palmerston North. Also collected at Tasman Glacier). *Eurhynchium muriculatum, Rhyncostegium tenuifolium* 2 o, 3 R a, 4 o. *Plagiothecium novae-seelandiae* 3 R + ("All I have from N.Z. are submontane," G.O.K.S.). *Catagonium politum* 3 R o. *Hypnum cupressiforme* Linn., 2 a, 3 o. *H. chrysogaster* C M, 3 E o.

Families 24, genera 47, species 65.
Epiphytes 23 spp.; 14 exclusively epiphytic, 9 also on rock or ground.
Rupestral 46 spp.; 33 exclusively rupestral, 13 also epiphytes or terrestrial.
Terrestrial 10 spp.; 2 exclusively terrestrial.

Pteridophyta and Spermatophyta.

1 = coastal rock and scrub, 2 = exposed interior rocks, 3 = climax coastal forest, 4 = *Leptospermum* forest, * = introduced.

Hymenophyllum rarum 3 r (on *Astelia* leaf-bases). *H. sanguinolentum* 3 R n, 4 R r. *H. dilatatum* 3 R r. *H. demissum* 3 r. *H. flabellatum* 2 r. *H. tunbridgense* 3 R r. *Trichomanes reniforme* 3 R o, 4 R o. *T. humile* 3 R 1 a. *Dicksonia squarrosa* 3 r. *Cyathea dealbata* 3 o, 4 o. *C. medullaris* 3 o. *Polystichum Richardi* 1 f, 2 o, 3 f–a, 4 o. *Dryopteris glabella* 3 +. *D. velutina* 3 1 f. *D. punctata* 3 +. *D. pennigera* 3 o. *Arthropteris tenella* 3 R o (also ascending trunks). *Asplenium adiantoides* 2 o, 4 o. *A. lucidum* 1 R a S o, 2 o, 3 f, 4 1 f (stouter above sea). *A. bulbiferum* 3 r. *A. flaccidum* 1 R o, 2 +, 3 R + E o. *A. lamprophyllum* Christ. 3 1 d, 4 v o. *Blechnum lanceolatum. B. capense* 1 S r, 4 v r. *B. filiforme* 3 R o, 4 R o. *B. membranaceum* 4 +. *Doodia media* 1 S o, 4 a. *Pellaea rotundifolia* 1 R o, 2 f. *Nothoclaena distans* 2 o. *Cheilanthes Sieberi* 1 R o, 2 f. *Hypolepis tenuifolia* 4 r. *Adiantum diaphanum* 3 o. *A. hispidulum* 2 o, 3 o. *A. affine* 3 r. *Pteris tremula* 4 r. *P. comans* 1 S 1 a, 3 1 f, 4 r. *P. macilenta* 3 o, 4 r. *Histiopteris incisa* 4 vr. *Pteridium esculentum* (Forst. f.) Ckn. 1 S la, 4 o. *Paesia scaberula* 4 vr. (on slip with *Typha*). *Polypodium dictyopteris* 3 R o. *P. pustulatum* 3 R f. *P. diversifolium* 1 S o, 2 a, 3 R r, 4 a. *Cyclophorus serpens* 1 R a, 2 a, 3 E o, 4 R o. *Lygodium articulatum* 4 r. *L. Billardieri* 2 o, 3 E o. *Agathis australis* 4 r (3 trees seen).

Typha angustifolia 4 vr. (on wet slip a few metres long). *Paspalum scrobiculatum* 1 1 (on C). *P. distichum* 1 1 a (on D, very luxuriant form). *P. dilatatum** 4 + (on C). *Oplismenus undulatifolius* 2 1 d, 3 vr, 4 o. *Microlaena avenacea* 3 vr. *M. polynoda* 2 1 a, 4 1. *Phalaris canariensis** 1 + (on A). *Anthoxanthum odoratum** 1 +, 4 +. *Stipa teretifolia* 1 R 1 d (on A, C, tolerates high bird concentration). *Echinopogon ovatus* 2 1 a. *Sporobolus capensis** Kunth. 1 R r. *Deyeuxia Forsteri* 1 R f. *D. Billardieri* 1 R f, 4 o. *Dichelachne crinita* 2 a, 4 R f. *Holcus lanatus** 4 r (on A, C). *Aira Caryophyllea** 1 R a–d, 2 a–d. *Trisetum antarcticum* 1 R r–a. *Danthonia semiannularis* 2 r–o, 4 o–a (a very robust form). *Arundo conspicua* 1 R r, S o, 4 1 f. *Briza minor** 4 +. *Dactylis glomerata** 4 la. *Poa anceps* 1 R f S f, 2 f, 3 +, 4 o–f. *Festuca Myuros** 1 R o, 2 a, 4 a. *F. bromoides** 1 R o, 2 o, 4 f. *Bromus arenarius* 1 R 1 a. *B. Gussonei** Parl. 1 R o, 2 1. *Agropyron multiflorum* 1 R la. *Pholiurus incurvatus** (L.) Hitchc. 1 R + (on A). *Mariscus ustulatus* 1 R 1, 4 r. *Scirpus cernuus* 1 R a. *S. nodosus* 1 R f. *Schoenus tendo* 4 + (T, seen in one locality). *Lepidosperma laterale* 4 + (T, seen in one locality). *Gahnia setifolia* 4 la. *G. lacera* 2 r, 4 la. *Uncinia australis* 4 +. *U. riparia* 4 +. *Carex virgata* (on C). *Leptocarpus simplex* 1 r (on A). *Rhopalostylis sapida* 3 la, 4 r. *Juncus polyanthemos. Rhipogonum scandens* 3 la, 4 +. *Cordyline Banksii* 4 o. *C. australis* 1 S r, 3 o, 4 ld. *Astelia Cunninghamii* 2 f, 4 a (rarely, if ever, epiphytic). *A. Banksii* 4 o. *A. trinervia* 4 +. *A. Solanderi* 1 R S o–f, 2 f–a, 3 E o, 4 va. *A. nana Carse* 2 r (female collected, in flower). *A. nervosa* 4 +. *Xeronema Callistemon* W. R. Oliv. 2 1 a (T, confined to walls of one valley). *Dianella intermedia* 2 o, 3 R o, 4 o. *Phormium tenax* 2 f, 4 o–f. *Arthropodium cirrhatum* 1 a, 2 a, 3 R o, 4 1. *Libertia ixioides. Dendrobium Cunninghamii* 2 E o. *Bulbophyllum pygmaeum* 4 E + (on A). *Earina mucronata* 2 o, 4 E o. *E. autumnalis* 2 r. *Sarcochilus adversus* 2 r, 3 E r. *Thelymitra longifolia* var. *alba* 1 o, 2 o, 3 R r. *Microtis unifolia* 1 S o, 2 o, 4 o. *Pterostylis Banksii* 3 R +, 4 +. *P. trullifolia* 2 +, 3 R +, 4 +. *Acianthus Sinclairii* 4 la.

*Salix babylonica** 4 + (on A). *Macropiper excelsum* 1 S a, 2 o, 3 a, 4 o (nearest to "var. *major*" where burrowing birds most abundant). *Peperomia Urvilleana* 2 o, 3 R o, 4 o. *Paratrophis microphylla* 4 r. *P. opaca* 1 S a, 3 1 a, 4 r (seedling and reversion shoots with deeply lobed leaves). *Urtica ferox* 4 R o. *Parietaria debilis* 1 S a, 2 1 a, 4 o. *Australina pusilla* 3 la. *Knightia excelsa* 3 f, 4 o–lf. *Rumex crispus** 1 s + (on A). *Muehlenbeckia complexa* 1 la, 2 la. *Rhagodia nutans* 1 la. *Salicornia australis* 1 o–la. *Pisonia brunoniana* 3 lf. *Mesembryanthemum australe* 1 R o, 2 r. *Tetragonia trigyna* 1 o. *Phytolacca octandra** (on D). *Spergularia media* 1 o. *Polycarpon tetraphyllum** 1 a, 2 a. *Stellaria parviflora* 1 o, 3 o. *Cerastium viscosum** 2 o. *Silene gallica** 4 +. *Scleranthus biflorus* 1 o, 2 la, 4 o. *Clematis indivisa* 1 S o, 4 a. *C. parviflora* var. 1 S o, 3 o, 4 a. *Ranunculus hirtus* 3 o. *Hedycarya arborea* 3 o, 4 o. *Laurelia novae-zealandiae* 3 + (one big tree in stream bed). *Beilschmiedia tarairi* 3 a–d, 4 o. *B. tawa* 3 o–f, 4 o. *Litsaea calicaris* 3 vr (on B, one tree). *Nasturtium* *stylosum* (dry shaded slopes). *Cardamine heterophylla* 3 o. *Lepidium oleraceum* 1 l. *L. ruderale** 1 +. *Brassica oleracea** 1 f. *B. campestris**. *Tillaea Sieberiana* 1 a, 2 a. *Pittosporum crassifolium* 1 S o–f, 3 o–f (at low levels). *P. umbellatum* 2 o. *P. cornifolium* 3 o. *Rubus australis* 3 a, 4 o. *Carmichaelia australis* 1 S o–f, 3 r, 4 o. *Edwardsia microphylla* 1 o, 2 a, 3 R 1 f, 4 o (prostrate on loose slopes of D). *Geranium molle**. *G. pilosum* 2 o. *G. dissectum* 2 o, 4 +. *Pelargonium inodorum* 2 o, 4 f. *Oxalis corniculata* 1 o, 4 f. *O. stricta* 1 o, 4 o. *Linum monogynum* 1 o. *Melicope ternata* 1 S la, 3 o, 4 o. *Dysoxylum spectabile* 1 S o, 3 a–ld, 4 o. *Euphorbia glauca* 1 o. *Coriaria ruscifolia* 1 S o, 4 o (on slip with *Typha*). *Corynocarpus laevigatus* 1 S la, 3 a, 4 o. *Alectryon excelsum* 3 r. *Dodonaea viscosa* 4 o. *Pomaderris phylicaefolia* 2 f, 4 R o. *Entelea arborescens* 1 S o–f, 3 f, 4 o (sometimes groves of saplings). *Hoheria populnea* 3 o–f, 4 o. *Melicytus ramiflorus* 1 S a, 3 a, 4 o. *Hymenanthera novae-zelandiae* va. 1 a–d, 2 o, 3 + (occasionally E). *Tetrapathaea tetrandra* 3 r. *Pimelea Urvilleana* 1 o, 2 o, 4 +. *Leptospermum scoparium* 2 o, 4 o–ld. *L. ericoides* 2 a, 4 d. *Metrosideros florida* 2 r. *M. diffusa* 3 R o, *M. excelsa* Sol. ex Gaertn. 1 a, 2 a–d, 3 o–ld, 4 o. *M. Scandens* 2 o, 3 R o. *Myrtus bullata* 4 o. *Epilobium nummularifolium* 4 + (T, on slip with *Typha*). *E. junceum* 4 +. *Fuchsia excorticata* 3 o. *Haloragis erecta* 1 o, 2 o. *H. depressa* 3 f. *Myriophyllum* sp. 4 + (T, in pit). *Nothopanax arboreum* 2 o, 3 f, 4 o–la. *Meryta Sinclairii* 3 la (rarely above 100 m., on T, A, B, C, D). *Schefflera digitata* 3 o. *Pseudopanax Lessonii* 1 S f, 2 o, 3 o, 4 o. *Hydrocotyle elongata* 3 o, 4 la. *Apium prostratum* 1 a. *Caucalis daucoides** 1 + (one stunted plant seen). *Angelica rosaefolia* 1 la, 2 o (2 m. tall on C). *Griselinia lucida* 2 f. *Leucopogon fasciculatus* 4 o. *L. Fraseri* 4 ld (on C, over small burnt areas). *Suttonia salicina* 4 + (one seen on T, girth 64.5 cm.). *S. australis* 1 S o, 2 o–f, 3 o, 4 la. *Samolus repens* 1 o. *Anagallis arvensis** 1 o, 4 +. *Sideroxylon novo-zelandicum* 1 S la, 3 f–la (seedlings abundant in forest). *Olea apetala* 1 S o, 3 la, 4 r (la. on ridges, short-trunked, spreading, 4–5 m. tall). *Geniostoma ligustrifolium* 1 S o, 3 1 f, 4 f. *Erythraea centaurium** 2 o, 4 o. *Parsonsia heterophylla* 1 S o, 3 o, 4 o. *P. capsularis* 3 +. *Calystegia sepium* 1 S o. *C. tuguriorum* 1 S a. *C. soldanella* (on D, very lax). *Dichondra repens* 1 o–a, 3 o, 4 o. *Vitex lucens* 3 la, 4 o. *Solanum nigrum* 2 o, 3 o, 4 o. *S. aviculare* 1 o (white and blue-flowered forms, leaves pinnatifid). *Hebe Bollonsii* 1 S 1. *H. salicifolia* 4 la. *H. parviflora* 1 S o–a, 2 o, 3 o, 4 o–l d (up to 9 m. tall in forest). *Orobanche minor** (T, C, on *Apium*). *Rhabdothamnus Solanderi* 3 a, 4 r (leaves 1.6 by 1 cm. to 9.5 by 8 cm.). *Myoporum laetum* 1 S r–o (prostrate and thick-leaved on C, D). *Plantago Raoulii* 1 +. *P. major** 1 o. *Coprosma macrocarpa* 1 f, 2 o, 3 o, 4 o. *C. grandifolia* 3 o, 4 f–ld. *C. lucida* 2 o, 4 o. *C. retusa* Hook. f. 1 a. *C. robusta* 1 S o, 2 o, 3 o, 4 o. *C. rhamnoides* 2 r, 4 la. *C. gracilis* A. Cunn. 4 +. *C. tenuicaulis?* (on T). *Alseuosmia* sp. 4 r. *Sicyos angulata* 1 S la. *Lobelia anceps* 1 f, 4 o. *Wahlenbergia gracilis* 1 o–f, 2 o. *Lagenophora pumila* 4 o. *Olearia furfuracea* 1 o, 4 o–f. *O. albida* 4 o. *Gnaphalium luteo-album* 4 R o. *G. japonicum* 2 o. *G. collinum* 4 R o. *G. purpureum** 4 +. *Helichrysum glomeratum* 1 +, 4 + (on A, B). *Bidens pilosa** 1 o, 2 la. *Erechtites scaberula* 4 o. *E. arguta* 4 o. *E. quadridentata* 4 f. *Brachyglottis repanda* 1 S o, 3 o, 4 la. *Senecio lautus* 1 a, 2 a. *S. Kirkii* 2 a, 4 o (broad-leaved form). *Picris hieracioides* 1 o, 2 la, 4 o–a. *Sonchus asper* 1 o. *S. oleraceus** 1 o, 2 o, 4 o. *Crepis capillaris** Wallv. 4 +. *Erigeron canadense** 2 o, 4 o. *Aster subulatus** 4 r. *Hypochaeris radicata** 1 o–f, 2 la, 4 o–a. *Carduus pycnocephalus** 2 la, 4 o. *Cnicus lanceolatus** 4 vr.

The 227 indigenous species include 46 pteridophyta (families 5, genera 23), 1 gymnosperm, 54 monocotyledons (families 9, genera 40), 126 dicotyledons (families 59, genera 92). The 36 introduced species are not abundant, and rarely penetrate unmodified areas. They include 12 grasses and 9 composites, while 28 have very light seeds.

Phytolacca octandra excepted, succulent-fruited weeds are conspicuously absent. Man's influence, apart from the introduction of *Salix* and a few weeds living for a time round camp-sites, has been greatest in recent years in the wanton burning of large areas.

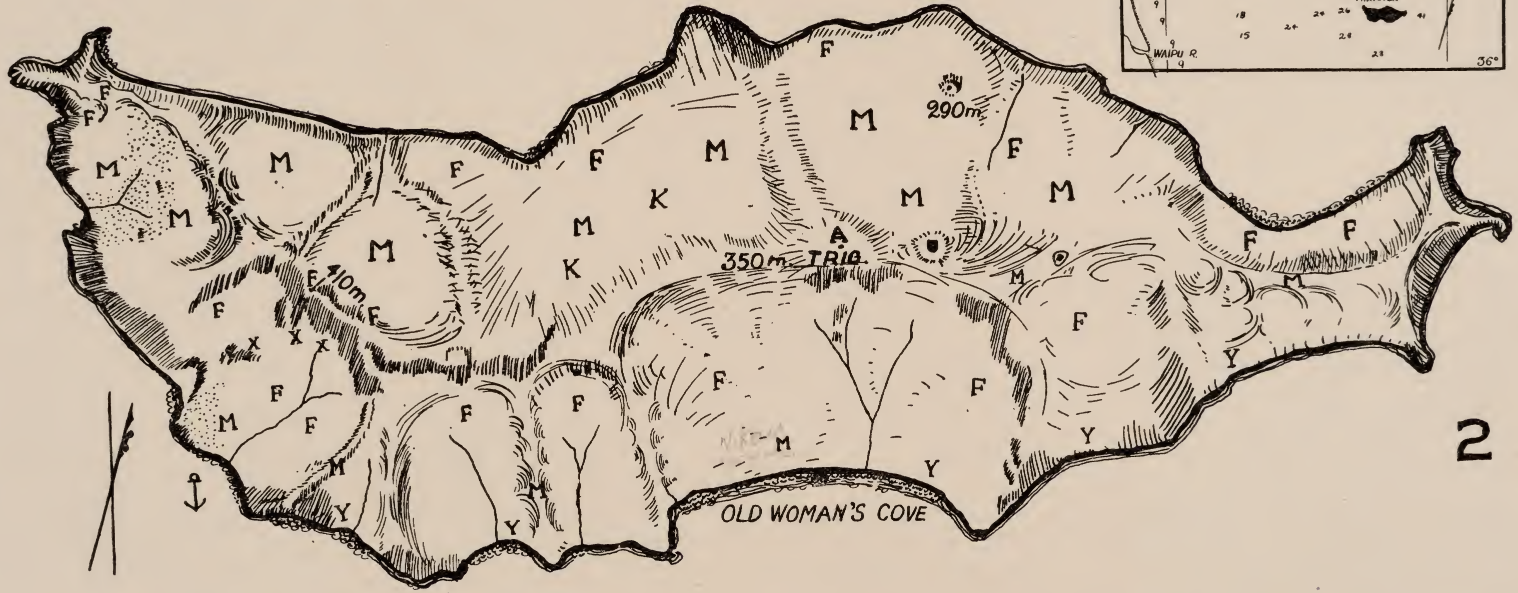

Fig. 1. Sketch showing position of Hen and Chickens Islands, from Chart No. 2543. *Taranga* = 1175 ac. (c. 476 hectares), A = 338 ac. (c. 136 h.), B = 168 ac. (68 h.), C = 49 ac. (c. 20 h), D = 7 ac. (c. 2.8 h.), E (not visited) = 77 ac. (c. 31 h.). Soundings in fathoms.

Fig. 2. Sketch map of Taranga, showing extent of modification. M = modified areas (*Leptospermum* usually dominant); F = coastal forest; K = *Agathis australis;* Y = groves of *Meryta Sinclairii;* X = *Xeronema Callistemon.*

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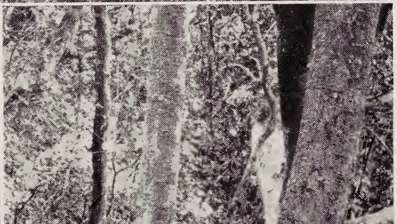

Fig. 1. View of topmost peaks (c. 400 m.) and coastal forest from western landing.

Fig. 2. *Agathis australis* on Taranga.

Fig. 3. Interior of *Beilschmiedia* forest on Taranga with typical floor-cover of *Asplenium lamprophyllum.* Light trunks are *B. tarairi* and dark ones *B. tawa.*

Notes on Penguins of the Genera *Megadyptes* and *Eudyptes* in Southern New Zealand.

By R. A. FALLA, M.A., Ornithologist.

In examining a collection of birds from Stewart Island and South-west Otago it was found that one or two additions and corrections could be made to the existing literature of the penguins of that region. Comparative study of specimens in the Otago, Canterbury and Dominion Museums has been made by courtesy of Dr. W. B. Benham, Professor R. Speight, and Dr. W. R. B. Oliver. The field observations recorded were made during a visit to Stewart Island in October and November, 1934, as guest of Captain G. M. Turner, and a subsequent visit to the West Coast Sounds in the N.Z.G.S. "Matai," by courtesy of the Hon. Minister for Marine.

Megadyptes antipodes (H. & J.).

Material examined: Skins and eggs in the Auckland Museum.

No.	Sex.	Locality.	Date.	Flipper.	Tail.	Tarsus.	Toe.	Culmen.
A.M. 120.1	♂	Stewart I.		200	50	33	79	59 mm.
120.2	♂ imm.	Stewart I.		205	62	32	83	56 mm.
120.3	—	Stewart I.		210	55	30	81	56 mm.
120.7	♀	Stewart I.	28/10/34	200	58	34	83	54 mm.
120.8	♀	Stewart I.	20/2/35	195	63	35	77	54 mm.
120.9	immat.	Stewart I.	20/2/35	194	65	31	85	53 mm.
120.5	chick	Stewart I.	12/12/32					

The uniformity of size in birds from Stewart Island is indicated above and confirmed by the examination of a large series in the Dominion Museum from the same locality, but without other data. Apparently the bill in males is slightly longer than in females. Adult birds show no variation in plumage except for the occurrence of a few white feathers in the upper tail coverts of some, a feature that occurs in several other species. In the flesh the feet are fleshy white and the iris honey yellow (Ridgway's Standards). The bill colouration is correctly depicted by Wilson (1907, pl. XI.), but the plumage pattern of the crown of the adult and appearance of the eye in life are better indicated by the accompanying photograph of an adult bird at Stewart Island. (Pl. 74, fig. 2.)

The full egg clutch is invariably two, of about equal size, and generally not much variation is shown in a series from one locality. The following measurements are from specimens in the Auckland Museum:—

Clutch No.	Locality.	Date.	Size.
1	Stewart Island	27th October, 1934	(a) 76 x 55 mm.
			(b) 75 x 55.5 mm.
2	Stewart Island	October, 1911	(a) 74 x 55.5 mm.
			(b) 75 x 55.5 mm.
3	Stewart Island	October, 1911	(a) 74.5 x 55.5 mm.
			(b) 76 x 56.5 mm.
4	Stewart Island	1st November, 1911	(a) 75.5 x 51 mm.
			(b) 80 x 50 mm.

The smaller, narrower eggs of clutch number 4 show irregularities of shell texture that suggest abnormality. The earliest laying date recorded is 22nd September, noted by Guthrie-Smith (1914, p. 61). This accords with the advanced stage of incubation of eggs found by us on 27th October, 1934, near Half Moon Bay, where subsequently Mr. R. H. Traill found eggs hatching on 6th November. A period of incubation of six weeks or longer seems to be indicated.

Nestling plumages have not been described. A well-grown chick in secondary down was collected at Stewart Island by Mr. E. F. Stead on 12th December, 1932. The bird weighed 2 lbs. 12 ozs. in the flesh, and was 43 cms. long from bill to tail. Bill pinkish brown, iris yellowish hazel, feet fleshy white above and black below. The entire coat of down is hair-brown in colour, slightly longer on the back, but generally short, dense and furry. In appearance and texture it is not unlike that of a half-grown chick of *Aptenodytes patagonica.*

The first teleoptyle plumage has been somewhat briefly described by authors. It is represented in the above series by No. 120.9, a bird taken in March, shortly after losing its down. Its dimensions are practically those of an adult bird, and the colours of the soft parts were only slightly duller than adult colouration. Its weight was 9 lbs. The plumage of the coronal area is interesting. In the adult this area consists of elongated feathers which are straw yellow with broad black shaft lines, the area being bounded posteriorly by the band of clear yellow feathers. In the first plumage the black-shafted pale yellow feathers occur only in the superciliary region, running from the nasal angle of the bill above and behind the eye. The central feathers of the crown are the same colour as the back, bluish with black shafts, and the continuity of this colour is not broken by any band behind the crown. The white of the breast plumage continues unbroken along the mid-line of throat and chin. The white strip leading from the breast on to the fore-edge of the flipper is slightly interrupted by a few small dark feathers which are not present in adults. The pale yellow tinge about the gape and the golden brown cheek of the adult plumage are present also in the first plumage.

Distribution and Habits:—The northern limit of the breeding range of the yellow-eyed penguin is the south side of Otago Peninsula, where there are still small colonies. The birds also nest in suitable localities at and about Nugget Point. On the east coast of Stewart Island and the "mutton bird" archipelago off Half Moon Bay this is an abundant species. Nests are usually to be found in the fringe of forest or scrub that runs down to stretches of coast that front the open sea and yet are not exposed to prevailing wind and sea. Under such conditions we found them along the ocean beach at The Neck, on the north side of the entrance to Paterson Inlet, and at Bench Island and Bunker's Island. On the west coast some were nesting on the more sheltered and less precipitous sides of the two Ernest Islands, south of Mason's Bay, while Mr. E. F. Stead has found them at the South Cape Islands, and also at Codfish Island. These nesting groups are in no strict sense of the term "colonies," but are due to suitable nesting conditions in one area being available for more than one pair. Otherwise the pairs are entirely independent and solitary, and in some places only one pair seem to be established.

It has been stated by Guthrie-Smith (1914, p. 59) that the birds "avoid stretches of soft sand and shingle as particularly irksome to a bird whose method of progression is by hopping." While this may be true of the birds' preferences it is somewhat misleading. At Ocean Beach, on the seaward side of "the Neck," we saw fifteen pairs of tracks crossing fifty yards of sandy beach and two lines of dunes before the bush was reached, and frequently watched the birds crossing the area with a rapid waddling walk. As compared with the various rock-hopping *Eudyptes, Megadyptes* is quite a good "walker" after the fashion of *Pygoscelis papua* and *Aptenodytes patagonica.*

About a dozen nests were examined, and all contained the uniform pairs of much discoloured eggs. Situations varied from the hollows between the buttresses of rata trunks to places in the undergrowth shaded only by *Blechnum* fern (Pl. 74, fig. 1). Both sexes were found sitting, with the partner often standing in the scrub near by. The sitting birds were invariably in the recumbent position shown in Plate 74, fig. 1. There would seem to be little mortality during nesting, and both chicks are usually reared. The moult of adults begins in March, when the young have already taken to the sea and begun to feed themselves. An adult ready to moult (March, 1935) weighed 14 lbs.

Mr. John Wesley, of Half Moon Bay, assures me that this bird is known to Stewart Island natives as "Tawaki," which may therefore be a generic name for the larger penguins, as it is applied also to *Eudyptes pachyrhynchus.*

Eudyptes pachyrhynchus pachyrhynchus Gray.

Material examined:—Skins, eggs and skeletons in the Auckland, Canterbury and Dominion Museums.

No.	Sex.	Locality.	Date.	Flipper.	Tail.	Tarsus.	Toe.	Cul-men.	Depth of Bill.
A.M. 122.1	♂	Otago Peninsula	—	179	—	27	77	54	(23)
122.15	♀	Puysegur Point	13/11/34	185	—	28	68	45	(21)
122.16	♀	Puysegur Point	13/11/34	183	73	29	69	47	(20.5)
122.17	♀	Puysegur Point	13/11/34	180	69	26	70	49	(22)
122.18	♀	George Sound	21/11/34	180	66	27	67	51	(22)
122.20	Skel.	Mason's Bay, Stewart Is.	—					44	(22)
122.14	♂ imm.	Karekare, N.Z.	16/10/30	190	85	24	80	55	(23)
C.M. 1029.5	♀	Otago	1892	180	—	30	64	49	(23)
A.M. 122.3	Chick	Dusky Sound	Sept., 1884						

The variation in size, especially of the bill in this species, has been remarked upon by various authors. It is probably not so great as indicated by Buller (1905, p. 89), for he included specimens from Snares, which are here regarded, for reasons given below, as a separable race. The specimens described above from Puysegur Point and George Sound are unfortunately all females, but it will be noted that two males, including a young one, from other localities have larger bills. From observation of mated pairs at Puysegur Point it would seem that this is generally the case. The colours of the soft parts are correctly given by Buller (1888, p. 287). The iris, which he describes as "brick-red," is in fact the "mineral red" of Ridgway's Standards. The superciliary yellow crests are not entirely drooping in life (Pl. 75, fig. 1). The upper feathers project straight behind and the lower ones droop away somewhat as in *E. cristatus.* This arrangement is evidently controlled by muscles, for it is usually not apparent in preserved skins. The pale patches sometimes seen on the cheeks and throats of adults are simply due to a disturbance of the feathers, showing their white bases. The white bases of throat feathers in this species serve as a useful additional means of distinguishing it from *E. sclateri* and *E. cristatus,* in which the bases of the feathers are grey. The progress to maturity has been described by Sutherland (1923, pp. 35-38), but as he mentions colour change without reference to the nature of the plumage—whether primary or secondary down—the description of the downy plumages is somewhat obscure. A chick in the Auckland Museum, collected by Reischek in September, 1884, at Dusky Sound is faded but has the colour pattern shown in Sutherland's plate (1920, p. 77) of a ten-day old chick.

No. 122.14 (Pl. 75, fig. 2), a young male about a year old, was picked up on 16th October, 1930, on a North Island beach about seven hundred miles north of the nearest known breeding colony.

It was in good condition, but thin, and had only a few cephalopod beaks in the stomach. The feathers of forehead and crown are edged with blue grey and not elongate and black, as in the adult. The incipient yellow crests are visible for their entire length, projecting slightly behind, but ill defined, as most of the yellow feathers are tipped with black. Iris brown, bill reddish brown, feet flesh pink above, black on outer edge of webs and beneath.

Distribution and Habits:—The crested penguin was abundant around the coast from Preservation Inlet to Martin's Bay in November, 1934. Nesting colonies were found at Sealers' Bay, Puysegur Point, Coal Island (all in Preservation Inlet region), Dusky Sound, George Sound, and at Anita Bay and Harrison Cove in Milford Sound. At night the braying and squealing of birds ashore could be heard at all the anchorages, and schools of twenty and thirty birds were frequently seen "porpoising" offshore by day. It is difficult to form an estimate of the penguin population or the size of colonies owing to the peculiar situations of the nests. Accessible cave colonies have been found by resident observers, but all the colonies we came across were inaccessible, and the young could only have been caught by a dog. Some were under the large boulders piled up along the shore, but many nesting birds had travelled inland up the wooded gullies to a distance of half a mile and were nesting in tunnels and cavities underground. These subterranean tunnels were formed partly by the spreading roots of trees, and had been enlarged by traffic and burrowing. Many were moist and muddy. Here and there young birds, well-grown but still in down, were seen standing at the entrances, but they always avoided capture by retreating out of reach. Adults coming to and from the sea were met with on the well worn tracks throughout the day. A pair of adults observed on the foreshore at Puysegur Point on 13th November were engaged in ablutions, standing in ten inches of water in a rock pool and, with feathers raised, rinsing themselves thoroughly. The well-known biting sandflies *(Simuliidae)* of these regions are a source of great annoyance to the birds, and their attacks, which are made only in sunshine, prevent the birds from standing about in the open. The prevalence of these insects in the Sounds region is probably one of the causes of the subterranean nesting of the penguins there.

The nesting season had evidently begun, as recorded by Reischek and Sutherland, in July, and the young that we saw would be ready to take to the water by early December. Sutherland (1920, p. 77) records a second laying in December in a cave colony in which nesting began in July. It remains to be determined, however, whether the same individual adults nest twice in a season. The November adults seen by us were beginning to look the worse for wear, and Sutherland remarks on the "grand condition" of the birds found sitting on 13th December, so that they were possibly a late breeding section.

Eudyptes pachyrhynchus atratus Hutton.

Material examined:—One adult skin in the collection of the Canterbury Museum, of which the particulars are:—

C.M. 1029.6 ♀, Snares Islands, 1892, Buller Collection. Dimensions: Flipper 220, tail 90, tarsus 36, middle toe and claw 64, bill length 63, depth closed bill 30 mm. It has been customary to include the crested penguin inhabiting the Snares in the category of *Eudyptes pachyrhynchus* Gray, but a consideration of the marked differences in habits suggested that a critical examination of specimens would disclose some characters separating it from the typical mainland form. From examination of the only localised specimen available, described above, the Snares Island bird appears to be of greater dimensions, especially in the size of the bill. The difference is admirably shown in Buller's plate (1905, p. 89) of two adult females which he used to demonstrate the supposed variation of bill size in the species. The upper figure appears to be of the identical specimen, now in the Canterbury Museum, described above. Although other specimens from the Snares are not available, the many published photographs of the rookeries there show the thick, heavy bill to be a constant character. The specific name *atratus* has been applied by Hutton (1875, p. 114) to a melanistic specimen from the Snares, and is now available for the race from those islands. Although the type has been lost (Oliver, 1930, p. 73), there is little doubt that the bird belonged to the form of *E. pachyrhynchus* breeding there. The possibility of Hutton's bird having been a stray *E. schlegeli* has been considered, but ruled out, as the figure (Buller, 1888, vol. II., pl. XLVI.) shows the crest to be of the *pachyrhynchus* form. Hutton, in the original description, remarks on the large size of the bill. A skeleton picked up at Mason's Bay, Stewart Island, in November, 1934, is possibly referable to this form. The bill dimensions are length 57 mm., depth when closed 29 mm.

Eggs from the Snares show a considerable range of variation in size and shape, but all those available have been collected in a haphazard way and are not of much record value. Particulars of three are:—

1. 9th October, 1906. 77 x 55.5 (G. Buddle Collection, Auck. Mus.).
2. No date. 72.5 x 55.5 (G. Buddle Collection, Auck. Mus.).
3. September, 1886. 66.5 x 54 (J. C. McLean Collection, Auck. Mus.).

As usual in penguins' eggs, the variation in diameter is much less than that of the axis, due probably to the uniformity of the oviduct in any species. The eggs in the G. Buddle collection are marked as having been "clutch of one," but photographs of rookeries show two eggs in some nests.

Habits:—Two respects in which the Snares crested penguin appears to differ from the mainland form are in situation of nests, and date of breeding. Regarding the former, all observers' accounts and their photographs indicate the formation of large colonies of birds in the open, in clearings amongst the scrub. This is in contrast with the subterranean habits of the mainland bird. The breeding season is fully a month later at the Snares. Oliver (1930, p. 74) quotes Captain Bollons as stating that the birds commence laying in September, and there is a September egg in the above series. E. R. Waite (in the "Weekly Press" of 27th February, 1907) states that on 31st January, 1907, at the Snares, the parent birds were tending their young ones, which were then losing their down. These young would therefore be fully feathered in February, and the old birds would moult in March, as they have been reported to do by Archey (1923, p. 119).

Eudyptes sclateri Buller.

Although not known to breed nearer than Antipodes and Bounty Islands, birds of this species are washed ashore on New Zealand beaches much more frequently than has been recorded. The Otago, Canterbury and Dominion Museums all possess series obtained from the beaches adjacent to Dunedin, Christchurch and Wellington, and all obtained over a period of years during the months of May, June and July. As these are the months during which the birds are absent from their breeding stations, it seems likely that *E. sclateri* spends the winter at sea in the coastal waters of New Zealand to the north of its breeding grounds.

In discussing the features distinguishing this species from *E. pachyrhynchus,* Ogilvie-Grant (1898, p. 641) considers the form of the bill to be a more reliable character than the position of the yellow eyebrow-stripe. Buller (1905, p. 89) takes the opposite view that the crest is constant and the bill varies. The series examined by the writer show both tendencies. The eyebrow stripe in some *E. sclateri* is continued indistinctly towards the nasal opening, and the culminicorn in some *E. pachyrhynchus,* viewed from above, tends to the parallel pattern of *E. sclateri.* There is, however, no evidence of intergradation in the series examined, and the species are undoubtedly distinct. The fact that the bases of the throat feathers are pure white in *E. pachyrhynchus* and grey to blackish in *E. sclateri* is another good character. *E. sclateri* has been described (Oliver, 1930, p. 75) as a larger species than *E. pachyrhynchus.* Although slightly larger than the mainland form of that species, it does not usually equal the dimensions of the Snares form.

Odd black feathers occur in the breast plumage of two of the series of *E. sclateri,* and Miss D. Hancock, of Dunedin, has shown me photographs of a melanistic individual which wandered ashore at St. Kilda Beach in the winter of 1934. The bird appears to be entirely black except for the crest, which is normal. Melanism has now been recorded in all the species of crested penguins *(Eudyptes* and *Catadyptes)* endemic in the New Zealand region.

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1

2

Fig. 1. *Megadyptes antipodes* on nest amongst forest undergrowth.

Fig. 2. Head of *Megadyptes antipodes*, adult, from life.

1

2

Fig. 1. *Eudyptes pachyrhynchus pachyrhynchus*, adult male, Puysegur Point.

Fig. 2. Head of *Eudyptes pachyrhynchus*, immature (Auckland Museum, No. 122.14).

Tertiary Mollusca from Motutara, West Coast, Auckland.

By A. W. B. POWELL, Conchologist and Palaeontologist.

The material described in this paper is from sparsely fossiliferous tuffs which occur underlying pillow-lavas in the coastal cliffs at Motutara,* between Muriwai and Te Henga, West Coast, Auckland.

The following extract from a paper‡ by Professor J. A. Bartrum describes the manner of occurrence of these fossils:—

"A little south of the beginning of the beach, the sea-cliffs exhibit remarkable columnar structures in andesitic lavas of mid-Tertiary age, which occur sporadically in a large mass of andesitic material which builds the coastal range of hills between Muriwai and the entrance of Manukau Harbour, 16 miles south. At Muriwai itself this andesitic mass consists largely of fine-textured ejecta, including important sheets of lava . . . . in some places they include marine fossils in tuffaceous debris between the pillows, whilst they rest on tuffs with similar fossils. The seas into which they were poured, however, were very shallow, for large-scale examples of contemporaneous erosion in the subjacent tuffs are common."

The fauna is a meagre one, only 30 species being listed, and of this number five are too imperfect for specific determination. Further, the matrix is so hard that weathering is slow and on this account there is little hope of much further material becoming available in the near future, particularly as it has taken over ten years of systematic hunting, representing some hundreds of visits to make the small collection here described.

Many of the species are represented by single specimens, the following being the only ones that occur at all commonly: *Thyasira bartrumi* n.sp., *Bathytoma mitchelsoni* n.sp., *Vaginella* cf. *torpedo Marshall* and *Lornia marwicki* n.sp.

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*Motutara is the name used for the coastal district between Muriwai Beach and Te Henga or Bethel's Beach.

‡Pillow lavas and columnar fan-structures at Muriwai, Auckland, New Zealand. Journ. of Geol. (U.S.A.) Vol. 38, no. 5, pp. 447-455, 1930.

With such a small and peculiarly assorted fauna and an unusual lithological facies, correlation is difficult, but what little evidence there is points fairly definitely to the Awamoan (Lower Miocene). Unfortunately only two species in the Motutara list occur at the type locality for the Awamoan, but three others (*Euspinacassis multinodosa* Powell, 1928, *Parvamussium zitteli* (Hutton, 1873) and *Hipponix centrifugalis* (Marwick, 1931) were recorded from the Tutamoe Series (= Awamoan Stage) of Gisborne District by Marwick (1931, N.Z. Geol. Surv. Pal. Bul. No. 13, pp. 8, 19 and 22). Another, *Astele boileaui* Marwick 1931 (l.c. p. 87) was described from the Ormond Series (=Taranakian Upper Miocene) (l.c. p. 8) and several others such as *Lornia marwicki* n.sp. and *Risellopsis prisca* n.sp., although related to species from stages lower than the Awamoan, are not specifically identical and could be very well the Awamoan evolutionary development from the earlier species.

Although these Motutara tuffs are here referred to the Awamoan, the writer still considers the basal Waitemata beds (Waiheke Island, Kawau Island and Cape Rodney) to be older, equalling the Hutchinsonian. Exact correlation is impossible, however, as molluscan fossils scarcely occur at the typical Hutchinsonian locality. Nevertheless the assemblage of species in the Waitemata beds seems definitely to be older than that of the Motutara tuffs.

The material was collected from the following five localities:

A. Sea cliffs about ½ mile south from Muriwai Beach, in large fallen blocks of tuff, from beneath a band of conglomerate 10 to 15 feet in thickness. A.1 is the conglomerate.

B. Sea cliffs about ¾ mile south from Muriwai Beach, from tuffs forming tidal platform and cliff, underlying pillow-lava at the entrance to a large cave, which has a boulder beach north of it and a small sandy beach to the south.

C. About 1¼ miles south from Muriwai Beach, from tuffs forming tidal platform and cliff, situated between two small sandy beaches, each with a waterfall.

D. Cliffs of tuffs about 1½ miles south from Muriwai Beach, just beyond second waterfall and before reaching gap which prevents further progress south at tide level.

E. Cliffs at beach level between last locality and Te Henga (access from nearer Te Henga), opposite a detached mass about 30 feet in height, which is separated from the shore except at low spring tides.

List of Species.

(Letters A—E indicate localities listed above.)

PHYLUM MOLLUSCA.

CLASS PELECYPODA.

	Localities
Nuculana (Saccella) motutaraensis Powell n. sp.	(A)
Glycymeris (Grandaxinea) monsadusta Marwick 1932	(A.1)
Parvamussium zitteli (Hutton 1873)	(A)
Myrtea maoria Powell n. sp.	(C)
Myrtea (Lucinoma) taylori Powell n. sp.	(A & B)
Pteromyrtea motutaraensis Powell n. sp.	(A)
Lima cf. *colorata* (Hutton 1873) (juvenile)	(A.1)
Ostrea (Crenostrea) wuellerstorfi Zittel 1864	(A.1)
Chama sp. (indeterminable)	(A.1)
Thyasira (Prothyasira) motutaraensis Powell n. sp.	(C)
Thyasira (Prothyasira) bartrumi Powell n. sp.	(C)
Ascitellina protensa Powell n. sp.	(A & B)
Nemocardium cf. *patulum* (Hutton 1873)	(C)

CLASS GASTEROPODA.

Astele boileaui Marwick 1931	(C)
Calliotropis motutaraensis Powell n. sp.	(A)
Risellopsis prisca Powell n. sp.	(A)
Hipponix centrifugalis Marwick 1931	(A)
Polinices motutaraensis Powell n. sp.	(A)
Uberella marwicki Powell n. sp.	(A)
**Euspinacassis multinodosa* Powell 1928	(C)
**Euspinacassis toreuma* (Powell 1928)	(C)
Falsicolus gemmatus Powell n. sp.	(C)
Marshallena carinaria Powell n. sp.	(C)
Bathytoma mitchelsoni Powell n. sp.	(C)
Gemula sp. possibly *orba* Marwick 1931 (material fragmentary)	(C)
Comitas fusiformis (Hutton 1873)	(C)
"*Turris*" *finlayi* Powell n. sp.	(C)
Conus sp. (indeterminable)	(A.1)
Cylichnania bartrumi Marwick 1931	(A)
Ringicula marwicki Powell n. sp.	(E)
Vaginella cf. *torpedo* Marshall 1918	(D & E)
Lornia marwicki Powell n. sp.	(B)

CLASS SCAPHOPODA.

Dentalium n. sp.	(A)
Cadulus n. sp.	(C)

Of the 34 species listed all are now extinct.

ACKNOWLEDGMENTS.

The writer is much indebted to Dr. H. J. Finlay, Dr. J. Marwick and Dr. C. R. Laws for certain identifications, as well as the loan of type specimens.

*Trans. N.Z. Inst., Vol. 59, pp. 634 and 636.

NUCULANIDAE.

Genus NUCULANA Link 1807.

Subgenus SACCELLA Woodring 1925.

Type (original designation): LEDA COMMUTATA Philippi.

Nuculana (Saccella) motutaraensis n. sp. Pl. 76, fig. 1.

Shell of moderate size, elongate-oval, narrowed posteriorly to a blunt upturned rostrum, beaks prominent, broadly rounded, situated a little in front of the middle. Anterior end broadly and regularly rounded. Posterior end concave along the dorsal margin, and gently upcurved basally to a blunt rounded rostrum which is tilted upwards slightly at the tip. Posterior area broad, concave, bounded by a slight ridge which bifurcates; the stronger arm running from the beak to the upper extremity of the rostrum and the weaker to a slight angulation between the lower extremity of the rostrum and the basal margin. Sculpture of strong, regular, well-spaced, concentric ridges, five per millimetre. The concentric ridges become obsolete over the posterior area proper, the lower ridge of the rostrum being crossed by the normal sculpture.

Height, 6 mm.; length, 9.5 mm.; thickness (one valve), 2 mm. (holotype).

Locality: Motutara (A).

Holotype in writer's collection, Auckland Museum.

In the somewhat upcurved beak, this species resembles Marwick's *N. (Saccella) waikohuensis* (1931, N.Z. Geol. Surv. Pal. Bull. No. 13, p. 50) but otherwise it has the proportions of the *bellula* series, yet is distinctive in outline and sculpture from those so far described.

CODAKIIDAE.

Genus MYRTEA Turton 1822.

Type (by monotypy): VENUS SPINIFERA Montagu.

Myrtea maoria n. sp. Pl. 76, fig. 2.

Shell fairly large, oval, almost equilateral, moderately inflated. Beaks low, rather small. Lunule and escutcheon long, narrow, slightly depressed and bordered by a thin ridge which is rendered somewhat serrate by the surmounting and termination of the concentric sculpture. The concentric sculpture is in the form of prominent widely spaced slightly lamellose, rounded upcurved ridges, about four in five millimetres over the lower half of the shell. The interstices are smooth except for occasional faint concentric growth lines, and radial sculpture is entirely absent. Anterior and posterior dorsal areas depressed, causing the traversing concentric ridges to cant a little and to appear slightly flatter and broader as they approach the dorsal edge.

Length (estimated) 23 mm.; height, 20 mm.; thickness (one valve), 4 mm. (holotype).

Locality: Motutara (C).

Holotype in writer's collection, Auckland Museum.

The simple, spaced, lamellate concentric ridges without radial sculpture and moderately large shell are features more in accord with the European *Myrtea* than with the Australasian *Notomyrtea* series which have radial as well as concentric sculpture.

Subgenus Lucinoma Dall 1901.

Type (original designation): Lucina filosa Stimpson.

Myrtea (Lucinoma) taylori n. sp. Pl. 76, fig. 3.

Shell of moderate size, suborbicular, sculptured with regularly disposed fine, sharp, concentric riblets, the interspaces each having four or five considerably finer and somewhat irregular concentric growth lines. The concentric riblets are a little less than one millimetre apart over the lower part of the shell. There is no radial sculpture, and the typical lucinoid anterior and posterior radial sulci are only just visible, mainly owing to a very slight reduction in strength of the concentric sculpture above the posterior sulcus in particular. There is a moderate-sized lanceolate pseudo-lunule, situated immediately in front of the beaks and a longer lanceolate ligamental groove posterior to the beaks. Interior of shell not accessible in any of the specimens.

Height, 30 mm.; width, 32.5 mm.; thickness (both valves), 15 mm. (holotype).

Locality: Motutara (A and B).

Holotype in writer's collection, Auckland Museum.

This species has a very striking resemblance to the North European *M. (Lucinoma) borealis* (Linn.). The European species, however, has the concentric riblets slightly more numerous and closely spaced, and the anterior and posterior radial sulci almost completely obsolete, otherwise the two are remarkably similar.

Genus Pteromyrtea Finlay 1926.

Type (original designation): Cyclina dispar Hutton.

Pteromyrtea motutaraensis n. sp. Pl. 76, fig. 4.

Shell of moderate size, ovate, longer than high, somewhat inflated, rather thin. Beaks central. Lunule narrowly lanceolate. Anterior wing long and clearly marked off by a groove. Sculpture consisting of extremely fine regular concentric threads, about five per millimetre. Valve margins smooth. Hinge typical, as shown by a paratype.

Height, 17 mm.; length, 21 mm. (holotype).

Locality: Motutara (A).

Holotype in writer's collection, Auckland Museum.

This species is much more oval in outline than any of the described species.

THYASIRIDAE.

Genus THYASIRA Lamarck 1818.

Subgenus PROTHYASIRA Iredale 1930.

Type (original designation): P. PERONIANA Iredale.

Thyasira (Prothyasira) motutaraensis n. sp. Pl. 76, fig. 7.

Shell small, triangulate, higher than wide, equivalve, moderately inflated and almost equilateral. Beaks about central, small, directed forwards and incurved at tips. Anterior end sharply descending, slightly concave, with a moderately long shallowly excavated lunule which is margined by a furrow running from near the beaks to the margin. On the posterior end there are two strong, slightly divergent furrows which are close to the posterior dorsal margin and extend from near the beaks to the margin. The ridges associated with these furrows are angular on their upper edges. Basal margin convex. Surface smooth except for microscopic concentric growth lines.

Height, 7.4 mm.; width, 6.5 mm.; thickness (two valves), 4.75 mm. (holotype).

Locality: Motutara (C).

Holotype in writer's collection, Auckland Museum.

This species is related to the Miocene (Taranakian) *Thyasira planata* Marwick (1926, Trans. N.Z. Inst. Vol. 56, p. 331), but it differs in being higher than wide, more acutely angular above, almost equilateral, and in having an additional radial furrow which borders the lunule.

Thyasira (Prothyasira) bartrumi n. sp. Pl. 76, figs. 5 and 6.

Shell of moderate size, thin, very oblique and inequilateral, equivalve and inflated. Beaks at about anterior seventh, small, directed forwards and incurved at tips. Anterior end short, with a large, deeply excavated lunule which extends from just below the beaks to the angle with the ventral margin. The greatly produced posterior end has two deep arcuate furrows bordering the dorsal slope, and a very broad but only slightly raised medial fold which runs from the beaks to behind the anterior fourth on the ventral margin. Surface smooth except for regular microscopic concentric lines of growth. Interior not accessible in any of the specimens.

Height, 15 mm.; width, 15 mm.; thickness (two valves), 10.75 mm. (holotype).

Locality: Motutara (C).

Holotype in writer's collection, Auckland Museum.

This species also shows relationship with the Taranakian *planata*, but it differs from that species and also from the above described *motutaraensis* in having a more deeply excavated lunule, not bordered by a furrow, and a very oblique outline.

GARIIDAE.

Genus Ascitellina Marwick 1928.

Type (original designation): A. donaciformis Marwick.

Ascitellina protensa n. sp. Pl. 76, fig. 8.

Shell small, thin, compressed, elongate-oval, rounded at both ends. Beaks a little in front of the anterior third, very little raised and directed forwards. Posterior end more narrowly rounded than anterior. Sculpture consisting of fine, somewhat irregular, concentric growth lines.

Length, 11.25 mm.; height, 6 mm.; thickness (one valve), 1.75 mm. (holotype).

Locality: Motutara (A and B).

Holotype in writer's collection, Auckland Museum.

The hinge is represented only by one fragment of the central portion of that of the left valve. Although fragmentary, the hinge features that are showing are in accord with those of the Recent *Tellina urinatoria* Suter 1913, which has been referred to *Ascitellina* by Marwick (1931, N.Z. Geol. Surv. Pal. Bull. No. 13, p. 74). The new species appears to be much more closely allied to the Recent *urinatoria* than to the Chatham Island oligocene genotype. From the Recent species, *protensa* differs in its more elongate-oval outline, more narrowly contracted posterior end, and less regular sculpture.

CALLIOSTOMATIDAE.

Genus Calliotropis Seguenza 1903.

Type (original designation): Calliostoma ottoi Phil.

Calliotropis motutaraensis n. sp. Pl. 77, figs. 12, 13 and 14.

Shell fairly large, thin, conical and widely umbilicate. Whorls 8½, including a minute globular smooth protoconch of 1½ whorls. First post-nuclear whorl of closely-spaced crisp axials. Subsequent whorls with two widely separated spiral rows of closely-spaced prominent spinose nodules. The distance between the spiral rows is slightly more than double the distance between either one of these spirals and the adjacent suture. There are

19 nodules in one spiral series on the last whorl, and 17 on the third post-nuclear. The body-whorl has a third spinose spiral proceeding from the suture, and four more on the base, the last of which borders a wide and deep funnel-shaped umbilicus, the maximum width of which is about one-third that of the base. The basal spirals have finer and much more numerous nodules. The surface of the upper whorls is smooth, but on the body-whorl there are close but somewhat irregular retractive axial growth lines, those on the base being somewhat stronger and more regular. Aperture rhomboidal. Peristome thin, discontinuous. Inner lip as a thin callosity over the parietal wall. Upper part of columella slightly reflected over the umbilical cavity.

Height, 17 mm.; diameter, 18 mm. (holotype).

Locality: Motutara (A).

Holotype in writer's collection, Auckland Museum.

Recent species of this genus are invariably from deep water, but the rest of the Motutara fauna and the lithological facies point definitely to shallow-water deposition. Either *Calliotropis* has not always been restricted to deep water or else the present species is incorrectly ascribed to that genus. The latter possibility does not seem likely, for the Motutara fossil has all the necessary characteristics of the genus.

LITTORINIDAE.

Genus RISELLOPSIS Kesteven 1902.

Type: FOSSARINA VARIA Hutton.

Risellopsis prisca n. sp. Pl. 78, figs. 20, 21 and 22.

Shell small, solid, depressed trochiform, perforate, spirally striated and prominently keeled. Whorls $4\frac{1}{2}$, including a typical almost flat protoconch of $2\frac{1}{2}$ smooth whorls. Spire-whorls with two strong cords, which later, with the addition of another strong cord from beneath the lower suture, develop into the three strong peripheral keels so characteristic of the Recent genotype. In addition, the surface, both above and below, is sculptured with fine spiral threads; about five above and three below the upper keel of the first post-nuclear whorl, and increasing to about double this number at the termination of the last whorl. On the base there is a strong spiral ridge almost the strength of one of the keels. This is situated midway across the base and defines the termination of the spiral cord sculpture from above from a smooth deeply excavated umbilical depression which terminates in a small perforation, overhung by the reflexed inner-lip callus. Medially the inner lip has a callus projection which overhangs the umbilical depression. Spire low, about half the height of aperture.

Height, 3.3 mm.; diameter, 5.5 mm. (holotype).

Locality: Motutara (A).

Holotype in writer's collection, Auckland Museum.

The above species differs from the Recent *varia* in having the tricarinate keels more strongly and evenly developed, a differently sculptured base with a more concave umbilical depression, and a strong callus projection on the outer reflexed edge of the inner-lip. A congeneric Tertiary species is Marshall's *Submargarita ? tricincta* (Trans. N.Z. Inst. Vol. 51, p. 227) from Hampden, Eocene (Tahuian).

NATICIDAE.

Genus Uberella Finlay 1928.

Type (original designation): Natica vitrea Hutton.

Uberella marwicki n. sp. Pl. 78, fig. 19.

Shell small, solid, globular, smooth. Spire depressed, about one-fourth the height of the aperture. Whorls four, including a typical paucispiral protoconch of one whorl. Suture abutting and somewhat impressed; axial growth lines fairly prominent for a short distance below the suture. Umbilicus small, not deep. Parietal callus narrow, widest above, with a small semi-circular gap in it at the umbilicus, and very much thickened on the lower section of the columella and around the basal part of the aperture.

Height, 6.5 mm.; diameter, 6.5 mm. (holotype).

Locality: Motutara (A).

Holotype in writer's collection, Auckland Museum.

Dr. J. Marwick, who kindly examined this species, groups it with *pseudovitreus* (Finlay 1924) and *maesta* (Marwick 1924). From these species the Motutara shells differ in having the lower portion of the columella and the basal section of the lip extremely massive. The semi-circular gap in the callus above the small shallow umbilicus is another distinguishing feature.

Genus Polinices Montfort 1810.

Type (original designation): Polinices albus Mont.

(= Natica mammillaris Lamk.)

Polinices motutaraensis n. sp. Pl. 78, figs. 17 and 18.

Shell small, solid, oval, smooth except for numerous axial growth lines. Whorls $4\frac{3}{4}$, including a protoconch not clearly marked off, but with a tiny nucleus, and probably about $2\frac{1}{2}$ whorls. Spire blunt, broadly rounded, about one-fifth the height of aperture (suture to basal lip). Suture tangential. Parietal callus peculiar, fairly heavy, widest below as it is coalescent with the funicle, completely filling the umbilicus. The medial part of the callus is surmounted by a prominent tubercle, and the outer edge is bounded by a shallow groove. Basal lip much thickened, especially at the point of contact with the umbilical callus.

Height, 8.9 mm.; diameter, 7.5 mm. (holotype).

Locality: Motutara (A).

Holotype in writer's collection, Auckland Museum.

Dr. Marwick kindly examined this species also, and considers it to be nearest to his *senisculus* from Wangaloa. Neither species is a typical *Polinices* and a new group name will be published by him later. The prominent tubercle on the parietal callus and the complete filling of the umbilicus serve to distinguish this species from all others so far described.

FASCIOLARIIDAE.

Genus FALSICOLUS Finlay 1930.

Type (original designation): FUSINUS KAIPARAENSIS Suter.

Falsicolus gemmatus n. sp. Pl. 77, figs. 10 and 11.

Shell of moderate size, fusiform, massive. Spire elevated, conic, a little more than half the height of the aperture plus canal. Whorls about seven, apex small, unfortunately obscured by matrix in only complete specimen. Outline of whorls convex, almost flat on spire, but with a very broad but extremely shallow subsutural depression. Canal rather short; pillar massive, straight, with a heavy oblique ridge at the base of the aperture. Outer lip not thickened. Sculpture of numerous rounded spiral cords and microscopic interstitial spiral threads, crossed by thin axials which render the cords slightly gemmate at the points of intersection. There are five spiral cords on the penultimate and about twenty-two on the body-whorl and canal-neck. The axials number nineteen on the penultimate, but on the body-whorl they become subobsolete and irregular, the gemmules being far more numerous and closely spaced. The axial sculpture does not extend over the spirals of the canal neck. Between each of the spiral cords on the spire whorls there are about six microscopic spiral threads, but these become obsolete below the periphery on the body-whorl. Aperture ovate, rather small.

Height, 42 mm.; diameter, 17 mm. (holotype).

Locality: Motutara (C).

Holotype in writer's collection, Auckland Museum.

This species is well characterised by its gently rounded whorls and delicate gemmate sculpture. It seems nearest allied to such species as *coerulescens* Finlay 1930 and *waiauensis* Finlay 1930.

TURRIDAE.

Genus MARSHALLENA Finlay 1926.

Type (original designation): BELOPHOS INCERTUS Marshall.

Marshallena carinaria n. sp. Pl. 78, figs. 26 and 27.

Shell small, broadly fusiform, sculptured with numerous rounded spiral cords having linear interspaces and prominent closely spaced oblique axial folds. Whorls angled at periphery, which is situated at the lower third on the first post-nuclear whorl, but rises to very little below the middle on the penultimate. There are eight whorls, including a typical tiny smooth protoconch of 2½ whorls. The spiral cords number eight on the second post-nuclear whorl and eleven on the penultimate, those above the periphery (five) being finer and less distinct, and there are about forty on the body-whorl, base and canal neck. The axial folds number 17, both on the penultimate and on the body-whorl. Spire turriculate, about equal to height of aperture plus canal. Aperture ovate, canal bent to the left, rather short, damaged. Suture impressed, bordered below by a rounded spiral fold that is crenulated slightly by the axial folds, which are strongly developed only from the periphery to the lower suture.

Height, 12 mm.; diameter, 6.75 mm. (holotype).

Locality: Motutara (C).

Holotype in writer's collection, Auckland Museum.

This species appears to be closely allied to Allan's *spiralis* (Verconella) (Trans. N.Z. Inst. vol. 56, p. 340, 1926) which differs from the Motutara species in having more bulging and not so sharply angular whorls.

Genus Bathytoma Harris and Burrows 1891.

Type: Pleurotoma cataphracta Brocchi.

Bathytoma mitchelsoni n. sp. Pl. 77, figs. 15 and 16.

Shell of moderate size, fusiform, solid, spire a little less than height of aperture plus canal. Whorls keeled very low, almost at lower suture. There are ten whorls, including a small smooth conical protoconch of 2¾ whorls. Spire whorls with a flat subsutural band bearing two spiral threads, which are broken up into a close series of rounded gemmules. Below this is a strongly concave shoulder extending to the keel, which is almost at the lower suture, being separated from it only by a deep groove. The keel also is made up of two spiral gemmate threads, which are so close together that the upper and lower opposed gemmules appear to merge as larger oval nodules in a single peripheral series. There are thirty-four of these nodules on the keel of the last whorl. On the concave shoulder, between the upper sutural band and the lower keel there are from four to seven fine spiral threads which are rendered gemmulate by close radial growth lines. On the base from below the keel there are twelve rather strong spiral cords, and in each interspace a weak spiral thread, the whole rendered gemmulate by the radial growth lines. Aperture narrow, produced below into a short, straight and wide canal. Outer lip with a deep, rather narrow sinus at the keel. Inner lip and columella smooth and polished, slightly excavated over parietal wall.

Height, 28 mm.; diameter, 13.5 mm. (holotype).

Locality: Motutara (C).

Holotype presented to Auckland Museum.

This species differs from *haasti* (Hutton 1877) in having the keel much lower, almost on to the lower suture, and also in the finer and more numerous gemmules.

The species is named after the late Hon. Sir Edwin Mitchelson, K.C.M.G., M.L.C., upon whose property most of the material was collected.

Genus TURRIS Bolten 1798.

Type (subsequent designation, Dall 1909), MUREX BABYLONUS Gmelin (error for BABYLONIUS) = MUREX BABYLONIUS Linn.

" Turris " finlayi n. sp. Pl. 78, figs. 28 and 29.

Shell small, bicarinate, fusiform, slender. Spire tall, higher than aperture plus canal. Whorls 7, including a blunt round-topped cylindrical-sided, smooth protoconch of two whorls, finishing with a few closely spaced thin axials. Spire whorls sculptured with two moderately strong widely spaced keels, which are produced into rounded nodules at the points of intersection with the rather distant protractively oblique axial folds. The distance between the keels is greater than that between either keel and its adjacent suture, and the lower carina is always nearer to the lower suture than is the upper carina to the upper suture. The axial folds number about ten per whorl. Body-whorl with a weak spiral thread between the two keels and ten spiral threads on the base and neck, those on the neck being more closely spaced. Aperture imbedded in matrix, but the growth lines clearly indicate the sinus to be rather deep, V-shaped, and situated on the upper carina.

Height, 8.5 mm.; diameter, 3.1 mm. (holotype).

Locality: Motutara (C).

Holotype presented to Auckland Museum.

This species really belong to a new group, but is placed in *Turris* provisionally at the suggestion of Dr. H. J. Finlay, who is preparing a monograph of the family.

The position of the sinus on the peripheral keels recalls *Polystira* (Woodring 1928. Mioc. Moll. Bowden, Jamaica. Carnegie Inst. Washington Pub. No. 385, p. 145) and *Gemmula* Weinkauff 1876 as well as *Turris*. Both *Gemmula* and *Turris* have a polygyrate protoconch, but *Polystira* has a paucispiral blunt protoconch similar to that of the Motutara shell. However, the American genus *Polystira* cannot be used for the Motutara species, for apart from the similarity in nuclear characters and peripheral position of the sinus the small New Zealand shell does not compare well in all other respects with the large, massive, distinctively sculptured West Indian genotype.

RINGICULIDAE.

Genus Ringicula Deshayes 1838.

Type (subsequent designation, Gray, 1847): Auricula ringens Lamarck.

Ringicula marwicki n. sp. Pl. 78, fig. 25.

Shell small, ovate, solid. Body-whorl inflated. Spire narrowly conical, about two-thirds height of aperture. Whorls 4½, including a small, smooth, dome-shaped protoconch of about 1½ whorls, the tip flattened and slightly tilted. Suture impressed and bordered below by a fairly strong groove. Spire whorls smooth, body-whorl sculptured with about 16 incised lines, five of them being between the sutures. Outer lip broken away below, but, by the remaining upper portion, it is shown to be strongly variced. Parietal wall with a strong fold and two more, equally strong, on the columella.

Height, 3 mm.; diameter, 2 mm. (holotype).

Locality: Motutara (E).

Holotype in writer's collection, Auckland Museum.

This species is nearest allied to Marwick's *R. torquata* (1926, Trans. N.Z. Inst. Vol. 56, p. 326) from Papapatiki stream, North Taranaki (Taranakian). It differs from the Motutara species in its larger size, more broadly conic spire, weaker subsutural border and in the spiral lines being restricted to the lower half of the body-whorl.

SPIRATELLIDAE.

Genus Lornia Marwick 1926*

Type (original designation): Lornia limata Marwick.

Lornia marwicki n. sp. Pl. 78, figs. 23 and 24.

Shell small, sinistral, discoidal, globular, spire sunken into a rather deep cavity of less than one-third the width of the base in diameter. Umbilicus large, very deep, width equal to that of the spire-cavity. Surface smooth. Aperture lunate, rather small. Whorls few, only the body-whorl showing, the whorls of the sunken spire in all specimens being obscured by matrix.

Height, 2.5 mm.; diameter, 3.9 mm.

Locality: Motutara (B).

Holotype presented to Auckland Museum.

This species differs from the Waiarekan genotype in being much more globular, and in having the spire deeply sunken.

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*Finlay 1926, Trans. N.Z. Inst., Vol. 57, p. 336, has referred this genus tentatively to the *Pteropoda,* comparing it with *Spiratella.*

DENTALIIDAE.

Genus DENTALIUM Linn.

Type (subsequent designation, Gray 1847): DENTALIUM ELEPHANTINUM Linn.

Dentalium n. sp.

Locality: Motutara (A).

I hesitate to describe this species, as no complete examples were collected, and the described New Zealand species are at present ill-defined.

Although only fragmentary sections of the Motutara species were collected, these exhibit perfect sculptural detail and suggest a new species allied to *mantelli* Zittel (1865, Voy. " Novara," Pal., p. 45, pl. 13, f. 7). From that species the Motutara shell differs in having more numerous radial primary ribs and less obvious alternation between primary and secondary ribs. The main feature is the persistence of the annular threads, which are closely spaced and crenulate the ribs throughout. At 2 mm. diameter there are 22 primary ribs, and at 6 mm., with the addition of interstitial ribs, a total of about 50 subequal ribs is reached. The interspaces are about twice the width of the radials above and equal to them or less below.

Genus CADULUS Philippi.

Type (monotypy): DENTALIUM OVULUM Philippi.

Cadulus sp.

Locality: Motutara (C).

One complete but decorticated specimen resembles Marwick's *Cadulus (Gadilopsis) prosperus* (1931, N.Z. Geol. Surv. Pal. Bul. No. 13, p. 159). It is too imperfect to describe, apart from giving the dimensions, which are:—

Length, 16 mm.; diameter—posterior, 0.6 mm.; maximum, 2.2 mm.; anterior, 1.8 mm.

PLATE 76.

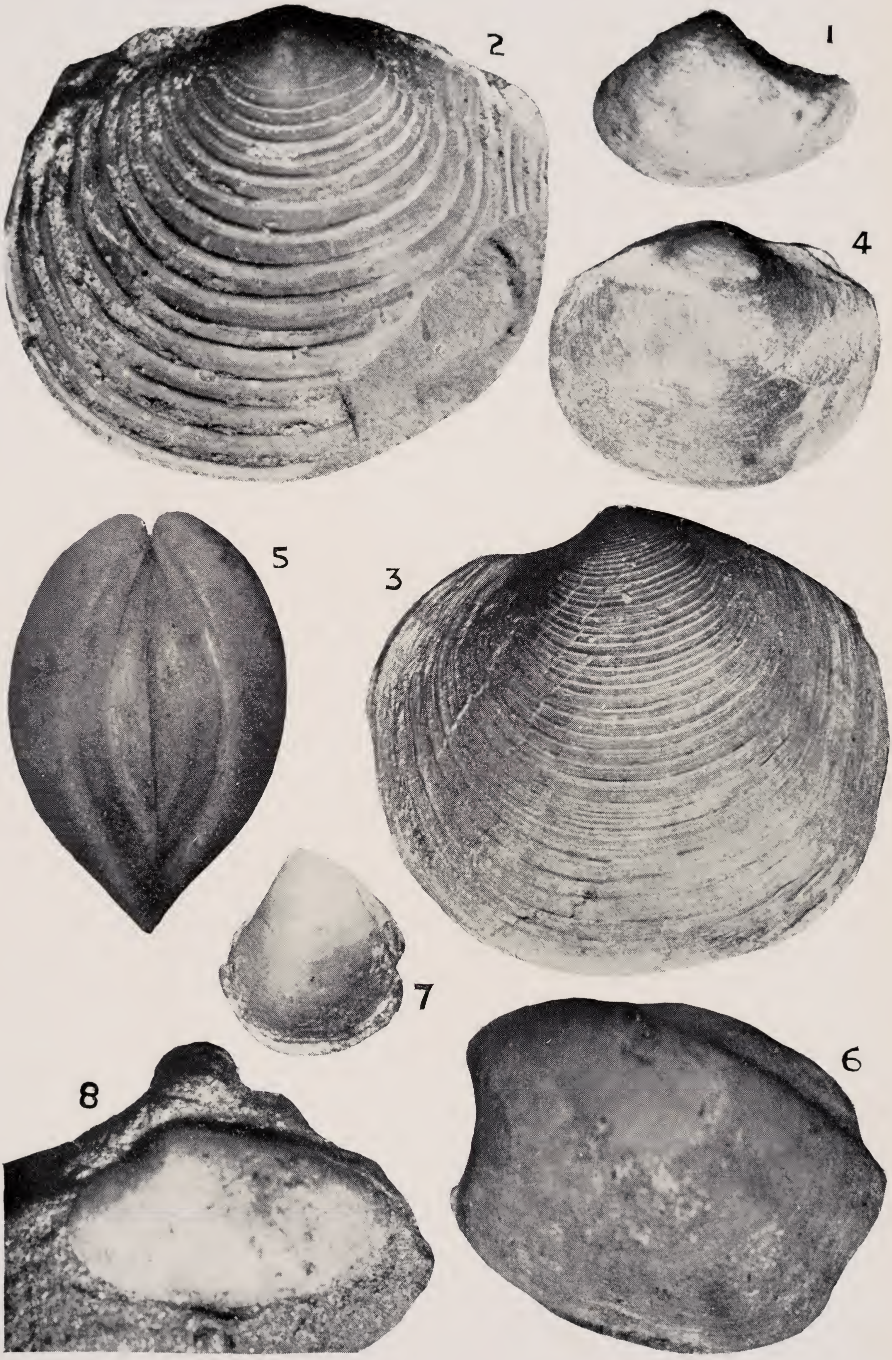


Fig. 1. *Nuculana (Saccella) motutaraensis* Powell n. sp. (Holotype).
Fig. 2. *Myrtea maoria* Powell n. sp. (Holotype).
Fig. 3. *Myrtea (Lucinoma) taylori* Powell n. sp. (Holotype).
Fig. 4. *Pteromyrtea motutaraensis* Powell n. sp. (Holotype).
Figs. 5 and 6. *Thyasira (Prothyasira) bartrumi* Powell n. sp. (Holotype).
Fig. 7. *Thyasira (Prothyasira) motutaraensis* Powell n. sp. (Holotype).
Fig. 8. *Ascitellina protensa* Powell n. sp. (Holotype).

PLATE 77.

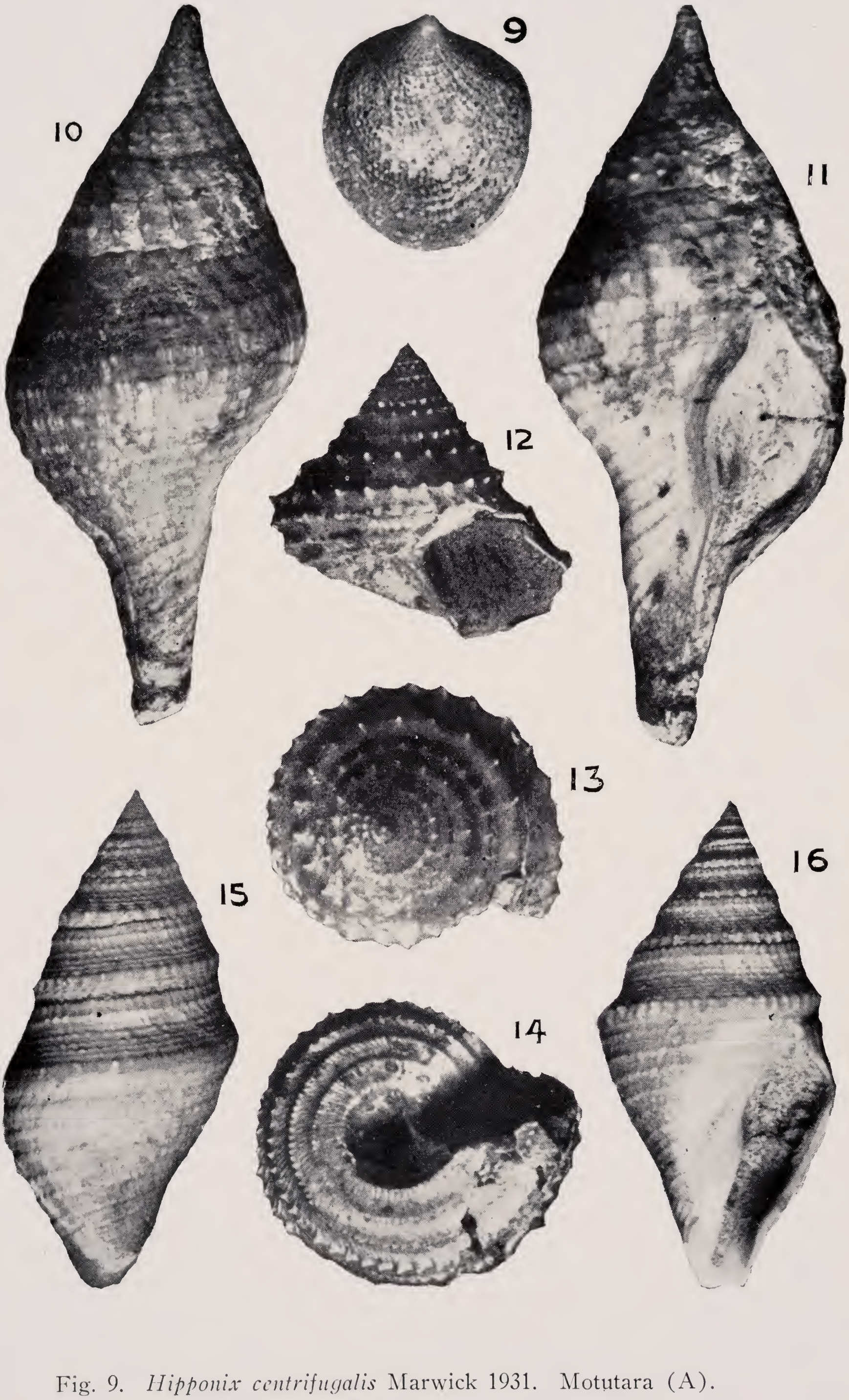
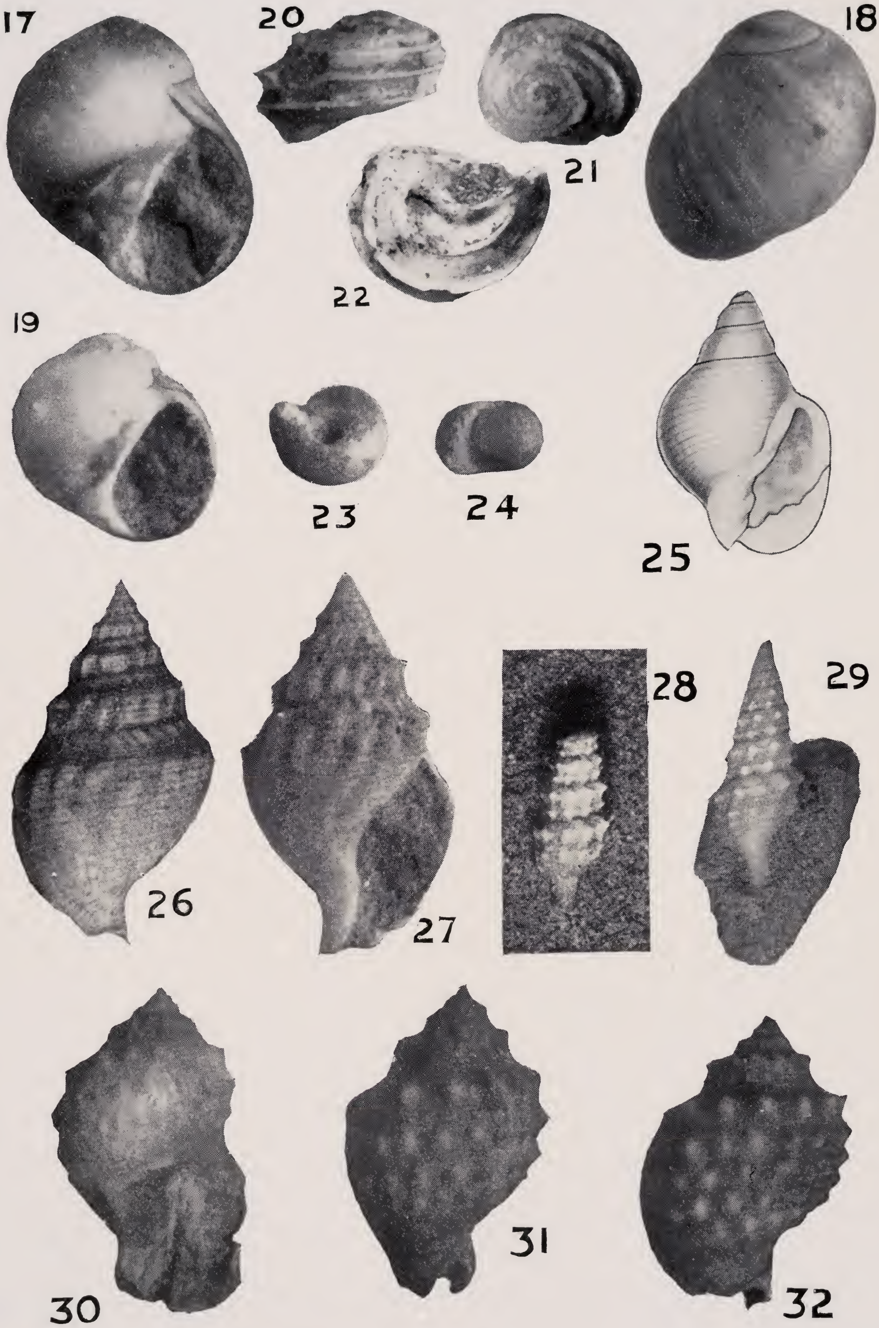


Fig. 9. *Hipponix centrifugalis* Marwick 1931. Motutara (A).
Figs. 10 and 11. *Falsicolus gemmatus* Powell n. sp. (Holotype).
Figs. 12, 13 and 14. *Calliotropis motutaraensis* Powell n. sp. (Holotype).
Figs. 15 and 16. *Bathytoma mitchelsoni* Powell n. sp. (Holotype, 16).



Figs. 17 and 18. *Polinices motutaraensis* Powell n. sp. (Holotype).
Fig. 19. *Uberella marwicki* Powell n. sp. (Holotype).
Figs. 20, 21 and 22. *Risellopsis prisca* Powell n. sp. (Holotype 20 and 21).
Figs. 23 and 24. *Lornia marwicki* Powell n. sp. (Holotype).
Fig. 25. *Ringicula marwicki* Powell n. sp. (Holotype).
Figs. 26 and 27. *Marshallena carinaria* Powell n. sp. (Holotype).
Figs. 28 and 29. *"Turris" finlayi* Powell n. sp. (Holotype 29).
Fig. 30. *Euspinacassis multinodosa* Powell 1928 (Holotype).
Fig. 31. *Euspinacassis multinodoso* Powell 1928 (Paratype).
Fig. 32. *Euspinacassis toreuma* (Powell 1928) (Holotype).

General Index.