

## The Waitotaran Faunule at Kaawa Creek, Part 2.

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THE present paper constitutes the second part of a revision of the faunule at Kaawa Creek. In the introductory portion of Part I, which has already appeared in these Transactions, there is discussion of the faunule as a whole, followed by systematic treatment of the pelecypod mollusca. As has been shown in Part I, the faunule contains a number of genera and a few species which provide an element of distinct Miocene aspect. As regards the age of the beds, it is shown in Part I that they correspond with, or are slightly older than, the Waitotaran Stage of the Wanganuiian, but it is pointed out that confident correlation cannot be made till a faunule associated with undoubted Waitotaran rocks of like facies in the Taranaki section has been discovered.

### LIST OF GASTEROPODA FROM KAAWA CREEK BEDS.

N. = Records new to the locality.

R. = Species still living.

<i>Schismope ngatutura</i> n.sp. . . . .	N.	<i>Hipponix centrifugalis</i> Marwick. . . . .	N.
<i>Schismope koruahina</i> n.sp. . . . .	N.	<i>Cheilea postera</i> n.sp. . . . .	N.
<i>Montfortula kaawaensis</i> (Bartrum).		<i>Maoricrypta opuraensis</i>	
<i>Haliotis</i> cf. <i>iris</i> Martyn.		(Bartrum and Powell).	
(J. Marwick).		<i>Zegalerus</i> sp.	
<i>Emarginula striatula</i> Q. and G. . . . .	R.	<i>Tanea notocenicica</i> (Finlay).	
<i>Emarginula paucicostata</i> n.sp. . . . .	N.	<i>Tanea socia</i> (Finlay). . . . .	N.
<i>Tugali bascauda</i> Hedley. . . . .	N.R.	<i>Tanea</i> cf. <i>inexpectata</i> (Finlay). . . . .	N.
<i>Tugali opuraensis</i>		<i>Uberella barrierensis</i> Marwick. . . . .	N.R.
Bartrum and Powell.		<i>Uberella kaawaensis</i> Marwick.	
<i>Trochus</i> ( <i>Coelotrochus</i> ) <i>bibaphus</i>		<i>Polinices propeovatus</i> Marwick.	
Bartrum and Powell.		<i>Kaawatina turneri</i>	
<i>Thoristella chathamensis gracilis</i>		Bartrum and Powell.	
n.subsp. . . . .	N.	<i>Xenophalium kaawaensis</i>	
<i>Antisolarium conominolium</i> n.sp. . . . .	N.	Bartrum and Powell.	
<i>Munditia proavita</i> n.sp. . . . .	N.	<i>Heligmope postulatus</i> (Bartrum).	
<i>Elachorbis cingulatus</i> (Bartrum).		<i>Cirsotrema zelebori</i> (Dunker) . . . . .	N.R.
<i>Elachorbis subedomita</i> n.sp. . . . .	N.	<i>Notacrisa</i> n.sp. . . . .	N.
<i>Elachorbis</i> n.sp. . . . .	N.	<i>Balcis geoffreyi</i> n.sp. . . . .	N.
<i>Cirsonella aedacula</i> n.sp. . . . .	N.	<i>Balcis</i> sp. A. . . . .	N.
<i>Lodderia</i> n.sp. . . . .	N.	<i>Balcis</i> sp. B. . . . .	N.
<i>Crosseola munditia</i> n.sp. . . . .	N.	<i>Badenia biangulata</i> n.sp. . . . .	N.
<i>Crosseola tenuisculpta</i> n.sp. . . . .	N.	<i>Mitra bicornis</i> n.sp. . . . .	N.
<i>Argalista promicans</i> n.sp. . . . .	N.	<i>Mitra</i> n.sp. . . . .	N.
<i>Astraea heliotropium</i> (Martyn). . . . .	N.R.	<i>Parvimitra</i> n.sp. aff. <i>scopi</i> Finlay. . . . .	N.
<i>Nerita melanotragus</i> E. A. Smith . . . . .	N.R.	<i>Austromitra</i> cf. <i>marginata</i>	
<i>Estea impressa</i> (Hutton). . . . .	N.R.	(Hutton). . . . .	N.
<i>Notosetia tantilla</i> n.sp. . . . .	N.	<i>Verconella koruahinensis</i>	
<i>Dardanula</i> n.sp. . . . .	N.	Bartrum and Powell.	
<i>Merelina kaawaensis</i> n.sp. . . . .	N.	<i>Verconella</i> sp. . . . .	N.
<i>Awanuia tenuis</i> n.sp. . . . .	N.	<i>Austrofusus</i> ( <i>Neocola</i> ) <i>ngatuturaensis</i>	
<i>Scrobs kaawaensis</i> n.sp. . . . .	N.	Bartrum and Powell.	
<i>Zemelanopsis trifasciata</i> (Gray). . . . .	R.	<i>Zelandiella propenodosa</i> (Bartrum).	
<i>Zaclys</i> sp.		<i>Cominella</i> ( <i>Acominia</i> ) <i>fascinerosa</i>	
<i>Notosinister infelix</i> (Webster). . . . .	N.R.	Bartrum and Powell.	
<i>Ataxocerithium kaawaensis</i> n.sp. . . . .	N.	<i>Poirieria</i> cf. <i>primigena</i> Finlay . . . . .	N.
<i>Lilae</i> n.sp. . . . .	N.	<i>Poirieria zelandica</i> (Q. and G.) . . . . .	R.
<i>Maoricolpus</i> cf. <i>proroseus</i> Marwick.		<i>Xymenella</i> cf. <i>lepida</i> (Suter). . . . .	N.
<i>Stiracolpus kaawaensis</i> n.sp. . . . .	N.	<i>Lepsis</i> cf. <i>haustrium</i> (Martyn). . . . .	N.
<i>Pareora striolata</i> (Hutton). . . . .	N.	<i>Inglisella hirta</i> n.sp. . . . .	N.
<i>Struthiolaria illepidia</i>		<i>Zemitrella</i> sp. . . . .	N.
Bartrum and Powell.		<i>Alcithoe</i> cf. <i>mackayi</i> Marwick.	
<i>Callusaria arthritica</i>		<i>Alcithoe</i> n.sp. . . . .	N.
Bartrum and Powell.		<i>Mauthoe parva</i> (Marwick).	
<i>Pellicaria pseudovermis</i>		<i>Alcithoe arabicula</i> Marwick.	
Bartrum and Powell.		<i>Pachymelon</i> ( <i>Palomelon</i> ) <i>powelli</i>	
" <i>Neofanacus</i> " <i>kaawaensis</i>		n.sp. . . . .	N.
Bartrum and Powell.		<i>Microvoluta vetusta</i> n.sp. . . . .	N.

## LIST OF GASTEROPODA FROM KAAWA CREEK BEDS—Continued

<i>Olivella (Lamprodomina) neozelandica</i> (Hutton).	<i>Guraleus ngatuturaensis</i> Bartrum and Powell.
<i>Baryspira (Allocospira) cæspita</i> Bartrum and Powell.	<i>Guraleus sinclairi</i> (E. A. Smith). (J. Marwick). R.
<i>Baryspira (Allocospira) subhebera</i> (Marwick). N.	<i>Zeacumina subtilissima</i> (Bartrum and Powell).
<i>Baryspira (Allocospira) novaezealandiae</i> (Sow.) N.R.	<i>Zeacumina parva</i> n.sp. . . . . N.
<i>Marginella (Glabella) hesterna</i> Bartrum and Powell.	<i>Pervicacia tristis</i> (Desh.) . . . . R.
" <i>Laracraea</i> " <i>sata</i> n.sp. . . . . N.	<i>Pervicacia benesulcata</i> (Bartrum).
<i>Gemmula disjuncta</i> n.sp. . . . . N.	<i>Kaweka bartrumi</i> n.sp. . . . . N.
<i>Phenatoma</i> cf. <i>zelandica</i> (E. A. Smith). N.	<i>Rhizorus marwicki</i> Bartrum and Powell.
<i>Splendrilla aoteana</i> Finlay. . . . . R.	<i>Cylichna thetidis</i> Hedley. . . . . N.R.
<i>Austrodrillia koruahinensis</i> Bartrum and Powell.	<i>Scaphander hiulea</i> n.sp. . . . . N.
<i>Austrodrillia consequens</i> n.sp. . . . . N.	<i>Cadulus</i> sp. . . . . N.
<i>Austrotoma minor</i> Finlay.	<i>Dentalium parcoraensis</i> Pils. and Sharp N.
	<i>Dentalium solidum</i> Hutton. . . . . N.

## Genus SCHISMOPE Jeffreys.

Type: *Scissurella cingulata* Costa.**Schismope ngatutura** n.sp. (Figs. 43, 44).

Shell very small; very similar to *S. lyallensis* Finlay, with the same strong keel below fasciole, and the same build and proportions throughout. Microscopic examination, however, reveals notable divergence. The flat area above fasciole is distinctly sculptured with thin, distinct, spaced radials (antecurrent to suture) and about 10 concentric threads, closer together towards fasciole. *Lyallensis* has radials absent from this area, and only indistinct microscopic spiral striae. Between fasciole and the keel below it there is a broad concave zone in each species; *lyallensis* has this zone unsculptured save for extremely fine growth-striae, but *ngatutura* has it sculptured with both radial and spiral threads, the latter (4 in number) stronger than the radials and quite distinct. Base lightly convex, with distinct axial threads and spirals over the outer zone giving a fenestrated effect. The outer zone of base of *lyallensis* has no spirals and the axials are weak and ill-defined. The umbilicus is surrounded by spaced spiral cords, the innermost one the strongest in both species. Between the heavy sub-fasciolar keel and the base there are 3 cords, the first and third of moderate strength, the middle much stronger. The lower two cords together form a second but weak keel to the body. In this respect the Kaawa fossil recalls *S. atkinsoni* Ten.-Woods. Such cords as those just referred to are entirely absent from *lyallensis*.

Height, 0.9 mm.; width, 1.2 mm.

Type (sole specimen) in writer's collection.

**Schismope koruahina** n.sp. (Figs. 45, 46, 47).

This species is related to *S. laqueus* Finlay, to which it is closely similar in outline and build. There is the same strong fasciole, but it is wider and more heavily filled in the fossil. Only the earlier post-nuclear volutions of *laqueus* have axials above fasciole, but in *koruahina* these are developed throughout the entire coiling of the shell. They are heavy, rounded, well spaced, and retro-current below. Below fasciole *laqueus* has a wide, smooth sunken area; this is narrower in *koruahina*. Below this strong axials are

present, antecurrent upwards, and 14 in number in both species. Those of *laqueus* are narrower, sharper and more widely spaced. Spirals on the base of *laqueus* are very weak, whereas in the Kaawa shell they are heavy, cord-like and nodulate the axials. *Koruahina* has the umbilicus very much wider. *Laqueus* has the columella straight; in *koruahina* it is sinuous.

Height, 1.0 mm.; width, 1.3 mm.

Type (sole specimen) in writer's collection.

*Laqueus* seems more closely related to *S. beddomei* Petterd (Australia) than to the Kaawa fossil.

#### Genus EMARGINULA Lamarck.

Type: *Patella fissura* Linné.

#### **Emarginula paucicostata** n.sp. (Fig. 48).

Shell small, moderately elevated, apex overhanging, a little behind posterior fourth. Sculpture of 21 heavy, widely and equally spaced radial ribs; no secondaries developed. The radials are reticulated by spaced concentric cords, which are weaker than the radials and cause no nodulation. The wide and regular spacing of both elements of sculpture produces a strongly latticed effect, much more open than that of related species. Margins dentate. Notch much as in *striatula*.

Height, 1.7 mm.; width, 3.5 mm.; length, 6.0 mm. (holotype).

Type and a broken paratype in writer's collection.

At once distinguished by the much more open sculpture, the many fewer radials, and total lack of secondary radial riblets.

*E. striatula* occurs fairly plentifully at Kaawa.

#### **Tugali bascauda** Hedley.

Bartrum (1919) listed this species from the Kaawa beds, but subsequently Bartrum and Powell (1928) determined that the shell so identified (by Suter) was a new species, which they named *opuraensis*. Recent collecting has, however, brought to light a specimen of Hedley's species. The sinus rib distinctly *bifurcates*, and the sculpture is altogether that of *bascauda*.

Specimen in writer's collection.

#### Genus THORISTELLA Iredale.

Type (o.d.): *Polydonta chathamensis* Hutton.

#### **Thoristella chathamensis gracilis** n.subsp.

Shell very close indeed to *fossilis* Finlay, an Awamoan fossil from the shell-bed at Target Gully. Ornamentation extremely like that of *fossilis*, but spirals thinner and with closer and finer beading. As in *fossilis* there are four light spirals per whorl of spire together with a heavier supra-sutural one, which, however, is more pronounced in the Awamoan species. *Fossilis* has the four posterior cinguli sub-equal in strength, whereas in *gracilis* the second below suture is somewhat finer than the others. Body-whorl with 4 cinguli above keel (5-6 in *fossilis*); periphery closely bicarinate, the lower keel the weaker; *fossilis* has a single heavy keel on periphery. Base

with 7 fine, equally spaced spirals, an eighth and heavier one bordering umbilicus. Features of umbilicus and of aperture quite those of *fossilis*.

Height, 5.0 mm.; diameter, 7.0 mm.

Type (unique) in collection of A.U.C.

Collected by Mr E. J. Searle, M.Sc.

#### Genus ANTISOLARIUM Finlay.

Type (o.d.): *Solarium egenum* Gould.

#### **Antisolarium conominolium** n.sp. (Fig. 50).

Shell small, elevated for the genus, height of spire greater than that of aperture. Protoconch diminished to a tiny embryo. Whorls ornamented with spiral cords; spire-whorls with three equally spaced cords; body-whorl with 6, also spaced equally, the lowest one at the periphery. Base lightly convex, with a broad band devoid of heavy sculpture, though marked by a very fine spiral striae. There are several cords encircling umbilicus, the strongest, situated on the rim, is slightly moniliform. The first and second cords on the body also are slightly beaded. The whorls are crossed by faint growth-striae which are antecurrent towards posterior suture. Aperture as in *egenum* (Gould).

Height, 3.0 mm.; width, 3.2 mm. (holotype).

Type in collection of Auckland University College. There are 9 paratypes, many of them juveniles.

This species grades towards *Conominolia*, for it has the spire higher than is typical of *Antisolarium* and the spirals are spaced more regularly and are more numerous than in that genus. It probably represents one of the stages of transition in the development of *Antisolarium* from Conominolid stock, and is no doubt ancestral to the Recent *egenum*.

Bartrum and Powell (1928, p. 140) indicated this new species, but no name was then given as the available material was too poor. There is an undescribed Pliocene species from Hawke's Bay having the spirals of the present species and the spire much lower than that of *egenum*.

#### Genus MUNDITIA Finlay.

Type (o.d.): *Liotina tryphenensis* Powell.

#### **Munditia proavita** n.sp. (Figs. 49, 51).

Shell very small, flat above, widely umbilicate below. Whorls 3, rapidly increasing. Protoconch tiny, of one smooth volution. Fine, close microscopic radial threads present between heavier axials, but probably originally universal (as in *tryphenensis*), the surface being somewhat rubbed. Axial corrugations present on all adult whorls, becoming prominent on last volution, which bears 17 of them. These corrugations are very weak on upper surface and on base, but are strongly developed over the peripheral convexity. There are 4 spiral keels, one within umbilical depression, one on middle of base, a third at the periphery, and a fourth above periphery at edge of upper flat surface of shell. There is also a low swelling a little

distant from suture, which is channelled. Axial serrations extend from preceding whorl into the sutural channel. There are teeth-like axial crenulations on umbilical carina, projecting into umbilicus. Aperture circular, its rim not appreciably thickened. Umbilicus deep, wide, perspective.

Diameters—greatest, 2.1 mm.; least, 1.7 mm. (holotype).

Type in writer's collection.

*Tryphenensis* is the nearest relative of this species, which can be distinguished by its strong peripheral keel, development of axials around whole circuit of whorl, smaller protoconch and less rapidly enlarging whorls. *M. serrata* (Suter) has axial serrations developed around entire whorl, but does not agree in the number of keels; and, further, axial corrugations are not present over periphery and on base.

This is the first fossil species of the genus to be recorded.

#### Genus ELACHORBIS Iredale.

Type (o.d.): *Cyclostrema tatei* Angas.

#### **Elachorbis subedomita** n.sp. (Figs. 52, 55).

Shell minute, sub-discoidal, broadly umbilicate. Embryonic nucleus very large. Whorls convex; suture well defined, situated at periphery. A little distance from suture there is a faint angulation, and from this the whorl is cut down to suture, causing a broad channel which increases in depth towards wall of previous whorl. Early whorls unsculptured; body-whorl with 3 or 4 exceedingly low, broad spirals above periphery; base smooth, convex. A strong spiral fold encircles the umbilicus; some distance within there is a second but weaker fold, which causes a faint sinuosity where it intersects the columella. Aperture broken back in all specimens, but apparently roundly quadrate.

Height, 1.1 mm.; diameter, 1.6 mm. (holotype).

Type in writer's collection.

Nearest to *E. edomita* Marwick, an Awamoan fossil from Gisborne District, but with a higher spire, aperture not so spread out laterally, whorls not so compressed vertically, and heavier embryo.

#### **Elachorbis** n.sp.

The single shell is not adult. The summit is depressed (in fact, quite flat), and there are few and heavy spirals. Six spiral keels on body-whorl, as follows: a weak one in middle of flat upper part, a strong one on angulation just above periphery, a weaker one at periphery, another strong one at infra-peripheral angulation, one in middle of base and another in umbilical hollow. Very fine, regular microscopic threads are also developed between the keels. It has not the very tiny protoconch of *E. cingulatus* (Bartrum), and noticeably fewer, more distant spirals.

Specimen in writer's collection.

There are thus three Elachorbids in the beds at Kaawa. At White Rock River, South Canterbury, however, four distinct species occur—*helicoides*, *politus*, *albolapis*, and an undescribed form.

**Elachorbis cingulatus** (Bartrum).*Trans. N.Z. Inst.*, vol. 51, p. 97, 1919.

This is the largest and most handsome of our Elachorbids. The minute embryo contrasts it with other Neozelanic species.

Genus CIRSONELLA Angas.

Type: *C. australis* Angas.**Cirsonella aedicula** n.sp. (Figs. 53, 54).

Shell minute, turbinate, very narrowly umbilicate. Sculpture absent. Spire depressed, its height about half that of aperture. Whorls strongly convex, globose. Base lightly convex. Umbilicus very tiny. Aperture simple, circular, a slight angle at suture; separated from parietal wall by a narrow groove.

Height, 0.75 mm.; diameter (greatest), 0.85 mm. (holotype).

Type in writer's collection.

The absence of sculpture distinguishes this species from *C. densilirata* Suter and from *C. consobrina* Powell. *C. parvula* Powell has a wider umbilicus and the suture abutting more.

Genus CROSSEOLA Iredale.

Type: *Crossea cancellata* Ten.-Woods.**Crosseola munditia** n.sp. (Fig. 57).

Shell minute, thick for its size, spire missing, whorl convex, strongly abutting. Related to *C. errata* Finlay, but smaller and with 4 spirals on penultimate whorl instead of 3; there are 8 spirals plus the umbilical cord on the body (*errata* has 6 plus umbilical cord). In *errata* the upper three cords on body are the strongest; in *munditia* the uppermost is very weak, the second very strong, the remaining cords diminishing in strength below. Axials as fine threads in interstices of spirals; axial sculpture always weaker than the spirals (in *proerrata* the axials override the spirals). Umbilical rib very stout, not crenulated. Aperture about circular; a narrow parietal callus present. There is a small, narrow umbilical chink. Pillar thick and heavy, broadening below.

Height (estimated), 1.5 mm.; width, 1.1 mm.

Type in writer's collection.

There is a closely related undescribed species in the beds at Clifden, Southland (band 8).

**Crosseola tenuisculpta** n.sp. (Figs. 30a, 30b).

The sole specimen is fractured and rather worn, but is a recognisably distinct species. It has 10-12 regularly-spaced spirals, all of equal strength, and many closely-spaced axials, these two elements of sculpture causing a closely fenestrated effect; the axials are not quite as heavy as the spirals. The umbilical rib is not strongly differentiated, but it is broader than the remaining spirals. Pillar thickened. There is a very narrow umbilical chink.

Height, 1.2 mm.; width, 1.1 mm.

Type in writer's collection.

The excessively fine sculptural reticulation distinguishes this species at a glance. *Cuvierensis* has spire higher relative to height of shell, and fewer spirals; *errata* has posterior spiral much stronger than anterior ones.

**Lodderia** n.sp.

There is the apical portion of a shell closely resembling *Lodderia* n.sp. from the Pliocene beds at Wanganui. Both have coarser sculpture than *L. eumorpha* (Suter), and not the fine hair-like axials of that species. The Kaawa species has a larger nucleus than either of the others, rather heavier embryonic whorls, and lacks the spiral on the flat shoulder that is present in the Pliocene Wanganui species.

Specimen in writer's collection.

Genus ARGALISTA Iredale.

Type (o.d.): *Cyclostrema fluctuata* Hutton.

**Argalista promicans** n.sp. (Figs. 56, 58).

Shell very small, greatly depressed, very widely umbilicate. Sculpture absent; surface smooth and polished. Protoconch large, convex, of about one whorl. Umbilicus very wide, perspective, its diameter at least one quarter that of greatest width of shell, encircled by a heavy nodulated carina; within umbilicus there is another spiral carina, more sharply elevated than those of *micans*. Aperture broken; outer lip effuse; apertural features much as in *micans*.

Height, 0.7 mm.; diameter (greatest), 1.25 mm.

Type in writer's collection.

Distinguished from *A. micans* Powell, its nearest relative, by more depressed spire, much wider umbilicus with heavier carina at edge. The crenulations on circum-umbilical cord of *micans* are very indistinct. There is an undescribed species in the Ototaran beds at Chatton with similar development of umbilicus, but the shell has spirals.

**Astraea heliotropium** Martyn.

Suter, *Man. N.Z. Moll.*, p. 166, 1913.

Six juvenile specimens consisting of the early planorboid phase of coiling have been recovered from sievings. These constitute a new record.

Specimens in writer's collection.

**Nerita melanotragus** E. A. Smith.

Suter, *Man. N.Z. Moll.*, p. 172, 1913.

One complete shell has been collected. It is small but adult. The spire is flatter than that of Recent adult specimens and the body-whorl embraces it more closely, though this is frequently a feature of immature Recent individuals.

Specimen in collection of A.U.C.

**Estea impressa** (Hutton).

*Trans. N.Z. Inst.*, vol. 17, p. 321, 1885.

Thirty specimens have been recovered from sievings. Most of them have the surface rubbed, but some are sufficiently well preserved to show the axial sculpture and the nodulated margin to the suture.

Specimens in writer's collection.

**Dardanula** n.sp.

A dozen or so specimens have been obtained. The species is characterised by an acute angulation of the whorl. The material is not considered good enough for further description.

Specimens in writer's collection.

## Genus NOTOSETIA Iredale.

Type (o.d.): *Barleeia neozelanica* Suter.

**Notosetia tantilla** n.sp. (Fig. 59).

Shell minute, solid, of low conic habit. Sculpture entirely absent. Spire a little higher than aperture, its outlines faintly pupoid. Nucleus of embryo minute, situated about centrally on broad summit of protoconch. Whorls increasing rather rapidly in width so that shell appears squat; outline of whorl very lightly convex; suture slightly impressed, not margined. Aperture broadly oval to circular; outer lip convex, slightly drawn back to suture; inner lip with a thick callus; columella set vertically, concave. There is a tiny umbilical chink present.

Height, 1.05 mm.; width, 0.8 mm. (holotype).

Type in writer's collection.

The shell is adult. Its closest relationship is with *N. neozelanica* (Suter), but it is very much smaller and lacks all sculpture, there being no trace of spirals surrounding umbilical area. It has a wider and shorter body than *verecunda* (Suter). Its proportions are somewhat similar to those of *subflavescens* (Iredale) but the whorls are flatter. *Lamprea* (Suter) has whorls of same convexity, but is very much taller.

## Genus MERELINA Iredale.

Type (o.d.): *Rissoa cheilostoma* Ten.-Woods.

**Merelina kaawaensis** n.sp. (Figs. 60, 61).

Shell very small, elevated. The specimens are rubbed, so that the embryo does not show the spiral striae typical of the genus. Sculpture clathrate. Post-embryonic whorls biangulated by 2 heavy spiral cords; on penultimate whorl there is a third but weaker cord close above suture. Axials narrow, spaced almost twice their own width apart and extending from suture to suture; 9 to 10 axials on body-whorl. Body-whorl about half height of shell; 2 heavy spirals above, a third weaker one emerging from near suture, and 3 still weaker cords on base. Aperture broadly oval, wide in front. A distinct oblique umbilical chink present, and over this the pillar is slightly reflexed. Outer lip thick, with a heavy varix.

Height, 2.0 mm.; width, 0.9 mm. (holotype).

Type in writer's collection.



## Genus SCROBS Watson.

Type: *S. jacksoni* (Brazier) (= *badia* Watson).**Scrobs kaawaensis** n.sp. (Fig. 62).

Shell very small, regularly conic, its form reminiscent of *Dardanula*. Protoconch very low, dome-shaped, glossy. Whorls 4, practically flat, unsculptured; suture very indistinct. Spire a little less than half height of shell. Aperture broadly oval, oblique; separated from body by a long, narrow, crescentic trench. Body-whorl narrowly rounded at periphery; base lightly convex.

Height, 1.5 mm.; width 0.85 mm. (holotype).

Type in writer's collection.

Nearest to *S. semen* Odhner, but shape is more like *Dardanula*. It lacks the heavy spiral cords of *semen*; further it is more robust, and has the outer lip not so effuse and the whorls flatter.

## Genus AWANUIA Powell.

Type (o.d.): *Awanuia dilatata* Powell.**Awanuia tenuis** n.sp. (Fig. 31).

Shell minute, slender in habit, whorls not enlarging as rapidly as those of the genotype. Protoconch with three spiral ridges, the middle one the heaviest and forming a strong keel on periphery. Post-nuclear whorls without spiral ornamentation, but bearing heavy axial costae spaced at intervals a little greater than their own width (about 10 per whorl). Whorls strongly shouldered at posterior third or fourth, the axials reaching across tabulation to suture. Much of the body-whorl is damaged, but sufficient of the aperture remains to show the callus continued across the parietal wall. A supra-sutural cord is present; the inter-axial furrows are excavated (as in *Chemnitzia* amongst Pyramidellids).

Height, 1.5 mm.; width, 0.5 mm.

Type in writer's collection.

At once distinguishable from *dilatata* by slenderer form, keel on embryo, and presence of axials on shoulder. This is the second species of *Awanuia* to be described, and is the first record of the genus as a fossil.

## Genus ZACLYS Finlay.

Type (o.d.): *Cerithiopsis sarissa* Murdoch.**Zaclys** n.sp.

There are a score or so fragmentary specimens. They lack the 4 spirals of later whorls of *sarissa*, and have no ridge on base running up to the columella. *Subantarctica* (Suter) has the embryo more tapering and its whorls not so convex. The ratio whorl-width : whorl-height (of embryonic whorls) is greater for the Kaawa shells, and the embryonic sutures are more cut in. Also the sculpture of the fossils is less gemmate. They have a longer embryo than that of *aequicineta* (Suter), which also has the protoconch keeled. The narrow, strongly convex whorls of embryo of the shells in question,

however, almost gives one an impression that a light keel is present. This species is not named, as it is expected that better specimens will be found.

Specimens in writer's collection.

Genus ATAXOCERITHIUM Tate.

Type: *Cerithium serotinum* Adams.

**Ataxocerithium kaawaensis** n.sp. (Fig. 63).

Shell small, with whorls very convex and very short between sutures. Outline of spire convex. Protoconch worn. Whorls about 7 in number. Surface ornamented with regular axial corrugations, the interstices a little wider than the ribs; there are 5 spiral cords per whorl, and these are strongest in the interspaces, weak on surmounting the axials (but surface is rubbed). Penultimate whorl with 13 axial ribs. Sutures very distinct, strongly incised. Apertural character not known as anterior portion of shell is worn off.

Height (estimated), 12.0 mm.; width, 5.3 mm.

Type in collection of Auckland University College. Collected by Mr I. J. Pohlen.

Separate from other Neozelanic species on account of its short, strongly convex whorls and coarse, regular, axial plications.

**Notosinister infelix** (Webster).

*Trans N.Z. Inst.*, vol. 38, p. 307, 1906.

This new record from the Kaawa beds is based on a number of specimens that have been recovered from sievings of matrix.

In instituting *N. tepikiensis*, a Castlecliffian fossil from Cape Runaway, Powell (1934, p. 266) has stated that it appears to be directly ancestral to the Recent *infelix*; but the present record shows that *infelix* was established as a species in early Pliocene times and that it is not derived from the Castlecliffian fossil.

Genus LILAX Finlay.

Type (o.d.): *Stephopoma nucleogranosum* Verco.

**Lilax** n.sp.

The nuclear whorls of 12 individuals were taken in sievings. The granules are heavier and not so crowded as those of *nucleogranosum*.

Specimens in writer's collection.

Genus STIRACOLPUS Finlay.

Type (o.d.): *Turritella symmetrica* Hutton.

**Stiracolpus kaawaensis** n.sp. (Fig. 65).

This is the shell previously listed as *T. symmetrica* Hutton. It differs from *symmetrica* in greater attenuation, flatter whorl-outline, and in having the primary spirals less heavy and usually not spaced equally. The interval between the two anterior cords is less than between the two posterior ones. Further, the posterior spiral is always the weakest. The protoconch is smaller and not as

globose, and has its nucleus more elevated. The embryo (of about 2 volutions) is lightly medianly sub-angled latterly. The angulation develops into a cord in brepthic stage, and this very soon becomes accompanied by a weaker (anterior) one. Finally, the third (posterior) cord appears and remains weak throughout all whorls. Secondary sculpture consists of numerous fine spiral striae.

Height, 18.0 mm.; width, 5.0 mm. (holotype).

Type and many paratypes in writer's collection.

These shells are not uncommon in the beds at Kaawa.

*Kanieriensis* (Harris) has the carinae subequal and equidistant.

**Maoricolpus** cf. *proroseus* Marwick.

Suter originally determined this shell as *Turritella huttoni* Cossm. (= *bicincta* Hutton), and it was subsequently listed by Bartrum and Powell (1928, p. 142) as *Turritella* cf. *huttoni* Cossm., Marwick having noted its divergence from Cossmann's species. Certainly the shell in question does not agree with Suter's figure and description (*N.Z. Geol. Surv. Pal. Bull.*, no. 2, p. 15, 1914) of *huttoni*. It bears close resemblance to *M. proroseus* Marwick, a Taranakian fossil from Gisborne District, the only divergence in adult sculpture being the presence on the Kaawa shell of a supra-sutural cord, much weaker, however, than the two prominent keels.

Two apices of a *Maoricolpus* have been found in sievings, and these probably are referable to this species.

**Pareora striolata** (Hutton).

*Trans N.Z. Inst.*, vol. 17, p. 329, 1885.

A single well-preserved specimen. It is rather stouter than *striolata* from Target Gully and other North Otago Awamoan beds, and has the whorls more convex. It matches perfectly, however, shells from White Rock River, South Canterbury.

Specimen in writer's collection.

This is the first occasion on which the genus has been recorded from Pliocene or later deposits. Previously known only from the Awamoan and Hutchinsonian. It is a common Oamaruan fossil.

**Hipponix centrifugalis** Marwick.

*N.Z. Geol. Surv. Pal. Bull.*, no. 13, p. 97, 1931.

This is the "*Hipponix* sp." recorded by Bartrum and Powell (1928, p. 144), who hesitated definitely to identify the species, as the material at their disposal (a single worn shell) was inadequate. Better and more abundant material has made it possible to identify the Kaawa shells with *H. centrifugalis* Marwick, an Awamoan fossil from Gisborne District. They show considerable variation in shape, height, and in position of apex, which sometimes overhangs posterior margin and at others is rather more forward.

Specimens in collections of A.U.C. and of the writer.

Genus CHEILEA Modeer.

Type (s.d., Woodring, 1928): *Patella equestris* Linné.

**Cheila postera** n.sp. (Figs. 68, 70).

Shell small, circular in outline, apex moderately elevated, situated towards anterior. Posterior slope convex; anterior slope below apex about straight, quickly descending, slightly overhung by apex.

Surface badly rubbed; but irregular concentric folds are present, and in one place fine radial striae are still to be seen. Internal appendage broken in both specimens, its insertion solid, semicircular.

Approximate dimensions: height, 2.5 mm.; diameter, 6.0 mm. (holotype).

Type and a paratype in writer's collection. Neither specimen complete.

The only other record of the genus from New Zealand is *C. plumea*, a fossil from Clifden, Southland.

The irregular concentric corrugations and lower apex show that this species approaches *C. equestris* rather than the New Zealand fossil from Clifden.

#### Genus MAORICRYPTA Finlay.

On examining the large series of Crepidulids now to hand from the Kaawa beds one at first becomes doubtful whether the two forms, *turnialis* and *opuraensis*, are really specifically distinct. The majority of specimens of *turnialis* are quite smooth, but some individuals have ribbing developed here and there, often on the later part of the whorl. The only observable difference seems to be that in *opuraensis* the ribbing is confined chiefly to one side of the shell and it is finer and more regular than that occasionally developed in *turnialis*.

Revision of the group as a whole is necessary before the status of these two forms can be decided.

#### **Zegalers crater** Finlay.

The record of this species cannot be upheld, for the Kaawa shells prove to be quite distinct from the Nukumaruan form. They are more elevated and with all whorls distinctly convex; the apex is not nearly central, and the sculpture is different, for the growth-lines are disposed, not as concentric circles (as in *crater*), but as distinct logarithmic spirals. These shells seem not unlike an undescribed species from the greensands at Target Gully, Oamaru.

#### **Tanea socia** (Finlay).

*Trans. N.Z. Inst.*, vol. 57, p. 499, 1927.

There are a half-dozen specimens, with the sutures rather weathered; but one has the suture well enough preserved to show the slight sub-sutural flattening that distinguishes this species at a glance from *inexpectata*. They also possess the very small funicle of *socia*.

Specimens in collections of A.U.C. and of the writer.

#### **Tanea cf. inexpectata** (Finlay).

A single shell with the sutures rendered canaliculate by weathering cannot be satisfactorily placed either with *inexpectata* or with *socia*. It is very much larger than the other shells here referred to *socia*, and for this reason is judged to be nearer to *inexpectata*.

Specimen in collection of A.U.C.

**Uberella barrierensis** Marwick.

*Trans. N.Z. Inst.*, vol. 55, p. 571, 1924.

This shell has been compared with topotypes. The only observable difference is the slightly narrower umbilicus of the fossil. *Barrierensis* is a deep water species; the type comes from 110 fathoms off Great Barrier Island.

**Kaawatina turneri** Bartrum and Powell.

*Trans. N.Z. Inst.*, vol. 59, p. 141, 1929.

Bartrum and Powell based this genus on two shells, but sievings have shown that the species is not as uncommon as originally supposed. The writer has obtained 18 specimens from a few tins of matrix, while additional shells have been collected by Professor Bartrum.

The axial ribs are sculptured with fine, irregular, wavy, microscopic ridges running axially along their summits, a feature not referred to in the original description.

The genus is very doubtfully a Rissoid one.

**Cirsotrema zelebori** (Dunker).

Suter, *Man. N.Z. Moll.*, p. 32, 1913.

Several fragmentary shells. These constitute a record new to the beds.

Specimens in writer's collection.

Genus **NOTACIRSA** Finlay.

Type (o.d.): *Turbonilla oamarutica* Suter.

**Notacirsa** n.sp.

The single specimen is too fragmentary for description, but the build of whorl and character of sculpture point unmistakably to *Notacirsa*. It has weaker axials than other species. Its very weak development of spirals recalls *awamoensis* (Marshall and Murdoch), but that species has quite prominent axial ribs. Varices are not present, but these are usually a feature of later whorls, and the fragment under discussion is apical.

This is another Awamoan genus appearing for the first time in the Pliocene, and is a new record for the locality.

Family **PYRAMIDELLIDAE**.

The Pyramidellid fauna is decidedly a rich one, for 16 species, belonging to 9 different genera, occur in the beds at Kaawa. All the species are new; but no names and descriptions are given in the present paper, for they will be considered in a monograph of the Neozelanic forms shortly to be prepared for publication. All the new genera and most of the new species were separated out prior

to this work on the Kaawa fauna. Unless otherwise indicated the genera and species listed below are in the writer's collection:—

*Turbonilla* n.sp. A (A.U.C. and writer's collection).

*Turbonilla* n.sp. B.

N. gen. et n.sp. aff. *Turbonilla* (collection of A.U.C.).

*Chemnitzia* n.sp. A (A.U.C. and writer's collection).

*Chemnitzia* n.sp. B.

*Odostomia* n.sp. A.

*Odostomia* n.sp. B.

*Odostomia* n.sp. C.

*Odostomia* n.sp. D.

N. gen. A et n.sp. aff. *Odostomia* (A.U.C. and writer's collection).

N. gen. B et n.sp. aff. *Odostomia*.

*Wakura* n.sp.

*Chrysallida* n.sp. Interesting in that it is the only Neozelanic record of the genus, and the only instance of a highly sculptured Odostomid group occurring in the region (the Kermadec Province excepted).

N. gen. et n.sp. aff. *Pyrgulina* (n.sp. A and n.sp. B).

N. gen. et n.sp. aff. *Eulimella*.

#### Genus BALCIS Leach.

Type: *B. montagui* = *B. alba* (da Costa).

#### **Balcis geoffreyi** n.sp. (Fig. 67).

Shell very small, high-conic, outlines straight. Protoconch large and very broadly convex over summit. Post-embryonic whorls  $5\frac{1}{2}$ , lightly convex; suture moderately distinct, very faintly and closely sub-margined; surface smooth and polished; here and there microscopic striae are present. Growth-striae not well marked. Outer lip sinuous, convex below. Columella thin, arcuate. There is a light parietal callus. Aperture broadly rounded in front.

Height, 2.8 mm.; width, 1.0 mm. (holotype).

Type and many paratypes in writer's collection.

Ancestral to *B. otagoensis* Powell, which it resembles in the broad, heavy protoconch. *Otagoensis*, however, has a higher body with longer and narrower aperture; the height of the body-whorl is about half that of the shell, whereas it is less than half the height in *geoffreyi*.

#### **Balcis** sp. A.

A single specimen with a faintly curved spire and the outer and basal lips badly broken back. Whorls quite flat; suture very indistinct. Periphery of body-whorl angularly convex.

Specimen in writer's collection.

#### **Balcis** sp. B.

A single fragment of upper whorls of spire, the whorls enlarging more rapidly than those of sp. A, and the shell larger and less attenuate. Probably the aperture is more broadly oval.

Specimen in writer's collection.

## Genus BADENIA Finlay.

Type (o.d.): *Powellia lactea* Finlay.**Badenia biangulata** n.sp. (Fig. 64).

Shell very small, conic, spire about twice height of aperture. Embryonic whorls similar to those of *lactea*, but smaller and a little overhanging laterally. Whorls about 4 in number, indistinctly biangulated by two low, rounded cords. Body-whorl wide in relation to height; aperture and outer lip outplayed. Base flatly convex, unsculptured. Aperture almost circular; outer lip with a thick varix, lightly convex below, retrocurrent to suture above; inner lip lightly callused. There is a narrow umbilical chink present. The suture is below the periphery of the whorls.

Height, 2.0 mm.; width, 1.0 mm. (holotype).

Type in writer's collection.

Distinct in its small size and biangulation of whorls. *Lactea* has a single subangulation low down near suture. Shows closer relationship with the several South Island Oamaruan species than with the Recent *semireticulata* (Murdoch and Suter).

## Genus MITRA Roeding.

Type: *Voluta episcopalis* Linné."Mitra" **bicornis** n.sp. (Fig. 66).

Shell small, biconic, height of spire a little greater than half that of aperture. Whorls of spire flat, suture indistinct. Growth-striae present, but other axial ornamentation absent; upper half of spire-whorls with weak spiral threads of rather irregular width and spacing; spiral threads also present above periphery on the body. Body-whorl long, flattish above, broadly convex over periphery and on base; gradually contracting and straightening out to neck; beak short, straight. Aperture narrow, crescent-shaped, the columella but little excavated; the aperture is narrowly angled behind and very lightly notched in front; columella with 4 distinct plaits, the anterior and posterior ones the smallest; the distribution of plaits much as in *hedleyi* (Murdoch). Parietal wall spread with callus which descends vertically down neck to beak.

Height, 10.0 mm.; width, 4.5 mm.

Type in collection of Auckland University College.

Closely related to *M. hedleyi* (Murdoch), but is larger and has flatter spire-whorls with less distinct sutures. Further, the greatest width of body is nearer the anterior, so that the whorl is not so much heaped up behind. *Hedleyi* has a broad, shallow notch at anterior of aperture; in *bicornis* the notch is very much less distinct. As stated above, *bicornis* has anterior and posterior columellar plaits the weakest. *Hedleyi* has plaits becoming progressively weaker towards anterior.

Finlay (1926, p. 408) suggests that *hedleyi* may be a *Microvoluta*, but Murdoch's species does not show the peculiar rostral twist of *Microvoluta*; and the present species, which is close to *hedleyi*, does not either.

**Mitra** sp.

Two fragmentary specimens of a *Mitra* were collected resembling *M. eusulcata* Finlay and *M. cf. eusulcata* Finlay of Marwick (1931, p. 123). The spire, however, is not so high relative to body, the sutures are narrowly channelled and the spiral grooves are finer and closer. The material, consisting of fragmentary shells in the collections of A.U.C. and of the writer, is too poor for further description.

## Genus PARVIMITRA Finlay.

Type (o.d.): *P. pukeuriensis* Finlay.

**Parvimitra** n.sp. aff. **scopi** Finlay.

This is represented by a shell with much of the last whorl missing. The nodules and axials are smaller and closer together than those of *scopi*. The apex also is noticeably smaller and not so broad over the summit.

*Scopi* is an Awamoan species (type locality, Target Gully).

*Parvimitra* is not an uncommon genus in the Miocene of New Zealand, but this is the only record from the Pliocene.

Specimen in writer's collection.

**Austromitra** cf. **marginata** (Hutton).

A single worn shell. Of the already described Neozelanic species, it approaches *marginata* most closely. New record.

Specimen collected by Mr E. J. Searle, M.Sc.

**Verconella koruahinensis** Bartrum and Powell.

*Trans. N.Z. Inst.*, vol. 59, p. 146, 1929.

*Koruahinensis* has close affinity with the Awamoan *V. marwicki* Finlay, of which it seems almost certainly to be a derivative. The height of spire and its apical angle are practically the same in both species. In both the suture is high up and undulates over the anterior portion of the tubercles, stepping of the spire being practically eliminated. They agree exactly in shape of body and in features of aperture, but *marwicki* has the beak narrower and drawn out more. The spiral sculpture is also closely similar in both these species, and is very much finer than that of *adusta*. The main characters distinguishing the Awamoan from the Kaawa species are found on the body-whorl. *Koruahinensis* has the nodules as rounded, conical knobs, not produced axially down the body; the row of nodules is set more towards the anterior, and behind them the whorl is much less concave than is that of *marwicki*; the neck is wider and the beak shorter. The peripheral carina connecting and surmounting the tubercles of *adusta* is not present in the holotype of *koruahinensis*, but in a large specimen recently collected a carina is present on the body-whorl, though much more weakly developed than that of *adusta*; the species is in this respect reminiscent of specimens of *marwicki* from White Rock River, though shells from the type locality have no peripheral keel.



**Verconella** sp.

A juvenile shell, with the apical whorls decorticated. The suture is strongly cut in and is well below the periphery, and the nodules are set around the middle of the whorl. They are more numerous, weaker and blunter than those of *marwicki*, and less numerous than those of *adusta*. Spiral sculpture strong and regular.

Specimen in collection of A.U.C.

**Cominella (Acominia) facinerosa** Bartrum and Powell.

*Trans N.Z. Inst.*, vol. 59, p. 148, 1929.

At the time of description the type was unique. Two further specimens have since been obtained, and at first sight the shape of body of these suggests recognition as a separate species. The holotype has the last whorl heaped up posteriorly and the anterior part drawn in early to axis of shell; in the topotypes the greatest width of body is about at the middle, and the base is not so soon contracted and is more bulging. Similar variation in the shape of the body is found in other species of *Acominia*, notably *adspersa* and *kereruenensis*. The three Kaawa shells show also variation in the development of the umbilicus, and this is found among individuals of *kereruenensis* also.

Specimens in collection of A.U.C.

**Poirieria** cf. **primigena** Finlay.

True *zelandica* along with a form closely resembling *primigena* (and practically indistinguishable from shells of that species from Blue Cliffs, South Canterbury) occurs in the beds at Kaawa.

Finlay (1930b, p. 76) in his diagnosis of *primigena* separates it from the Recent species by the position of the keel, which is below the middle in *primigena* and at, or slightly above, the middle in *zelandica*. This seems to be the only separative character, but it gives the species a very different appearance from *zelandica*, for in *primigena* the spire has straight outlines and is not stepped.

Specimens in writer's collection. New record.

**Xymenalla** cf. **lepida** (Suter).

Two specimens, one badly rubbed and the other considerably decorticated. This is the first record of the genus from Kaawa.

Specimens in writer's collection. Collected also by Mr E. J. Searle, M.Sc.

**Lepsia** cf. **haustrum** (Martyn).

Two fragmentary specimens consisting of the body-whorl only. Very close to *haustrum*, but with parietal wall concave, pillar flatter and not so ridged up in front. The shoulder is evenly rounded, not sub-angled as in the Recent form, and the aperture is wider in front and more broadly ovate.

Specimens in collections of A.U.C. and of the writer.

Genus INGLISELLA Finlay.

Type (o.d.): *Ptychatractus pukeuriensis* Suter.

**Inglisella hirta** n.sp. (Fig. 69).

Shell small, height of spire about twice that of aperture. Extreme summit of embryo missing, remaining portion quite that of the genus. Whorls shouldered high up; shoulder little sloping, almost a tabulation; descending straight below shoulder. Axials much like those of *I. cincta* (Hutton), antecurrent to suture on shoulder, straight and vertical below that; axials about 14 in number on penultimate whorl, spaced their own width apart, dying out early on base of last whorl. Shoulder with 3 fine spiral threads; below shoulder there are 4 heavier spirals, the first and third from above very coarse, the others weaker. Body-whorl with 3 heavy spirals above line of suture and 2 weaker ones alternating between them; from posterior of aperture another heavy spiral emerges; base with 6 or 7 spiral threads. Where heavier spirals intersect axials there is slight nodulation on all whorls. Body-whorl strongly shouldered above; lightly convex over periphery and base. Aperture ovate, broadly angled behind, produced into a short open canal in front; parietal wall very lightly callused; columella straight above, flexed strongly to left below, rather thickly callused; outer lip sinuous, there being a broad, shallow sinus posteriorly; columella with 2 very low folds well within aperture, not seen from the front.

Height, 4.5 mm.; width, 2.0 mm. (holotype).

Type in writer's collection. Fragmentary paratypes in collections of A.U.C. and of the writer.

The axial sculpture is more like that of *I. cincta* than that of *I. pukeuriensis*, but the spirals are coarser and ruder than those of either of the Awamoan species. The base is more excavated in *cincta* and *pukeuriensis* and the canal not so much bent to the left. The straight whorls and much less sloping shoulders also serve to distinguish the Kaawa species.

This is another instance of a hitherto distinctly Oamaruan genus appearing in the beds at Kaawa.

Genus ALCITHOE H. and A. Adams.

Type: *Buccinum arabicum* Martyn.

**Alcithoe** n.sp.

There is a fragmentary shell with most of the body-whorl lost. It shows characters of both *transformis* Marwick and *swainsoni* Marwick. The axials of the spire are finer and closer than those of *transformis*, and become more prominent towards the aperture than is usual in *swainsoni*. The material is too poor for further description.

Specimen in collection of A.U.C.

**Alcithoe** cf. *mackayi* Marwick.

A shell with most of the spire missing and the outer lip broken back comes nearest to *mackayi*, but does not fit that species exactly. It has the same shaped whorls and a similar sculpture, but slightly

more numerous axials, which are perhaps a little more tubercular on the shoulder and rather less strongly produced down the whorl. The beak also shows a slight twist to the left.

Specimen in collection of A.U.C.

***Alcithoe propearabacula* Bartrum and Powell.**

Finlay (1930a, p. 252) rightly considers this a synonym of *Mauithoe parva* (Marwick).

***Alcithoe arabicula* Marwick (Figs. 71, 72, 73).**

*Trans. N.Z. Inst.*, vol. 56, p. 293, 1926.

The holotype, apparently the only material available at the time of description, is an incomplete shell with practically all of the spire absent. About 10 more or less complete specimens have since been collected, and several of these are figured to show the very great variation amongst individuals of this species. Judging from Marwick's figure the holotype is not quite typical of the species, for none of the shells collected by Professor Bartrum and the writer shows the tubercles so far above suture. The periphery is extremely low on whorls immediately above suture, so that the spire is regularly conic and suggestive of *depressa*. Indeed, the species seems to be closely allied to *depressa*, and one of the Kaawa individuals bears striking resemblance to the holotype of *depressa* as figured by Marwick.

It is possible that we have evidence of actual species transformation, for great evolutionary activity seems to have been going on in the Kaawa *arabacula*. Certainly the species was then in a state of flux, and it seems not unreasonable to suggest that the recent *depressa* may have been a product of this evolutionary display.

The general build and form of shell is similar in all these individuals, but they differ strikingly and inconstantly among themselves as regards features of sculpture. The form and sculpture of whorls of spire show no variation, but it was only as the animal attained maturity that evolutionary influences, whatever they were, were able to express themselves in visible form.

The most outstanding variation is to be had in the size of the adult shell, the largest adult individual measuring about 99 mm. in length, the smallest adult about 63 mm. In all shells a transition in the character of axial sculpture begins at about the close of the penultimate whorl. Normally the transition is from nodules on penultimate and earlier whorls to tubercles on body-whorl. One individual, however, shows the gradual obsolescence of all axial sculpture on the body. The number of tubercles on the last whorl is inconstant, and ranges between 10 and 7. There is also a very marked variation in tubercular shape and strength, one shell in particular having exceptionally prominent tubercles rather flattened in a plane parallel with that of the suture; typically the tubercles are not unduly large and are not compressed.

Genus PACHYMELON Marwick.

Type (o.d.): *Waihaoia amoriaformis* Marwick.

Subgenus PALOMELON Finlay.

Type (o.d.): *Cymbiola lutea* Watson.

**Pachymelon (Palomelon) powelli** n.sp. (Fig. 75).

Shell very small, of solid build; spire a little over half height of aperture, its outline practically straight. Periphery below middle of whorls, marked by a row of close, inconspicuous nodules, slightly elongated axially; posterior zone of whorls concave; suture considerably clasping. Body-whorl about three-quarters length of shell, broadly excavated above periphery, which appears as a well-marked shoulder; periphery of body-whorl not nodular, but crossed by thin, light axials which extend inconspicuously down on to the base; the axials are subobsolete on the concave shoulder. Body-whorl contracts slowly and regularly to beak, there being very little excavation towards anterior. Fasciole inconspicuous. Aperture narrow behind, broadening in front; basal notch wide, shallow; outer lip thin, straight; inner lip with a thick pad of callus, sweeping out across whorl and then descending vertically to beak; columella straight, slightly oblique, its plaits (4 in number) distinct, widely spaced, the posterior three subequal in strength and moderately oblique, the anterior plait much weaker and very oblique.

Height, 28.0 mm.; width, 13.5 mm. (holotype).

Type in collection of Mr A. W. B. Powell, Auckland. Paratypes in collection of A.U.C.

The writer's thanks are due to Mr Powell for permission to use his shell as holotype.

Genus MICROVOLUTA Angas.

Type: *M. australis* Angas.

**Microvoluta vetusta** n.sp. (Fig. 74).

Shell small, spire stepped, its height about equal to that of aperture. Whorls keeled at middle, concave above. Suture margined by a small slightly swollen band. Keel set with distinct, sharp tubercles, weakly prolonged below, but not reaching suture; penultimate whorl with 11 or 12 tubercles. Embryo of one or two smooth convex volutions. Body-whorl long, over half height of shell, concave above carina; base excavated above fasciole, which is strong and swollen; beak very considerably twisted. Aperture typical of the genus; columella with 4 plaits diminishing in strength towards the anterior; canal like that of *biconica*. Weak spiral striae are present over most of the surface, and become stronger on the swollen fasciolar area. A little distance within the outer lip there is a row of fine, linear lirations.

Height, 9.0 mm.; width, 4.0 mm.

Type (unique) in collection of Auckland University College.

*Cuvierensis* Finlay is a smoother shell and has the swollen subsutural border wider and the concavity of shoulder narrower *Linca* (Hutton), from the Pliocene of Hawkes Bay, is a stouter

shell with wider spire and body. *Vetusta* is closest to *biconica* (Murdoch and Suter), but is larger and has weaker spirals, whilst the nodules are heavier, more prickly and not continued axially to anterior suture, as in *biconica*.

This record of the genus prolongs its ancestry in the New Zealand region back to early Pliocene times; but it occurs in Balcombian (Oligocene) beds in Australia (*M. ligata* Tate).

***Baryspira (Alocospira) subhebera* (Marwick).**

*Trans N.Z. Inst.*, vol. 56, p. 323, 1926.

This is the shell which Bartrum and Powell (1928, p. 149) compared with *hebera* (Hutton). A larger range of specimens is now to hand, and study of these shows that they should be referred to *subhebera* (Marwick). *Hebera* has straighter sides, is relatively longer and narrower, has typically a spirally striated apical callus, and columella less excavated.

***Baryspira (Alocospira) novaezelandiae* (Sow.).**

A single shell, quite distinct from *exspata* (Bartrum and Powell), and agreeing entirely with specimens of *novaezelandiae* from Castlecliff and Hawkes Bay.

Specimen in writer's collection.

**"*Liracraea*" *sata* n.sp. (Fig. 77).**

Shell small, height of spire somewhat greater than that of aperture plus canal. Protoconch similar to that of *Mangilia leptosoma* Hutton, but larger, blunter and much broader at base. Brephic sculpture of 5 coarse spirals (*leptosoma* has 4 fine ones) and low, weak axials, the axials on brephic whorls of *leptosoma* being well defined, thin, sharp, widely spaced. Adult whorls keeled slightly below middle, the keel bearing the heaviest spiral of the whorl; below keel there are 2 other cords, less heavy than that on keel and 1 or 2 fine interstitial threadlets; shoulder long, sloping, straight, bearing 6 or 7 very fine spiral threadlets, which tend rather to alternate in strength. Axials much as in *leptosoma*, but not so widely spaced, nodulated on carina of whorls; axials 12 in number on the body. Body-whorl long and narrow, a fairly long sloping shoulder and angulated periphery. Below keel there is the following development of spiral sculpture in order from keel to anterior of shell: keel, 3 fine threadlets, a cord of moderate strength, 2 fine threadlets, cord of moderate strength, 1 threadlet, a cord not so strong as the posterior ones, about 12 threads of approximately equal strength, the interstices about same width as threads (above details of sculpture seen on a paratype). Aperture pyriform, angled behind, drawn out into a moderately long widely open canal in front; inner lip lightly callused, beak long; outer lip thin, a distinct sinus at shoulder, lightly convex below shoulder.

Height, 4.8 mm.; width, 2.1 mm. (holotype).

Type in writer's collection.

In features of embryo and general shell characters this species has alliance with the Awamoan *leptosoma* Hutton rather than with *epentroma* (Murdoch) and *titirangiensis* Marwick. Generic distinction seems to be indicated.

The single strong keel separates *sata* at a glance from *epentroma*, which has 2 strong cords. Also the spiral sculpture is much coarser in the Kaawa species, and the beak wider and less drawn out anteriorly.

**Guraleus ngatuturaensis** Bartrum and Powell.

*Trans. N.Z. Inst.*, vol. 59, p. 151, 1929.

In the build and sculpture of adult whorls *ngatuturaensis* is reminiscent of *G. gracilentata* (Suter); but its suture is rather more cut in and the axials less fine and sharp. Fine spiral sculpture is common to both, and this at a glance separates them from *G. sinclairi* (Smith), which also has much ruder axial sculpture. The embryo of *gracilentata* has more volutions and is more sharply pointed than that of either *sinclairi* or *ngatuturaensis*.

Genus GEMMULA Weinkauff.

Type (s.d., Cossmann, 1896): *Pleurotoma gemmata* Rve.

**Gemmula disjuncta** n.sp. (Fig. 82).

Shell small, spire about twice height of aperture; protoconch not observed. Post-embryonic whorls about 7 in number, keeled at, or slightly below, middle, the keel ornamented by a row of blunt, heavy, rounded tubercles about 14 in number on penultimate whorl, but becoming obsolete on the body. On the keel and in intervals between tubercles there are several fine threads. The subsutural border has subobsolete nodules and is weakly chordate. Between sutural border and keel there are several fine threads; below the keel one, and sometimes two, coarser threads just above suture. The base carries distinct, regular cords, spaced evenly over earlier part, but becoming closer and finer on neck. Outer lip with a deep sinus on keel. Inner lip callused, the callus thickening on neck.

Height, 11.5 mm.; width, 4.2 mm. (holotype).

Type in writer's collection. Paratypes in collections of A.U.C. and of the writer.

This is the shell referred to as *Turris* cf. *duplex* Suter by Bartrum and Powell (1928, p. 151), and also as *Turris* cf. *bimarginata* Suter by Henderson and Grange (1926, p. 57). It seems nearer to *bimarginata* than to *duplex*. The latter has the spiral row of nodules not so outstanding from whorl, and situated more towards the anterior. Also the subsutural border is stronger. Further, the subsutural spiral carries tubercles in *duplex*, and these are almost obsolete in the Kaawa shells.

*Bimarginata* is taller, has sharper tubercles in a medianly placed spiral, which stands up very strongly from whorls. The two strong cords just below periphery of last whorl of *bimarginata* are not present in *disjuncta*, but as in that species there are threads over the base. *Disjuncta* has a shorter canal.

*G. peraspera* Marwick is somewhat similar, but is taller and has sharper tubercles set on a sharper keel.

**Phenatoma** aff. *zelandica* (E. A. Smith).

Three fragmentary shells. These may require recognition as a new species when better material is available. The sinus is deeper in *zelandica*.

**Splendrillia aoteana** Finlay.

Finlay (1930, p. 47) has used the above name for *Pleurotoma laevis* Hutton (preoccupied). The type of *laevis* is a Recent shell from Stewart Island. The Kaawa specimens are inseparable from shells taken off Otago Heads.

Genus **AUSTRODRILLIA** Hedley.

Type (o.d.): *Pleurotoma angasi* Crosse.

**Austrodrillia consequens** n.sp. (Figs. 76, 78).

Shell small, spire about  $1\frac{1}{2}$  times height of aperture. Protoconch of two smooth volutions. Whorls keeled slightly below middle, the keel nodulated bluntly where crossed by axials. A wide concave shoulder above bearing several weak cords. Suture submargined by a stronger cord. The strongest spiral cord is on the keel, below which there are 2 or 3 strong, well-spaced spirals. Frequently the keel bears 2 prominent cords of equal strength. Interstitial threadlets are sometimes present between the cords anterior to the keel. Body-whorl with a wide concave shoulder, a strongly rounded periphery, and contracting rapidly to neck, which is short and wide. The base and neck have equally-spaced, regular spiral cords, about 12 below the keel of the whorl. Outer lip deeply notched, the apex of the notch at the middle of shoulder; the lip convex below that.

Height (estimated), 8.0 mm.; width, 3.0 mm. (holotype).

Type and several paratypes in writer's collection. Paratypes also in collection of A.U.C.

Of already described species this comes closest to *A. cinctuta* Marwick, but *cinctuta* is not so slender and has finer, thread-like spiral sculpture. It resembles certain undescribed species from Awamoan beds in North Otago. Of the Gisborne species it seems to be nearest to *afflicta*, but there are considerable differences.

**Austrotoma minor** Finlay.

*Trans. N.Z. Inst.*, vol. 55, p. 515, 1924.

A half-dozen shells differ in no constant way from topotypes of this common Awamoan species. Axial obsolescence appears to be retarded somewhat on the shells from Kaawa, when they are compared with topotypes, but this character is found to vary a little when specimens of *minor* from different South Island Awamoan horizons are inspected.

Specimens in collections of A.U.C. and of the writer.

## Genus ZEACUMINIA Finlay.

Type (o.d.): *Terebra sulcata* Marshall.**Zeacuminia parva** n.sp. (Figs. 80, 85).

Shell much smaller than typical *Zeacuminia*, and with a low, widely conic, polygyrate embryo of pupoid habit. This contrasts with the high nucleus of more typical species. Suture bordered below by a spiral tumidity set with distinct nodules; below this is a narrow sulcus bearing no sculpture; the rest of the whorl is convex and is sculptured by fairly sharp, slightly curved axials which extend to anterior suture. On body-whorl the axials evanesce early below periphery. A narrow fasciolar ridge is present.

Possibly a new group is indicated. *Parva* resembles shells from Awamoan localities in the South Island, notably White Rock River and Target Gully.

Height (estimated), 8.0 mm.; width, 2.1 mm. (holotype).

Type and a number of paratypes (fragmentary) in writer's collection.

**Zeacuminia subtilissima** (Bartrum and Powell).

*Trans. N.Z. Inst.*, vol. 59, p. 151, 1928.

This species was referred by its authors to *Pervicacia*, but the apex (polygyrate and pointed in a high spiral) as well as other shell characters shows it to be a *Zeacuminia*. *Biplex, pareoraensis* and *cantuariensis* all have a prominent subsutural tumid band, below which the whorl is flat or very lightly concave; in *subtilissima* the subsutural zone is only very slightly differentiated into a swollen border.

**Pervicacia tristis** (Deshayes).

The shell listed as *tristis* is doubtfully referable to that species. Important divergent characters are much smaller adult size; pupoid outline over earlier whorls; smaller, less blunt embryo standing more exsert. It probably represents a new species.

**Pervicacia benesulcata** (Bartrum).

*Trans. N.Z. Inst.*, vol. 51, p. 99, 1919.

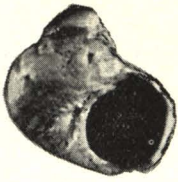
This species has paucispiral convex embryo typical of *Pervicacia*. The type is a fragmentary shell, not well preserved. Good specimens show fine spiral striae except on the concave shoulder. The beak is short and strongly twisted to the left.

## Genus KAWEKA Marwick.

Type (o.d.): *K. fulva* Marwick.**Kaweka bartrumi** n.sp. (Figs. 79, 81).

Shell small, of  $6\frac{1}{2}$  adult whorls, spire nearly 3 times height of aperture. Protoconch broken off at tip, but apparently paucispiral. Spire-whorls sharply angled at middle, the angle strongly tuberculate; concave above. Axials weakly continued across whorl both





30a



31.



30b.



43.



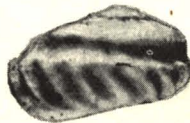
44.



45.



46.



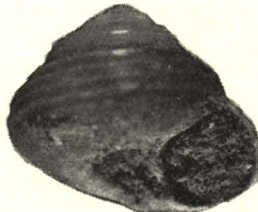
47.



48.



49.



50.



51.



52.



53.



54.



55.

FIGS. 30a, 30b.—*Crosseola tenuisculpta* n.sp.; holotype,  $\times 17.3$ . FIG. 31.—*Awanuia tenuis* n.sp.; holotype,  $\times 17.3$ . FIGS. 43, 44.—*Schismope ngatutura* n.sp.; holotype,  $\times 17.3$ . FIG. 45, 46, 47.—*Schismope koruahina* n.sp.; holotype,  $\times 17.3$ . FIG. 48.—*Emarginula paucicostata* n.sp.; holotype,  $\times 3.0$ . FIG. 50.—*Antisolarium conominolium* n.sp.; holotype,  $\times 10.3$ . FIG. 49, 51.—*Munditia proavita* n.sp.; holotype,  $\times 12.4$ . FIGS. 52, 55.—*Elachorbis subedomita* n.sp.; holotype,  $\times 17.3$ . FIGS. 53, 54.—*Cirsonella aedicula* n.sp.; holotype,  $\times 17.3$ .

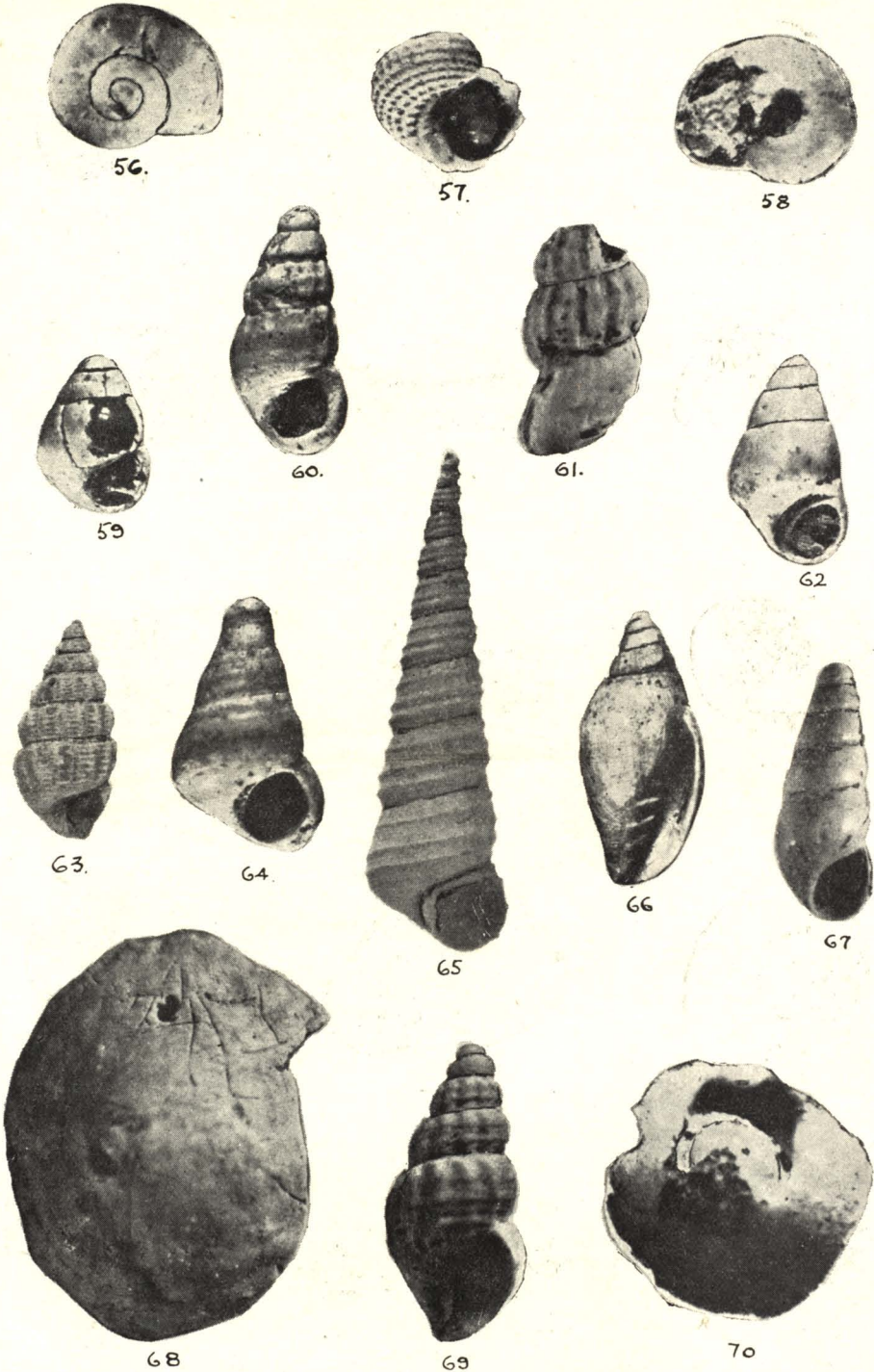
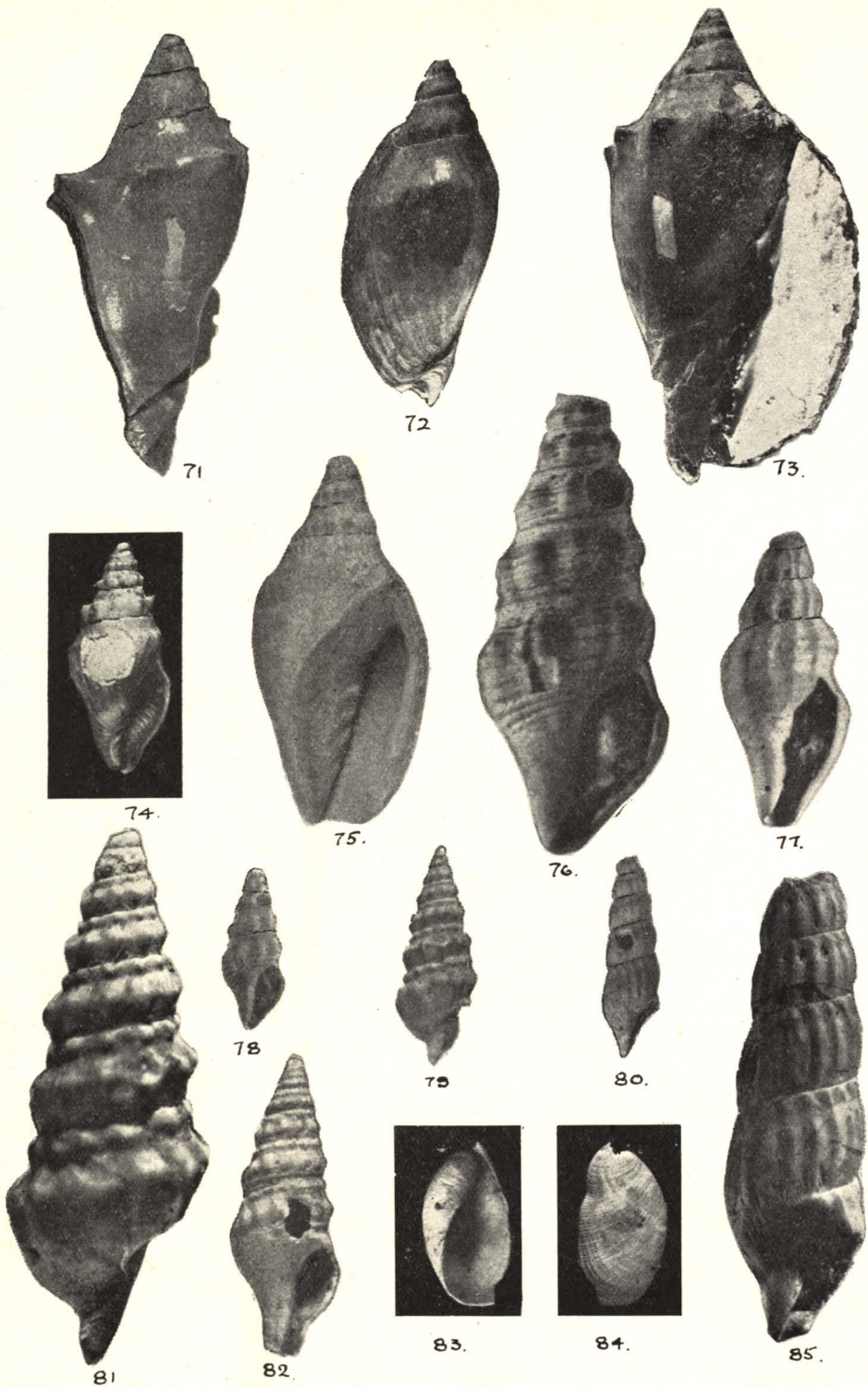


FIG. 57.—*Crosseola munditia* n.sp.; holotype,  $\times 17.3$ . FIGS. 56, 58.—*Argalista promicans* n.sp.; holotype,  $\times 17.3$ . FIG. 59.—*Notosetia tantilla* n.sp.; holotype,  $\times 17.3$ . FIGS. 60, 61.—*Merelina kaawaensis* n.sp.; holotype,  $\times 17.3$ . FIG. 62.—*Scrobs kaawaensis* n.sp.; holotype,  $\times 17.3$ . FIG. 63.—*Atarocerithium kaawaensis* n.sp.; holotype,  $\times 2.6$ . FIG. 65.—*Stiracolpus kaawaensis* n.sp.; holotype,  $\times 3.8$ . FIGS. 68, 70.—*Cheilea postera* n.sp.; holotype,  $\times 9.0$ . FIG. 67.—*Balcis geoffreyi* n.sp.; holotype,  $\times 12.5$ . FIG. 64.—*Badenia biangulata* n.sp.; holotype,  $\times 17.3$ . FIG. 66.—“*Mitra*” *bicornis* n.sp.; holotype,  $\times 3.7$ . FIG. 69.—*Inglisella hirta* n.sp.; holotype,  $\times 8.8$ .



FIGS. 71, 72, 73.—*Alcithoe arabicula* Marwick; topotypes (Figs. 72, 73,  $\times .7$ ). FIG. 75.—*Palomelon powelli* n.sp.; holotype,  $\times 1.9$ . FIG. 74.—*Microvoluta vetusta* n.sp.; holotype,  $\times 3.6$ . FIG. 77.—“*Liracraea*” *sata* n.sp.; holotype,  $\times 8.5$ . FIG. 82.—*Gemmula disjuncta* n.sp.; holotype,  $\times 3.6$ . FIGS. 76, 78.—*Austrodrillia consequens* n.sp.; holotype,  $\times 3.0$  (Fig. 78). FIGS. 80, 85.—*Zeacuminia parva* n.sp.; holotype,  $\times 4.0$  (Fig. 80). FIGS. 79, 81.—*Kaweka bartrumi* n.sp.; holotype,  $\times 3.7$  (Fig. 79). FIGS. 83, 84.—*Scaphander hiulca* n.sp.; holotype,  $\times 3.2$ .



above and below carina. Subsutural band well marked, nodulated where intersected by axials. The body-whorl carries 10 axial ribs. The biangulate body and the aperture have all the features typical of the genus.

Height, 8.3 mm.; width, 3.1 mm.

Type (sole specimen) in writer's collection.

It is interesting to find this genus, previously known only from the Miocene of Gisborne District, turning up in the Pliocene. The present species is nearer to *K. fulva*, with which it agrees very closely indeed in sculpture, but the spire is much higher relative to height of body than is that of *fulva*; the base is shorter and more rapidly drawn in to the twisted neck. The fasciole and its posterior limiting ridge are well defined.

This species is named in honour of Professor J. A. Bartrum, of Auckland University College.

### *Cylichna thetidis* Hedley.

Suter, *Man. N.Z. Moll.*, p. 532, 1913.

There are 2 specimens. The only observable difference from *thetidis* is to be had in the slightly weaker columellar swelling. Suter referred this species to *Cylichnella*, but this location cannot be maintained as that genus has two folds on the columella. *Cylichnina* Monterosato with its more oval body and shorter columella does not conveniently cover it; it seems to fit more naturally into *Cylichna* Loven, which was Hedley's original location.

### Genus SCAPHANDER Montfort.

Type (o.d.): *Bulla lignaria* Linné.

### *Scaphander hiulca* n.sp. (Figs. 83, 84).

Shell small, fragile, wide in front, narrower behind, not umbilicate. Spire involute. Body-whorl embracing all earlier volutions. Aperture narrowly channelled behind, effuse in front (outer lip broken). Parietal callus thin. Columella very long, thin, arcuate. Sculpture of very numerous, flat, wavy, spiral cords often arranged in pairs, and coarser and more widely spaced on posterior half of shell: interspaces flat-floored, of rather unequal width. There is a very distinct, broad depression on shoulder encircling posterior end of the body.

Height, 7.0 mm.; width (estimated), 4.1 mm.

Type (sole specimen) in writer's collection.

Easily distinguished from *S. scapha* Laws, which otherwise it simulates closely, by the depressed zone at posterior of body. Also the outer lip projects more behind and the columella is longer and much less arcuate. *S. malleatus* Marwick has straight sides and the columella very much shorter and strongly excavated.

This is the third species recorded from New Zealand, though several undescribed Oamaruan fossils are known. So far as the writer knows it is the only occurrence of the genus in post-Miocene rocks in New Zealand. It has close alliance with *S. scapha* from Awamoan beds in the South Island.

**Cadulus** sp.

There are a half-dozen more or less fragmentary specimens. No attempt has been made to determine them specifically. This is a new record for the locality. A number of new species from South Island Oamaruan beds await description.

Specimens in writer's collection.

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