

The Molluscan Fauna of Target Gully: Part 1.

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SINCE Target Gully is the richest fossil deposit in New Zealand, and in many ways is regarded as a type locality for the Awamoan horizon, it is necessary that its fauna should be thoroughly examined. Five visits have been paid to Oamaru localities, and some forty to fifty thousand specimens have been obtained. Examination of these has shown that the existing list of fossil shells from this locality (13a)* is far from complete, and needs much revision in its nomenclature. The present paper is a preliminary attempt to deal with this: it consists of lists of new records from four Oamaru localities, and a series of notes on the necessary nomenclatural changes. A complete list of the Mollusca from Target Gully will be presented on a future occasion.

The following species, not previously obtained from this locality, may now be added to the list. Where a name has been corrected, the old name is placed in square brackets after it. To facilitate reference the lists are in alphabetical order. An asterisk denotes a Recent species. Probably it will prove, when actual specimens have been compared, that the "Recent" species in these and other lists are not in all cases conspecific with now-living forms, but for the present these names are in usage and can be adopted as tentative.

Aethocola spinifera Finlay and McDowall.

Alectrion latecostata Sut.

Bela tenuilirata (Sut.). [*Ptychatractus*.]

**Cadulus delicatulus* Sut. (Recorded as fossil previously only from Pakaurangi Point.)

Callanaitis speighti Sut. [*Chione*.]

Chlamys chathamensis (Hutt.). [*Pecten*.]

Cominella pulchra Sut.

Crossea cf. *cancellata* (T.-Woods). (New as a fossil.)

Cucullaea alta var. B Hutt.

Cucullaea attenuata Hutt.

Galeodea senex (Hutt.).

**Hexaplex octogonus* var. *umbilicatus* (T.-Woods). [*Murex*.]

**Hexaplex octogonus* var. *espinosus* (Hutt.). [*Murex*.]

* Numbers in brackets refer to the bibliography at the end of the paper.

- **Lepidopleurus iredalei* Ashby. [*L. inquinatus*.] (New to the Miocene, and the first Chiton recorded from the Awamoan.)
- **Murex zelandicus* Q. & G.
- **Nuculana bellula* (A. Ad.). [*Leda*.]
Ostrea wuellerstorfi Zitt. (A juvenile shell, but apparently referable to this species.)
- Pecten beethami* Hutt.
- Pecten hutchinsoni* Hutt.
- **Pleurodon maorianus* Hedley. (Previously recorded fossil only from Pukeuri.)
- **Saxicava arctica* (L.). (New for the Miocene.)
- Sinum miocaenicum* (Sut.).
- Struthiolaria subspinoso* Marwick.
- Struthiolaria tuberculata* Hutt.
- Typhis maccoyi* T.-Woods.
- Vexillum fenestratum* Sut. (Also at the Rifle Butts.)
- Vexillum linctum* (Hutt.).

In addition, various authors have recorded the following species from Target Gully:—

- Admete suteri* Marsh. & Murd (8b, p. 132).
- Admete maorium* Marsh. & Murd. (8c, p. 82).
- Aethocola spinifera* Finlay and McDowall (3, p. 113).
- Austrotriton neozelandica* Marsh. & Murd. (8d, p. 122).
- Calliostoma suteri* Finlay (2a, p. 101).
- Calliostoma suteri* var. *fragile* Finlay (2a, p. 102).
- Couthouyia concinna* Marsh. & Murd. (8c, p. 80).
- Drillia laevis* Hutt. (8a, p. 249).
- Eulima aoteaensis* Marsh. & Murd. (8c, p. 84).
- Euthria subcallimorpha* Marsh. & Murd. (8c, p. 83).
- Ficus subtransennus* Marsh. & Murd. (8a, p. 249).
- Ficus imperfectus* Marsh. & Murd. (8a, p. 255).
- Melina zelandica* Suter (8c, p. 77).
- Odostomia pseudorugata* Marsh. & Murd. (8c, p. 83).
- Venericardia bollonsi* Suter (8a, p. 249).
- Vermicularia ophiodes* Marsh. & Murd. (8c, p. 80).

Notes on *Admete*, *Austrotriton*, *Euthria*, and *Odostomia* will be found later on in this paper. The record of *Melina zelandica* Sut. is here confirmed (though the name should be *Isognomon zelandicum* (Sut.), *Isognomon* Solander, 1786, having two years' priority over *Melina* Retzius, 1788—see 6b, p. 303); but the identification of *Drillia laevis* Hutt. is probably erroneous. The name *Ficus subtransennus* is possibly a *lapsus calami* for *F. transennus* Sut.; if not, it is a *nomen nudum*, as no such shell has been described or figured.

Of the remaining species, *Admete suteri* and *A. maorium* are two of the shells termed "*Merica* n. spp." by Suter in the list of 1916; *Calliostoma suteri* is his "*Calliostoma* n. sp.," and its variety *fragile* is his "*Basilissa* n. sp."; *Eulima aoteaensis* is his "*Eulima* n. sp."; *Odostomia pseudorugata* is one of his "*Odostomia*, 2 n. sp."; and *Vermicularia ophiodes* is his "*Vermicularia* sp."

Suter's "*Merica* (*Aphera*) n. sp." is a juvenile shell of *Latirus brevis* (Hutt.). This species is undoubtedly a Cancellarid, and, though not quite typical, agrees fairly well with *Bivettia* as defined by Cossmann. A true (undescribed) species of *Aphera* does, however, occur at Target Gully. Suter's "*Sveltia* n. sp." is probably a *Vexillum* (*Fusimitra*) n. sp.

As regards the "*Barnea* n. sp." of the list, there is considerable doubt. I have a small indeterminate fragment of a shell that may belong to this species, and perhaps this was the species Suter referred to; but in the collection of the Otago School of Mines is another shell which is so labelled in Suter's writing, and which is only a much-twisted left valve of *Anomia trigonopsis* Hutt., with the scars and ornamentation quite distinct.

An examination of specimens from Target Gully of *Modiolus australis* (Gray) and *Monodonta coracina* (Troschel) is desirable, as these records are very doubtful. I have already shown (2a) that the record of *Trochus tiaratus* Q. & G. is almost certainly erroneous.

As regards the nomenclature of the recorded species, many changes are necessary, for the work of Iredale, Hedley, and others has shown that the old common names are often wrongly used. Most of the corrections to be made in the present list are contained in the "Commentary" published by Iredale in 1915 (6a). Others are contained in papers contributed by the same author to the *Proc. Mal. Soc.* (6 b, c, d); several changes have been made by Hedley in various publications (4 a, b); some corrections were suggested in these *Transactions* by Cossmann (1); and I have advocated various nomenclatural changes (2b). The following are the necessary changes as regards names of Target Gully shells:—

Calyptraea maculata (Q. & G.) should be *C. novae-zelandiae* (Lesson) (6a).

Chamostraea and *Cytherea* should respectively be *Cleidothaerus* (1) and *Antigona* (6a).

Circulus helicoides (Hutt.) and *C. politus* Sut. are congeneric with the Recent *C. subtatei* Sut. of New Zealand and *C. tatei* (Angas) of Australia, which is the type of Iredale's genus *Elachorbis* (6a), so that here *Circulus* must give place to his genus-name. *Circulus cingulatus* Bartrum (7), from Kaawa Creek, is another member of this genus.

Leda should be *Nuculana* (6a), and *Lissospira exigua* Sut., which is congeneric with *L. micra* (T.-Woods), should be classed with it as a *Lissotesta* (6a).

Of the three *Pectens* listed, two belong to the genus *Chlamys* (6a)—namely, *burnetti* Zitt. and *radiatus* Hutt.

The name *Cyclostrema* must disappear from the list. There are many minute species from Target Gully that fall very well into the genera of Iredale's family *Liotiidae* (6a), but *Cyclostrema*, as Iredale has shown, is indeterminate, being too indefinitely characterized.

Cossmann, after examining specimens of *Cylchnella soror* Sut. and *C. enysi* Hutt., pronounced them both to belong to *Bullinella* (1). The same author states that *Leptothyra fluctuata* (Hutt.) is a *Tiburnus* (1), but Iredale has named this species as the type of his genus *Argalista* (6a), and, unless it is shown that the two are identical, this is the genus-name it will bear. Iredale mentions (6a) that *Leptothyra laeta* Montrouzor, *L. picta* Pease, and *Pseudoliotia imperforata* Sut. are congeneric, and adopts the name *Leptothyra* (6a) for all; but later (6d) he has shown that *Leptothyra* was proposed for a different kind of shell, and has introduced the name *Collonista* for these species, with *C. picta* (Pease) as type. *Collonista imperforata* (Sut.) has not yet been found fossil.

Loripes, *Psammobia*, and *Tellina glabrella* Desh. should respectively be *Lucinida* (6a), *Gari* (6a), and *Macoma edgari* Iredale (6a).

Murex angasi Crosse falls into the genus *Pteronotus* (6a), while *M. octogonus* Q. & G. is placed by Iredale in Perry's genus *Hexaplex* (6a). *Trochus chathamensis* (Hutt.) is the type of *Thoristella* Iredale (6a), but the shell so called from Target Gully is distinguishable by its umbilical characters from Recent specimens, and will be described later. All the Target Gully

Trophons are members of Iredale's genus *Xymene* (6a), being congeneric with *X. plebejus* (Hutt.), the type of this genus.

Odostomia has been divided generically by Iredale (6a): *O. pudica* Sut. remains in *Odostomia*, but *O. rugata* Hutt. should be *Pyrgulina rugata* (Hutt.), and *O. pseudorugata* M. & M. should accompany it here.

Surcula, *Tornatina*, *Tritonidea*, and *Volvulella* should respectively be *Turricula* (6c), *Retusa* (6b), *Polia* (6a), and *Rhizorus* (6b).

Suter's usage of the name *Hemiconus ornatus* (Hutt.) being illegal (2b), its place must be taken by *H. trailli* (Hutt.).*

Venericardia pseutes Sut. should be *V. awamoensis* Harris (2b), and the record of *V. difficilis* (Desh.) should be expunged, being based on juveniles of the shell listed as *V. subintermedia* Sut. n. var.

The shell identified as *Cantharidus tenebrosus* A. Ad. is not that species, but a new one, closer to *C. sanguineus* Gray.

The type of *Crepidula striata* (Hutt.) is lost, and the species indeterminable; the shells classed under that name should be *C. radiata* (Hutt.) (2b)—Hutton's *Pilaeopsis radiatus*. The forms recorded as *C. costata* (Sow.) belong in some cases to *C. radiata* (Hutt.), in others to a species easily separable from the Recent *C. costata* (Sow.), and this name should be omitted. *C. incurva* Zitt. (which is not identical with *C. gregaria* Sow.) is preoccupied, and has been renamed *C. wilckensi* Finlay (2b).

The record of *Xymene quirindus* Iredale (Suter's *Trophon hanleyi* Ang.) refers to a variant of *X. lepidus* (Sut.), which is plentiful at Target Gully, and varies considerably in size, shape, and ornament, though it is fairly constant at Ardgowan. I have found no specimen of *X. quirindus* in the Miocene, so that the record of this Recent species had better be omitted from Target Gully lists until authentic specimens are found. It may be mentioned here that *Cymatium suteri* M. & M. (8c, p. 80) is evidently a *Xymene*, quite close to *X. lepidus* (Sut.) and other new Awamoan species.

Limopsis catenata Sut., described as a new species from Target Gully, is the juvenile form of *L. zitteli* Iher., common at that locality.

Mitra armorica Sut. does not occur at Target Gully, the form found there differing markedly from Otiake and Blue Cliffs specimens.

Rissoina emarginata (Hutt.) is included in the list, being given as new for the Miocene. This record is based on a shell not very common at Target Gully, but plentiful at Pukeuri. Good specimens from the latter locality are easily obtained, and show that the species, though closely related to *Nozoea emarginata* (Hutt.) (6a), is certainly distinct, presenting characters intermediate between *N. emarginata* (Hutt.) and *N. coulthardi* (Webster), being probably the ancestral form from which these Recent species diverged.

Similarly, the Recent *Fusinus spiralis* (A. Ad.) is not a member of the Target Gully fauna, the species occurring there being referable to *F. dentatus* (Hutt.), which should not be treated merely as a subspecies of *F. spiralis*. The occurrence of *F. climacotus* Sut. is doubtful.

Mr. Marwick is of the opinion that *Cardium patulum* Hutt. and *Protocardia alata* Sut. should be united under the name *Protocardia patula* (Hutt.). It seems probable that *Protocardia sera* Hutt. is also a synonym; topotypes in my collection seem indistinguishable from *P. patula*. At all events, only the latter species should be admitted to the lists from the Awamoan localities here discussed.

* Since treating of this species (2b) I have discovered that the name *Conus trailli* is also preoccupied, by A. Adams (*Proc. Zool. Soc.*, 1855, p. 121). I now propose for the New Zealand Tertiary species the name *Cenospira bimutata* nom. nov. The shell disagrees radically with *Hemiconus*, and is best left where Suter originally placed it.

The record of *Cymatium minimum* (Hutt.) should be erased from all Awamoan lists, and probably from most others, the type of that species (which has been found by Mr. Marwick, and which, through his courtesy, I have examined) having a tall, slender spire, and in sculpture and appearance differing altogether from the form which is common at most Awamoan horizons, and which really represents a new species of *Austrotriton*, very closely related to the Recent *A. parkinsonianum* (Perry). The shell described from Target Gully by Marshall and Murdoch as *A. neozelanica* seems to have little in common with that genus, and is more fittingly placed in *Charonia*; a new species I have from Clifden, Southland, is closely related and is undoubtedly a *Charonia*.

Turris regius Sut. and *Borsonia rudis* (Hutt.) are characteristic Waiarekan species, and really occur, as far as is yet known, only in the Waihao greensands. Nothing like them occurs at Target Gully, and both these records should be expunged. The existing records of *Borsonia* from the Awamoan (and often other horizons) are mostly based on fractured examples of Suter's *Ptychatractus pukeuriensis* or allied species (which are discussed later). I have not yet seen any example of a true *Borsonia* from the Awamoan.

Corbula canaliculata Hutt. and *C. humerosa* Hutt. are listed as separate species, but are really opposite valves of the same species. All the specimens of *C. canaliculata* that I have, from many Oamaru localities, are right valves, and all of *C. humerosa* are left valves; all my double-valved shells are *humerosa* on one side and *canaliculata* on the other. The two forms always occur together. Suter, when examining the type of *C. humerosa*, mistook the ligament process for a cardinal tooth, and the dental socket for a resiliary pit; he accordingly described it as a right valve, but from the sculpture and his figure it is undoubtedly a left valve. The type of *C. canaliculata* is from Mount Harris, and that of *C. humerosa* from White Rock River; these horizons are both Awamoan and approximately coeval, so that when the above remarks are borne in view any doubt as to their representing the same species disappears. The specific name *humerosa* has two years' priority, and should be used to cover all these forms.

The shells classed in *Bela*, *Ptychatractus*, and *Borsonia* by Suter are unsatisfactorily placed in several cases, but their true position is very difficult to determine. *Ptychatractus tenuiliratus* Sut., *Bela infelix* Sut., and *B. canaliculata*, Sut., whatever their true location may be, are undoubtedly congeneric, agreeing in details of general shape and ornament, conoidal, many-whorled protoconch, columellar plications, and distinct rounded sinus close to the suture. Cossmann has referred *B. canaliculata* Sut. to *Ptychatractus* (1) in the family Fusidae, but the sinus shows that these shells are Turrids: possibly the shell Cossmann studied was wrongly labelled. Suter's location in *Bela* auct.—for which, by the way, Iredale has advocated the substitute *Oenopota* (6a)—is also unhappy, as this genus has a different protoconch, and no columellar folds. Tate (14) has referred what seems to be an essentially similar shell to *Cordieria*, and compared the Australian *C. conospira* Tate with the Paris Basin *C. marginata* Desh. and *C. turbinelloides* Desh., but these have quite different columellar plaits, and are much more like some New Zealand species of *Borsonia* from the Waihao greensands. Tate's species agrees very well with *P. tenuiliratus* Sut. in sculpture, apex, and plaits, but is more slender. More recently, May (10) has figured *Daphnella columbellioides* T.-Woods, which he places in *Buchozia*, and this shell seems still closer to the Neozelanic *P. tenuiliratus* Sut. Evidently a homogeneous group of species is represented by these shells, and their peculiar nature will probably

demand the creation of a new genus. This will be attended to in a revision of the New Zealand Turridae; in the meantime they may be left temporarily in *Bela*. In connection with this note it may be mentioned that *Daphnella varicostata* M. & M., recently described from the beds at Awamoa, is a synonym of *B. canaliculata* Sut. The figure does not show the important columellar plaits, and the sutures are more sloping than usual, but both these differences (as also those mentioned regarding sculpture, protoconch, and suture) can be matched by specimens in my collection from Pukeuri and Target Gully. It is very unusual for the plaits to be obsolete, but two of my senile specimens have an almost smooth pillar. Probably if the specimens used by Marshall and Murdoch were examined they would show this generic feature; it is to be noted that the diagnosis contains the words "columella . . . with small oblique threadlets corresponding with the adjacent spirals," so that these are probably not restricted to the parietal wall as in the figure. In all other respects their shell is a typical senile *B. canaliculata*.

On the other hand, Suter's remaining species of *Ptychatractus*—namely, *P. nodosoliratus* and *P. pukeuriensis*—are certainly not congeneric. Cossmann places the former in *Bela* (Buchozia) (1), but it is very doubtful if the shells he examined were really *P. nodosoliratus* Sut. The parcels sent to this eminent authority seem to have been somewhat carelessly packed, as there are several cases where confusion of species seems to be the only explanation that will account for the remarks made on them—e.g., *Limopsis aurita*, *Bela canaliculata*, and the species at present under consideration. It seems very probable that the last two species were interchanged, for Cossmann's generic reference in each case seems to apply better to the other species, though even then still apparently incorrect. *P. nodosoliratus* is really a Turrid, and it and other congeneric species (including *Borsonia brachyspira* Sut. and *Antimitra vexilliformis* M. & M. will be dealt with in an account of this family; at present it may be left in *Ptychatractus*.

P. pukeuriensis Sut., however, has little in common with either Fusidae or Turridae, and shows far more analogy with some sections of the Cancellaridae. So far as can be judged from figures and descriptions, it is congeneric with the Australian shells placed by Harris in *Narona*, which, however, has a much longer aperture and a canal. The characteristically curved columella of *Bonellitia* is completely absent, and the shells bear no resemblance to true New Zealand members of this genus, such as *B. hampdenensis* M. & M. Cossmann mentions a deep sinus at the extremity of the anterior canal as an attribute of *Narona*; this is not present in *P. pukeuriensis* Sut., but some of the Australian species show no sinus; in general aspect, detail of ornamentation, columellar plaits, shape of aperture and canal, lirate outer lip, and bluntly conical protoconch, slightly askew posteriorly, and with longitudinal plications anteriorly, *P. pukeuriensis* agrees exactly with the Australian *Narona* group, more especially *N. etheridgei* (Johnston), and to a less extent *N. caperata* (Tate). Cossmann, in the *Essais*, vol. 3, has referred the former of these doubtfully to *Broccina*, and, apart from this genus, the only other to which these shells bear much resemblance is *Sveltella*. As regards the Australian species of this family, both the classification given by Tate in the "Census" (*loc. cit.*) and that of Cossmann above referred to seem unsatisfactory and inconsistent, but it would be a difficult task to draw up a correct one; the New Zealand species, too, are not easy to place, and the correct generic position of *P. pukeuriensis* Sut. and other species must be left in doubt till the family can be revised. In the meantime, however, since *Ptychatractus*

is quite inadmissible, Cossmann's choice of *Brocchina* seems to be the least discordant, and the name *Brocchina pukeuriensis* (Sut.) may be used till some more suitable alternative is found. *Admete anomala* M. & M. from Hampden is possibly another congeneric species, while "*Borsonia*" *cincta* (Hutt.) certainly is, and is doubtfully separable specifically. It has already been mentioned that members of this group are responsible for most of Suter's records of *Borsonia* spp. It may also be mentioned that *Admete suteri* M. & M. is evidently the Neozelanic representative of such Australian Tertiary forms as *Cancellaria ptychotropis* Tate and *C. gradata* Tate, which have been variously placed in *Bivetia* and *Aneurystoma*, but both these locations seem unhappy; *Plesiocerithium* seems nearer, but the Neozelanic shell had better remain in *Admete* until the family is revised. *Bivetia* (?) *brevirostris* (Hutt.) is the New Zealand representative of *C. modestina* Tate, but the relation is not very close. *Admete maorium* M. & M. is possibly a *Sveltella*, but may be left in *Admete* at present. Of the other New Zealand members of this family, *Admete ambigua* Hutt. is probably an *Actæon*, and *A. lacunosa* Hutt. is a *Bonellitia*. A summary, therefore, of the Target Gully members of this family reads,—

Admete (?) *maorium* M. & M.

Admete (?) *suteri* (M. & M.).

Bivetia (?) *brevirostris* (Hutt.).

Brocchina pukeuriensis (Sut.).

The name *Siphonalia* cannot be retained. Iredale has proposed the name *Verconella* (6a) for the forms with large embryos, strong spiral sculpture, and generally rounded whorls, while he puts *S. nodosa* (Martyn) in the subgenus *Aethocola*. There are many fossil species in our Tertiary that must be placed with *S. nodosa* (Martyn), and in Mr. Marwick's opinion *Aethocola*, which has a deep sinus at the extremity of the anterior canal, must be treated as a full genus and removed to the family Buccinidae, while *Siphonalia* (which is a Japanese genus and has no representative in New Zealand) and *Verconella* belong to the family Chrysodomidae. Of the list species, *S. costata* (Hutt.), *S. conoidea* (Zitt.), and *S. nodosa zitteli* Sut. belong to *Aethocola*, while *S. caudata* (Q. & G.), *S. dilata* (Q. & G.), *S. excelsa* Sut., and *S. subreflexa* (Sow.) fall under *Verconella*.

Extensive alterations are necessary in the specific names, as follows: Hedley (4a) has shown that the shell called *Megalatractus maximus* (Tyron) is almost certainly the true *Verconella dilatata* of Quoy and Gaimard, while the species usually called *Siphonalia dilatata* must bear the name *Verconella adusta* (Phil.). The matter does not end here; for neither of the Recent species *V. dilatata* (Q. & G.) and *V. adusta* (Phil.) really occur in Awamoan horizons, the records referring to new species of *Verconella*, so that these two names must be expunged from Oamaru lists.

Again, *V. caudata* (Q. & G.) does not occur at Target Gully, nor in the Awamoan at all, the record in this case apparently referring to extremes of the variable species Suter has named *Tritonidea compacta*. Similarly, *V. subreflexa* (Sow.) is wrongly recorded, Suter having probably mistaken examples of one of the *Verconella* n. spp. mentioned above for the South American shell.

The species of *Aethocola* are in no better state. Suter's *S. nodosa zitteli* is well worthy of specific rank, but the Target Gully shells so named are very different from both the type from White Cliffs and the described specimen from Nelson, which itself is not conspecific with the type. The Target Gully shell is a new species, and it was also on a variant of this that Suter's record of *S. conoidea* (Zitt.) was based, so that *S. zitteli* Sut. and *S. conoidea* (Zitt.) should disappear from these lists.

To summarize, the actual species of these shells that occur at Target Gully are—

Verconella n. sp. (formerly termed *adusta* Phil.).

Verconella n. sp. (formerly termed *dilatata* Q. & G.).

Verconella excelsa (Sut.).

Aethocola costata (Hutt.).

Aethocola n. sp. (formerly termed *zitteli* Sut. and *conoidea* Zitt.).

Of the five species of *Turritella* listed, not one is correct; they should be replaced by *T. cavershamensis* Harris, *T. abscisa* Sut., and two or three new species. Similarly, nearly all the *Turritellas* given in the lists from Ardgowan, Pukeuri, and Awamoa are wrongly named and must be omitted. All the species of *Fulgoraria* are likewise incorrect, there being six new species of *Volutes*, together with *Miomelon parki* (Sut.), which is not synonymous with *M. corrugata* (Hutt.). The name *Alciithoe* (the genotype of which is *F. arabica* Mart.), which Suter uses as a subgenus of *Fulgoraria*, should replace this, and be used as the generic name for these shells, true *Fulgoraria* having a different apex.

Mr. Marwick in his paper on *Glycymeris* (9b) has shown that *G. subglobosa* Sut. does not occur at Target Gully, being restricted to the lower Waiarekan; that *G. globosa* (Hutt.) is preoccupied by Sowerby and is renamed *G. huttoni* Marwick; and that the Target Gully shell differs again and is named *G. robusta* Marwick. Again, in a revision of our species of *Struthiolaria* he has separated the Oamaru forms from *S. cincta* Hutt. and *S. tuberculata* Hutt., with which they have previously been confused, and named them *S. subspinosa* Marwick. This is the common *Struthiolaria* occurring at Oamaru localities, the only other species being *S. cf. obesa* Hutt. (Awamoa beach boulders), *S. calcar* Hutt. (Ardgowan—neotype), *S. spinosa* Hect. (Ardgowan), and *S. tuberculata* Hutt., one perfect and typical specimen of which I have found at Target Gully.

Of the four species of *Ancilla*, only one, *A. hebera* (Hutt.), should be retained. Mr. Marwick has shown (9a) that *A. papillata* Tate has been wrongly recorded, and he has renamed the large Awamoan species to which that name had been applied by Suter *A. (Baryspira) robusta* Marwick.

Although not mentioned in the Target Gully lists, *Surcula oamarutica* Sut. is given by Suter as occurring here, and is noted in the list of shells from Ardgowan. This species was described from a stray specimen in Suter's collection and several specimens which had been collected at Target Gully by Professor J. Park, and has not been recorded from any but these two localities. It might thus be regarded as a typical fossil of this deposit were it not for the fact that it is probably identical with *Turricula* (= *Surcula*) *fusiformis* (Hutt.), a common fossil at Oamaru localities. If the two diagnoses are carefully compared, it will be seen that they run practically parallel except for the number of nodules (12 in *oamarutica*, shell of 11 whorls; 10 in *fusiformis*, shell of 8–10 whorls) and the greater height of the spire in *oamarutica*. Both these characters are, of course, specifically unreliable in such a genus as *Turricula*, and *T. fusiformis* (Hutt.) is especially variable in these respects. The only plentiful large *Turricula* at Target Gully is *fusiformis* (Hutt.): I have collected exhaustively at this locality and found no other, much less "a number of specimens." After examining over a hundred specimens from Target Gully, many from Ardgowan and from Pukeuri, and several from Awamoa, Devil's Bridge, Rifle Butts, and Mount Harris, and after comparison with the holotype of *T. fusiformis* (Hutt.) in the Otago Museum, I cannot find any constant differences between the species, and think it probable that *T. oamarutica* (Sut.) is merely a gerontic form of

T. fusiformis (Hutt.). Since, however, I have shown (2b) that this name is preoccupied, the alternative term *T. oamarutica* (Sut.) should be used to cover all these shells. I have a strong suspicion that *S. huttoni* Sut. will also prove inseparable from *T. oamarutica* (Sut.), but, not having seen the holotype, I cannot yet express a definite opinion. In the present list all these forms are included under *T. oamarutica* (Sut.).

Similar confusion prevails in regard to the shells named by Suter *Leucosyrinx alta* subsp. *transenna* (N.Z. Geol. Surv. Pal. Bull. No. 5, p. 44) and *Bathytoma antecostata* (loc. cit., p. 53). Marshall and Murdoch (8d, p. 126) have referred the subsp. *transenna* also to *Bathytoma*, and it may be left there for the present, though not really related to that genus. It seems to grade easily into *B. antecostata* Sut. at Target Gully, and it is doubtful whether the latter species should be retained. Suter's records of *B. albula* (Hutt.) from Oamaru localities are based on these forms; the Recent species does not occur in the Awamoan. Of the two remaining species of *Bathytoma* admitted by Suter, *B. perlata* Sut., though not typical, may stand for the present, but *B. sulcata* (Hutt.) is a *Pseudotoma*, and on account of the preoccupation of Hutton's name has been renamed *P. huttoni* Finlay (2b).*

Suter has described as distinct species *Tritonidea compacta* Sut. and *Tritonidea elatior* Sut., and these two are quite different from the only other New Zealand species, *T. acuticingulata* Sut. (also plentiful at Target Gully), but very similar to each other. Two years ago I found difficulty in allotting the dozen specimens I then had to these two species. Now, with over a hundred specimens, the difficulty has increased so much that the only conclusion possible is that the two forms must be united, *T. elatior* Sut. being only a slender juvenile form of *T. compacta* Sut. On comparison of the diagnoses the points of separation seem at first to be fairly numerous—viz., solidity of shell, number of axials per whorl, height and angle of spire, protoconch, and tubercles on the inner lip. Taking these points in turn, one finds from a study of a large suite in conjunction with the types of the two species that—(1.) Shells otherwise the same are quite indifferently thin or solid. (2.) The spire varies from a little less than the height of aperture and canal to considerably more than this height, its angle consequently varying greatly. (3.) The axial ribs vary from 9 to 16 per whorl, but are generally 11 or 12; they may be very sharp and prominent on the body-whorl, or low and flat, and they usually become obsolete on approaching the aperture; sometimes they are restricted to the upper whorls, the body and penultimate whorls being smooth except for spiral sculpture. (4.) The spirals may be sharp and distant or flattish and close together, the interstices varying from two-thirds to four times their width. (5.) The tubercles on the inner lip vary in number between 8 and none at all: they are quite irregularly spaced, and may be strong or weak. (6.) The protoconch is also variable, mostly $1\frac{1}{2}$ whorls, sometimes set obliquely to the shell-axis, the nucleus prominent or inconspicuous. These facts show how extremely inconsistent this species is. Another variant seems to be the form described by Marshall and Murdoch (8c, p. 83) as *Euthria subcallimorpha*. This species is widely different from *Euthria callimorpha* Sut., which belongs to a totally unrelated genus; but if the figure is compared with that of *Tritonidea elatior* Sut. it will at once be seen that the shells are congeneric,

* In this change I have been anticipated. I notice that in the *Revue Critique de Paléozoologie* (received since the reading of the paper), vol. 20, No. 1, January, 1916, p. 9, Cossmann has noted the preoccupation of this name, and has supplied a substitute; the correct name is therefore *Pseudotoma suteri* (Cossmann).

and, in my opinion, also conspecific. *E. subcallimorpha* has only 8 ribs on the body-whorl; this seems to be due to the wide spacing and obsolescence near the aperture, for the figure shows more ribs on the spire-whorls; in any case, this feature is very variable. The only important difference seems to be the spiral sculpture, which in *E. subcallimorpha* is said to consist of "fine, close, incised lines, forming lightly raised threadlets on the upper spire-whorls." But it is also mentioned that the only example is rubbed; wearing of the spiral ridges in this shell produces a groove down the centre, so that a shell in which the ribs are originally close seems to have a sculpture of still closer linear grooves when worn. Although no specimen in my collection exactly matches *E. subcallimorpha* M. & M., every point mentioned can be matched on different shells. As in the case of *Bathytoma transenna* (Sut.), the conditions prevailing at Target Gully seem to have induced excessive variation, but for all these forms only one species can be admitted. So many different forms occur that it is impossible to find valid distinctions, no one difference being constant. *Tritonidea compacta* Sut. has priority of place, and, as it was mentioned earlier in this paper that the generic name *Politia* must displace *Tritonidea*, the species *T. compacta* Sut., *T. elatior* Sut., and *Euthria subcallimorpha* M. & M. should be united under the name *Politia compacta* (Sut.). Even this, however, is only provisional, for these shells are congeneric with the Pliocene *Euthria striata* (Hutt.) (which again differs from the Recent shell so called). Iredale (2d) has separated our Recent *Euthrias* from the true European forms under the genus-name *Euthrena*, and *E. striata* (Hutt.) does not seem congeneric with *E. vittata* Q. & G., the type of this genus; it may, however, be possible to place it in *Evarne*, the type of which is *E. lineata* Mart., but I have not enough Recent material to judge at present. The correct placing of this group will demand much labour. While this subject is being dealt with, it may be iterated that the records of *Verconella caudata* (Q. & G.) from Target Gully are based on examples of *P. compacta* (Sut.) which have lost the outer lip and have no denticles on the columella.

The case of *Natica zelandica* Q. & G. needs consideration. Doubt has been thrown by other writers (7) on Suter's accuracy in identifying the small fossil Naticas, so plentiful in Awamoan horizons, with the Pliocene and Recent form; and here, again, study of a large number of specimens shows that Suter erred. Castlecliff forms, allowing for individual variation, are identical with the Recent shell, but I have so far failed to find *N. zelandica* Q. & G. in any Awamoan horizon, the nearest approach to it being specimens of a new species from White Rock River, which, though decidedly distinct, is in some ways intermediate between *N. zelandica* Q. & G. and the common *Natica* of Awamoan localities. This latter form, which has been generally taken for *N. zelandica* Q. & G., differs from it in many respects, notably its consistently smaller size and totally different spire. It is very plentiful at Target Gully and Pukeuri, and occurs at most Miocene localities. A third species, occurring at Pukeuri, Target Gully, and Ardgowan, though much less frequently than its companion, is more nearly allied to the White Rock species, and, like it, bears a superficial resemblance to *N. zelandica* Q. & G. *Natica maoria* Finlay (= *australis* Hutt. (5)) and *Polinices vitreus* (Hutt.) are also represented in Awamoan beds by distinct species. These new species, together with many others, will be described and figured later, but in the meantime *Natica zelandica* Q. & G., *N. maoria* Finlay, and *P. vitreus*

(Hutt.) must be omitted from the Target Gully, Pukeuri, Ardgowan, and Awamoia lists, and from all other Awamoan lists.

In the Veneridae more confusion seems to exist than anywhere else. By far the commonest Venerid at Target Gully is the shell Hutton described (5) as *Chione vellicata*, of which species the later *Cytherea chariessa* Sut., from Otiake, is undoubtedly a synonym. In the collection of the Otago School of Mines, specimens of this shell are indiscriminately labelled *Chione meridionalis* (Sow.), *Cytherea oblonga* (Hanley), and *C. subsulcata* (Sut.). Since the list-names are apparently based on such records as there, it is unquestionable that several of the names must be dropped, as the species to which they refer do not really occur at Target Gully. Instances of this are *Cytherea sulcata* (Hutt.) and *C. subsulcata* (Sut.). As a result of weathering, the sculpture of Target Gully shells is not normal—the ribs appear too far apart; it is only on Pukeuri and Otiake specimens that the true sculpture of fine, close, erect lamellae is seen. Cossmann has stated that the *C. oblonga* (Hanley) of Target Gully differs from Pliocene forms, and has proposed the name *C. suboblonga* (1). As there is no published figure or description of this shell, Cossmann's name is a *nomen nudum*; but there is at Target Gully a species heavier than *C. vellicata* Hutt., and with different hinge, and this is probably the species referred to by Cossmann.* *C. yatei* Gray (which, by the way, is the type of Iredale's genus *Callanaitis* (6c), and should bear this genus-name) does apparently occur at Target Gully, one shell having been found which is inseparable from Recent examples. *Callanaitis speighti* (Sut.) is listed from Awamoia; I have found one fragment of this species at Target Gully. Not so rare, but still rather uncommon, is the shell Suter identified as *Chione mesodesma* (Q. & G.), but which Cossmann considers distinct from this Recent species and names *C. marshalli* (1)—another *nomen nudum*. Study of a dozen or so specimens shows quite clearly that the shell is easily separable from *C. mesodesma* (Q. & G.) by its thinner, smaller, and more elongate shell, and its much finer sculpture, the ribs being narrower and almost twice as dense as in the Recent shell.

There is room for doubt as to the correctness of the identification in the following cases: *Crassatellites obesus* (A. Ad.), *Placunanomia zelandica* (Gray), *Steptochetus* n. sp., *Turbonilla prisca* Sut., *Sinum carinatum* (Hutt.), and *Heliacus imperfectus* Sut. Notes on these are given as follows:—

Crassatellites obesus (A. Ad.) has been stated by Murdoch (in 7) to differ from the Recent form. Study of the very plentiful Target Gully material shows the shell to be very variable in shape and dimensions; also, Target Gully forms are generally almost smooth except for a small concentrically-sculptured area below the beaks, while forms from other localities are generally strongly ribbed all over. Much material from other localities must be studied before it can be decided whether these and other differences are specific, varietal, or merely local. It may be noted that young shells of the nearly allied Wharekuri species *C. subobesus* M. & M. are practically indistinguishable from *C. obesus* (A. Ad.): elongation occurs in a disproportionately rapid manner with age.

Placunanomia zelandica (Gray): There is considerable difficulty in correctly identifying fossil specimens of this genus and the related genus

* Mr. Marwick has completed a thorough revision of the New Zealand members of this family, and in his manuscript, which I have been privileged to see, has placed *C. suboblonga* in the section *Ventricola* of *Antigona*, and *C. vellicata* in the section *Ventricoloidea* of the same genus. He also rejects the records of *Dosinia greyi* Zitt. and *Macrocallista multistriata* (Sow.) from Awamoan localities.

Anomia. Oliver has recently (11) limited the New Zealand Recent species to two, *A. walteri* Hect. and *A. trigonopsis* Hutt., making *A. huttoni* Sut. a synonym of the latter, and removing *A. furcata* Sut. to the genus *Monia*, where *P. zelandica* (Gray) should accompany it. Suter (13b) recorded *M. furcata* (Sut.) from the Hutchinsonian of Mount Brown, and gave his opinion that the correct name for the common fossil *Anomia* was *A. trigonopsis* Hutt., of which *A. walteri* Hect. should be regarded as a synonym. Thus at present the Tertiary species are in a very unsatisfactory state; as regards *Monia*, only one Miocene species—viz., *M. incisura* (Hutt.)—should be recognized in the meantime.

Streptochetus n. sp. is probably a *Voluta* species or its cast. There is no such label in the Otago School of Mines collection, and Mr. Marwick informs me that there are no Target Gully specimens so named in the Geological Survey collection, while shells from Black Point and Kakahu so named by Suter are only Volutoid casts. The name should be dismissed from the lists until better-authenticated specimens are found.

Turbonilla prisca Sut.: The identity of the specimens so named by Suter from Target Gully with the type from Blue Cliffs has yet to be confirmed. Cossmann has referred *T. oamarutica* Sut. to *Acirsella* (1) (misspelt *Acissella* in the reference), a genus of the Epitoniidae, and this is a much better location than *Turbonilla*. The apex is not heterostrophic, no fold whatever is visible on the columella, and the periphery is much more rounded than is usual in *Turbonilla*. There is another undescribed species of *Acirsella* at Target Gully and Pukeuri, and at least four true species of *Turbonilla*, one of which certainly seems to be a *Mormula*; but until specimens of *T. prisca* Sut. are examined it cannot be stated whether that species is a *Mormula* or an *Acirsella*. It may be noted, in passing, that the discontinuous varices which Suter emphasizes in the case of *T. prisca* Sut. are also present on most specimens of *A. oamarutica* (Sut.).

Sinum carinatum (Hutt.): No authentic records of this peculiar shell from any other than the type locality, White Rock River, are known. Suter's identifications from Target Gully and elsewhere are based on fragments of *Calyptraea*. For the present it had better be omitted from the Target Gully list.

Helicacis imperfectus Sut.: The holotype of this species should be in the Otago Museum, but cannot be found, and I know of no other specimen. The diagnosis that Suter was able to draw up is so poor as to render trustworthy identification almost impossible, and the worn state of the lost holotype makes its generic position so doubtful that the best thing to do under the circumstances is to drop this species altogether.

Phalium pyrum (Lamk.) is recorded from the Rifle Butts and Ardgowan, but no full-grown, or even half-grown, complete specimen of that species has been collected from Awamoan horizons so far as I am aware: the record from the two localities mentioned is based on juvenile shells alone. Some specimens in the Otago School of Mines collection from Awamoan are also labelled with this name. A comparison of these specimens and shells from Ardgowan, where the form is not uncommon (though no perfect shells have been found), with Recent specimens of the species shows that there are constant differences in the apices (e.g., the spiral striation is much stronger and coarser, the keel of the spire-whorls is much more prominent, due to the greater strength of its nodules, &c.), and especially there are radical differences in the body-whorl, which in the fossil shells bears four nodulous keels, gradually decreasing in strength, but in the true *Cassidea pyra* (Lamk.) is practically smooth apart from

the one row of low nodules on the keel. The fossil shells, though at a casual glance deceptively like the Recent shell, are in reality only juvenile and imperfect forms of a shell long known from the Oamaru Tertiaries—namely, *Galeodea senex* (Hutt.). The occurrence of these “pyrum” forms together with perfect adult shells at Pukeuri and Ardgowan enables a direct comparison to be made, and the identity of the two is certain, so that the record of *C. pyra* (Lamk.) from Awamoan horizons should be replaced by that of *Galeodea senex* (Hutt.). The shell of *Galeodea senex* (Hutt.) being fragile, and its distribution in Oamaru localities wide, it is not surprising that, though the occurrence of perfect specimens is rare, the finding of apical fragments is not uncommon, and, as these fragments, as noted, have given generic trouble in one case, it is quite possible that they may have done so in other cases. Thus specimens in collections have quite possibly been included under *Strutholaria* (whose apex they much resemble, especially when worn), *Siphonalia*, and *Ficus*.

This completes the rather lengthy tale of necessary alterations in the list as it stands at present. At the same time, however, it must be borne in mind that no European palaeontologist has yet examined any considerable number of our Tertiary species; when this is done we may expect extensive alteration in the generic names at present adopted, and in many cases the location of shells of which there are no New Zealand Recent representatives must be regarded as tentative.

Some remarks on the general variation noticeable at Target Gully may not be out of place here. As mentioned by Park (12, p. 93), the deposit is of no great depth, though deep- and shallow-water shells are intermingled, and many rolled fragments are present, showing that the shell-bed was subject to strong disturbances while being laid down. This unsettled nature of the habitat induced great variation in certain species which under normal conditions were fairly constant. It must have been a period of stress and struggle and rapid change of environment. For this reason Target Gully is not always a satisfactory collecting-ground: though species and specimens are very numerous, they are often ill-preserved, and, worse still, atypical. If a species occurs there and also at another locality, it is generally safer to take the second form as the more typical one. The application of this really matters, however, in only a few special cases, practically all noted previously in this paper; the majority of the Target Gully shells form very satisfactory and fairly constant specimens. The Ardgowan shell-bed, which of all the Awamoan horizons is the nearest approach to the actual Target Gully bed, is very similar to it stratigraphically and palaeontologically; the sandy matrix is lighter in colour, though glauconite is more abundant, and the fossils are often much more poorly preserved and fragile than at Target Gully, with a characteristic whitish and often chalky appearance. There is a considerable difference in the common species, and the Ardgowan fauna is not so rich as the Target Gully fauna, though the species are much more constant, this bed being deposited probably during quieter conditions. Among the species which are fairly constant at Ardgowan but variable at Target Gully are *Xymene lepidus* (Sut.), *Polia compacta* (Sut.), *Turricula oamarutica* (Sut.), *Venericardia lutea* (Hutt.). The Pukeuri beds consist of very fine sandy material, well consolidated, and, when damp, almost of the consistency of clay. Very poor results are obtained if fossils are sought in the dry bank, either by scanning or by digging; the specimens are quite hidden by the matrix unless well weathered out, and are also exceedingly fragile. Fortunately the clay crumbles readily on sieving in water, a

surprising amount of rich and clean material remaining. Target Gully and Ardgowan shell-sand is more satisfactorily sieved in the dry state. Awamoan clay is much more difficult to work with, and crumbles only very slightly in water. Otiake sandy matrix crumbles easily in the dry state, but not any more easily when damp.

The state of the beds at Pukeuri indicates peaceful deposition. Perfect shells are more often found, and there is little variation: it is consequently a good locality for typical specimens. Interesting minutiae also abound here. Variable Target Gully shells which are fairly constant at Pukeuri are *Acirsella oamarutica* (Sut.), *Bathytoma transenna* (Sut.), *Cerithiella fidicula* Sut., *Corbula pumila* Hutt., *Mesalia striolata* (Hutt.), and *Vexillum fenestratum* Sut. Other very variable Target Gully species are the forms of *Turritella*, *Ancilla*, and *Terebra orycta* Sut.

The lists of shells from Pukeuri, Ardgowan, and Awamoan may be brought up to date by making the same corrections as indicated here for the Target Gully list, and adding the following new records.

PUKEURI LIST.

Add the species *Bullinella soror* (Sut.) [*Cylichnella*], *Alectrion latecostata* Sut., and *Brocchina pukeuriensis* (Sut.) [*Ptychatractus*], originally described from this locality, but somehow omitted from the list; also *Pagodula vegrandis*, *Antimitra vexilliformis*, and *Columbarium maorium*, described by Marshall and Murdoch from this locality (8d); and the following forms:—

- Acirsella oamarutica* (Sut.). [*Turbonilla*.]
- Bela infelix* Sut.
- Bela tenuilirata* Sut. [*Ptychatractus*.]
- Bullinella* cf. *striata* (Hutt.). [*Cylichnella*.]
- **Cadulus delicatulus* Sut.
- Calliostoma suteri* Finlay.
- Calliostoma suteri* var. *fragile* Finlay.
- **Calyptrea tenuis* (Gray).
- Chlamys chathamensis* (Hutt.). [*Pecten*.]
- **Crepidula monoxyla* (Less.).
- Cucullaea australis* (Hutt.).
- **Dentalium ecostatum* Kirk.
- **Divaricella cumingi* (Ad. & Ang.).
- Erato neozelanica* Sut. (Also from Devil's Bridge.)
- Eulima obliqua* (Hutt.).
- **Gari* cf. *lineolata* Gray. [*Psammobia*.]
- Lucinida laminata* (Hutt.). [*Loripes*.]
- **Macoma edgari* Iredale. [*Tellina glabrella*.]
- Mactra* cf. *discors* Gray.
- Mactra scalpellum* Reeve.
- Mesalia striolata* Hutt.
- Monia incisura* (Hutt.). [*Placunanomia*.]
- **Murex zelandicus* Q. & G.
- Nuculana* cf. *semiteres* (Hutt.). [*Leda*.]
- Pecten huttoni* Park.
- Pholadomya neozelanica* Hutt.
- **Philine constricta* M. & S. (New as a fossil.)
- Pseudotoma suteri* Cossm. [*Bathytoma sulcata*.]
- **Rhizorus reflexus* (Hutt.). [*Volvulella*.]
- Ringicula uniplicata* Hutt.

- **Saxicava arctica* (L.).
- Sinum miocaenicum* Sut.
- Struthiolaria subspinoso* Marwick.
- **Tellina eugonia* Sut.
- **Tellina liliana* Iredale. [*T. deltoidalis*.]
- Terebra costata* Hutt.
- Trichotropis* sp. near *clathrata* Sow.
- Trivia avellanoides* McCoy.
- **Turbonilla zelandica* Hutt.
- Typhis maccoyi* T.-Woods.
- Ventricoloidea vellicata* (Hutt.). [*Chione*.]
- Xymene lepidus* (Sut.). [*Trophon*.]

ARDGOWAN LIST.

- Actaeon praecursorius* Sut.
- Aethocola spinifera* Finlay and McDowall. [*Siphonalia*.]
- **Anomia trigonopsis* Hutt.
- Bathytoma transenna* Sut. [*Leucosyrinx alta transenna*.]
- Bela tenuilirata* Sut. [*Ptychatractus*.]
- Brocchina pukeuriensis* (Sut.). [*Ptychatractus*.]
- Bullinella enysi* (Hutt.). [*Cylichnella*.]
- Bullinella soror* (Sut.). [*Cylichnella*.]
- **Cadulus delicatulus* Sut.
- Calliostoma cancellatum* Finlay.†
- Calliostoma marwicki* Finlay.
- Calliostoma suteri* Finlay.
- Calliostoma suteri* var. *fragile* Finlay.
- Cerithiella fidicula* Sut.
- Chlamys* (*Pallium*) *burnetti* (Zitt.). [*Pecten*.]
- Chlamys chathamensis* (Hutt.). [*Pecten*.]
- **Chlamys radiatus* (Hutt.). [*Pecten*.]
- Corbula pumila* Hutt.
- Couthouyia concinna* M. & M. (Known previously only from the holotype from Target Gully.)
- **Dentalium ecostatum* Kirk.
- **Diplodonta globularis* (Lamk.).
- **Divaricella cumingi* (Ad. & Ang.).
- Dosinia magna* Hutt.
- Elachorbis helicoides* (Hutt.). [*Circulus*.]
- Elachorbis politus* (Sut.). [*Circulus*.]
- **Emarginula striatula* Q. & G.
- Erato neozelanica* Sut.
- Galeodea senex* (Hutt.).
- Leucosyrinx alta* (Harris).
- Limca transenna* Tate.‡
- Limopsis zitteli* Iher.
- **Lucinida concinna* (Hutt.). [*Loripes*.]

† This name being preoccupied by Schefman (*Res. Siboga Exped.*, Livr. 39, p. 69, 1908), I propose to substitute for it the name *Calliostoma temporemutz* nom. nov.

‡ This is a very interesting discovery, as there are surprisingly few Australian fossils that are found in our Tertiaries, and this record adds a well-known Balcumbian shell to their number. Three complete valves have been found here, but the shell has not been discovered elsewhere. Genus and species new to fauna.

- **Macoma edgari* Iredale. [*Tellina glabrella*.]
- Marginella fraudulenta* Sut.
- Mesalia striolata* (Hutt.).
- **Murex zelandicus* Q. & G.
- **Nucula hartvigiana* Pfr.
- **Nucula simplex* A. Ad. [*N. strangei* A. Ad., which does occur here, contrary to the statement in *Bull.* 20.—See 12.]
- Nuculana* cf. *semiteres* (Hutt.). [*Leda*.]
- **Pleurodon maorianus* Hedley.
- Polia compacta* (Sut.). [*Tritonidea*.]
- **Protocardia pulchella* (Gray).
- Pseudotoma excavata* (Sut.). [*Bathytoma*.]
- **Pteronotus angusi* (Crosse). [*Murex*.]
- Ringicula uniplicata* Hutt.
- Struthiolaria calcar* Hutt.
- Struthiolaria spinosa* Hector.
- Struthiolaria subspinosa* Marwick.
- Terebra orycta* Sut.
- Trivia avellanoides* (McCoy).
- Typhis maccoyi* T.-Woods.
- Ventricoloides vellicata* (Hutt.). [*Chione*.]
- **Zenatia acinaces* Q. & G.

AWAMO A LIST.

There are several different kinds of matrix from which shells have been collected at this well-known locality, and lists from these will, if found necessary later, be given separately. In the meantime the new records made here are marked according to the matrix in which they were found—(1) Shelly boulders cast up on the beach; (2) blue clays forming the banks of the creek; (3) very hard and rather poorly fossiliferous mudstones apparently resting on the blue clays, and cropping out all along the beach at high-tide level. Fossils often as casts, but no records are here made on such.

The list specimens come chiefly from (1), as also did the bulk of the Geological Survey Awamoa specimens, which were not examined by Suter. Good collections have not previously been made from the far more important locality (2).

- Actaeon praecursorius* Sut. (1).
- Aethocola spinifera* Finlay and McDowall (1).
- **Amphidesma subtriangulata* Wood (3). [*Mesodesma*.] (New for the Miocene; the specimen is a young shell and may be referable to the subsp. *phiocenica* Oliver.)
- Anomia trigonopsis* Hutt. (1).
- Bivetia brevirostris* (Hutt.) (1). [*Latirus*.]
- Brocchina pukeuriensis* (Sut.) (2). [*Ptychatractus*.]
- Bullnella soror* (Sut.) (1 & 2). [*Cylichnella*.]
- Corbula humerosa* Hutt. (2).
- **Crepidula monoxyla* (Less.) (1).
- Crossea* cf. *sublabiata* Tate (2). (Probably same as the species recorded by Marshall as *C. labiata* T.-Woods from Pakaurangi Point.)
- Cucullaea alta* Sow. (2).
- Cucullaea alta* var. B Hutt. (1 & 3).

- Cucullaea australis* (Hutt.) (1).
 **Diplodonta globularis* (Lamk.) (1).
 **Divaricella cumingi* (Ad. & Ang.) (1 & 2).
 **Emarginula striatula* Q. & G. (1).
Galeodea senex (Hutt.) (2 & 3).
Glycymeris huttoni Marwick (1). [*G. globosa* (Hutt.).]
Lima bullata Born (2).
Lucinida laminata (Hutt.) (1 & 2). [*Loripes*.]
 **Macoma edgari* Iredale (1 & 3). [*Tellina glabrella*.]
 **Mactra* cf. *discors* Gray (3).
 **Mactra scalpellum* Reeve (1).
 **Malletia australis* (Q. & G.) (1, 2, & 3).
Monia incisura (Hutt.) (1 & 2). [*Placunanomia*.]
Pecten huttoni Park (3).
 **Protocardia pulchella* (Gray) (1).
Pyrgulina pseudorugata (M. & M.) (2).
 **Rhizorus reflexus* (Hutt.) (1). [*Volvulella*.]
 **Serpulorbis siph* (Lamk.) (1).
Sinum miocaenicum Sut. (2).
 **Spisula* cf. *aequilateralis* (Desh.) (3). (New for the Miocene.)
Struthiolaria subspinoso Marwick (1 & 2).
Struthiolaria cf. *obesa* Hutt. (1).
 **Tellina gaymardi* Iredale (3). [*T. alba* Q. & G.] (Record confirmed.)
 **Tellina libiana* Iredale (1). [*T. deltoidalis*.]
Terebra orycta Sut. (3).
Teredo heaphyi Zitt. (1).
Ventricoloidea vellicata (Hutt.) (1 & 3). [*Chione*.]
Vexillum linctum (Hutt.) (2).
Vexillum rutidolomum Sut. (3).
Xymene lepidus (Sut.) (2). [*Trophon*.]
 **Zenatia acinaces* (Q. & G.) (1).

Add also the species *Eulimella awamoensis* M. & M. (2) and *Turbonilla awamoensis* M. & M. (2), recorded by Marshall and Murdoch (8c), but not *Daphnella varicostata* M. & M., which is a synonym of *Bela canaliculata* Sut. (see ante). Besides the above, the following forms have been recorded as occurring at Awamo. They are not given in the list, but are mentioned in various places in *Pal. Bull.* 2, 3, and 5—in several cases as holotypes.

- Aethocola costata* (Hutt.) (2 ?). [*Siphonalia*.]
Bathytoma transenna (Sut.) (2). [*Leucosyrinx*.]
Corbula kaiparaensis Sut. (2).
 **Crassatellites obesus* (A. Ad.) (1, 2, & 3).
Drillia awamoensis (Hutt.) (2).
Lima colorata Hutt. (1, 2, & 3).
Limopsis zealandica Hutt. (2). [*L. aurita* Brocchi; not of Brocchi.]
Rissoina vana Hutt. (2). (In another paper in this volume (p. 493) it is shown that this name should be omitted from these lists.)
Trigonia semiundulata Jenkins. [*T. subundulata* Jenkins.] (Mr. Marwick has shown that this record should be deleted, as it is based on an Australian specimen.)
Turricula huttoni (Sut.) (1 & 2). [*Surcula*.]

The above lists considerably reduce the number of species peculiar to any one of the localities, and it is very probable that more exhaustive collecting would still further reduce them.

A résumé of new points in connection with nomenclature and range of species indicated in this paper would run as follows :—

(1.) New generic placings :—

<i>Latirus brevirostris</i> (Hutt.)	..	<i>Bivettia</i> . (?)†
<i>Circulus helicoides</i> (Hutt.)	}	<i>Elachorbis</i> .
<i>Circulus politus</i> Sut.		
<i>Circulus cingulatus</i> Bart.		
<i>Odostomia pseudorugata</i> M. & M.	..	<i>Pyrgulina</i> .
<i>Cymatium suteri</i> M. & M.	..	<i>Xymene</i> .
<i>Austrotriton neozelanica</i> M. & M.	..	<i>Charonia</i> .
<i>Ptychatractus tenuiliratus</i> Sut.	..	<i>Bela</i> (provisional).†
<i>Ptychatractus pukeuriensis</i> Sut.	..	<i>Brocchina</i> (provisional).†
<i>Admete anomala</i> M. & M.	..	<i>Brocchina</i> (provisional).†
<i>Borsonia cincta</i> (Hutt.)	..	<i>Brocchina</i> (provisional).†
<i>Admete lacunosa</i> Hutt.	..	<i>Bonellitia</i> .
<i>Leucosyrinx transenna</i> Sut.	..	<i>Bathytoma</i> (provisional).

(2.) New synonyms advocated (correct name second) :—

<i>Protocardia sera</i> Hutt.	..	<i>P. patula</i> (Hutt.).
<i>Corbula canaliculata</i> Hutt.	..	<i>C. humerosa</i> Hutt.
<i>Daphnella varicostata</i> M. & M.	..	<i>Bela canaliculata</i> Sut.
<i>Surcula fusiformis</i> (Hutt.)	..	<i>Turricula oamarutica</i> (Sut.).
<i>Surcula huttoni</i> Sut.	..	<i>Turricula oamarutica</i> (Sut.) (?)
<i>Tritonidea elatior</i> Sut.	..	<i>Polia compacta</i> (Sut.).
<i>Euthria subcallimorpha</i> M. & M.	..	<i>Polia compacta</i> (Sut.).
<i>Cytherea chariessa</i> Sut.	..	<i>Antigona vellicata</i> (Hutt.).

(3.) Species wrongly recorded from the Awamoa stage :—

- **Thoristella chathamensis* (Hutt.).
- **Trochus tiaratus* Q. & G.
- **Cantharidus tenebrosus* A. Ad.
- **Venericardia difficilis* (Desh.).
- **Crepidula costata* (Sow.).
- **Xymene quirindus* Iredale.
- Mitra armorica* Sut.
- **Nozeba emarginata* (Hutt.).
- **Fusinus spiralis* (A. Ad.).
- Cymatium minimum* (Hutt.).
- Turris regius* Sut.
- Borsonia* (all species).
- **Verconella caudata* (Q. & G.).
- **Verconella dilatata* (Q. & G.).
- **Turritella*, **Ancilla*, and **Alcithoe* (all Recent species).
- Glycymeris subglobosa* Sut.
- **Bathytoma albula* (Hutt.).
- **Natica zelandica* Q. & G.
- **Natica maoria* Finlay.
- **Polinices vitreus* (Hutt.).
- **Antigona oblonga* (Hanley).
- Chione subsulcata* Sut.
- **Chione mesodesma* (Q. & G.).
- **Cassidea pyra* (Lamk.).

† See addendum.

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ADDENDUM.

Most of this paper was written more than two years ago. Since then much new material, both Neozelanic and foreign, has come into my hands; also, I have much information that was not then available; and I now find that it will be imperative to create new groups for some of the species discussed. It is wiser to give a difficult species a niche of its own than attempt time and again to force it into genera which will not satisfactorily contain it. As it will be some years before all the various genera discussed can be treated separately, and confusion over these species will but increase during that time, I have decided to deal with some of the more urgent cases now, and herewith propose new genera for their reception. Incorporation of these in the paper would have necessitated so much alteration of the type that my earlier remarks have been allowed to stand, and the new names all brought together in a postscript.

INGLISELLA n. gen. Type, *Ptychatractus pukeuriensis* Sut.

Classed provisionally as a *Brocchinia* in the paper, this shell and its allies differ from that genus in the thin shell, different form of growth, discrepant sculpture, much straighter columella, and rather pronounced posterior notch in the outer lip just at the keel.

The genus-name for these attractive little shells is with much pleasure given in honour of Dr. J. K. H. Inglis, of Otago University, in appreciation of his unfailing kindness and consideration.

MAORIVETIA n. gen. Type, *Turbinella brevirostris* Hutt.

The various previous locations of this shell in *Turbinella*, *Peristernia*, *Taron*, *Latirus*, *Aphera*, *Leucozonia*, and, finally, *Bivetia*, sufficiently attest

the need for a new division. The shell is very peculiar, having the very large protoconch of *Uxia* (but far more asymmetrical, and with an immersed nucleus), the shell formation of *Aphera*, the strong basal fasciole and notch of *Cancellaria*, a slight umbilicus, and a straight columella. The general appearance is that of *Bivetia*, but the anterior notch is more lateral, the columella plaits different, and the pillar much less bent backwards and twisted; the apex disagrees radically. Cössmann, in mentioning this shell, has already indicated the probable need for a new group. *Merica wannonensis* (Tate) has a somewhat similar aperture, but a different form of growth and embryo.

OAMARUA n. gen. Type, *Admete suteri* M. & M.

This shell and its Australian allies do not correlate well with any Cancellarid group: the reticulate sculpture of strong, sharp, spiral and axial ridges; the very strong peripheral keel, and wide, smooth shoulder; the inflated body-whorl, and rather short spire; the mere truncation of the slightly developed canal; the absence of fasciole and umbilicus; the straight pillar, flexed a little to the left below, and bearing two close, transverse plaits as in *Inglisella*, with a third spirally twisted, almost vertical ridge forming the base of the columella; and the small, one-whorled, askew protoconch, form a characteristic and easily recognized combination.

NASSICOLA n. section. Type, *Neptunea costata* Hutt.

In shape and appearance of canal somewhat intermediate between *Aethocola* and *Cominella*, but the apex shows that relationship is really with the former. The strong, keeled fasciole; the short and rather indistinct canal, bent strongly to the left instead of spirally downwards; and the general habit of the shell, all demand sectional recognition under *Aethocola*. Further species of both *Aethocola* s. str. and of *Nassicola* are awaiting description.

RUGOBELA n. gen. Type, *Ptychatractus tenuiliratus* Sut.

This shell and its Neozelanic and Australian allies have been fully discussed in the paper, and the necessity there shown for a new genus.

PARASYRINX n. gen. Type, *Pleurotoma alta* Harris.

Related to, and classed by Suter under, *Leucosyrinx*, which has a different type of sculpture; shorter, more flaring, and more bent canal; and much shallower, more open sinus. The sinus of *Parasyrinx* is in shape and depth quite reminiscent of *Bathytoma*, but is on the lower third of the shoulder instead of on the keel. Characteristic of the new genus, too, is the one strong peripheral keel, the typical species being otherwise quite bare of ornament, though other forms have weak basal spirals. Here may be placed *Leucosyrinx subalta* M. & M. and *Surcula protransenna* M. & M. There are several genera to which these shells bear resemblance: *Leucosyrinx*, *Irenosyrinx*, and *Steiraxis* all contain forms more or less superficially similar to species of *Parasyrinx*, but, on close inspection, uniformly of a different facies; their sinus is open and not deep, and the pillar much shorter and obliquely truncated. *Parasyrinx* has a but faintly twisted, long, slowly narrowing pillar. *Ancistrosyrinx* and *Rouaultia* are likewise carinated,

but the former has a recurved, spiny keel, and a sutural sulcus bounded by an elevated ridge, while the latter has a stout, twisted pillar, and the sinus on the keel. Perhaps the nearest relative is *Cochlespira* Conrad, an Oligocene genus; but this also has a spiny keel, and the fasciole is separated from the suture by a beaded ridge.

AUSTROTOMA n. subgen. Type, *Bathytoma excavata* Sut.

For *Bela woodsi* Tate, an Australian Tertiary species, Cossmann has proposed the genus *Belophos*, which he places in the Buccinidae. This shell, however, belongs to the Turridae, being quite similar in facies to *Pseudotoma*, though it may at once be separated from the typical Italian forms by the deep basal notch, with its accompanying prominently carinated fasciole. *P. laevis* Bell. and *P. intorta* Br. have only a weak notch and a feeble fasciole, without a carina. The New Zealand species *B. excavata* Sut. and its allies (*B. eximia* Sut., *B. suteri* Cossm., *B. robusta* Hutt.,* *Clavatula neozelandica* Sut., &c.) seem to represent a later stage in development than *B. woodsi*, in that the axials tend to multiply, weaken, and ultimately vanish, and the spirals to form strong raised cords, often of greater general prominence than the axials. *B. woodsi* has (like *P. laevis* and *P. intorta*) weak and thin spirals, but strong, persistent, and far more prominent axials, and the body-whorl is anteriorly far more contracted. Evolution is also evident in the embryo, which in *P. intorta* has a planorbid tip and bears only spiral threads; in *B. excavata* Sut. the little pullus is erect and the whorls more closely knit, and for some distance before the terminal varix axial acceleration is shown, producing reticulation. Some of our species have already been referred by Suter to *Pseudotoma* Bell.; in rejecting this name from the Neozelanic fauna I would point out that *Pseudotomus* Cope, 1872 (Mammalia), has a year's priority and invalidates Bellardi's name. As a substitute, *Pseudotomina* nom. nov. (type, *P. laevis* Bell.) may be suggested as causing the least confusion. From study of the apex it would seem that *Pseudotomina* descended from a form whose forte was spiral ornament, perhaps *Cryptoconus* or *Conorbis*; strong axial sculpture (and, in *Belophos*, a basal notch) then developed; this became impressed on the protoconch in later forms, and finally began to grow obsolete again in *Austrotoma*, some of the New Zealand Pliocene forms of which have lost all but the embryonic remnants of axial ribs.

PHENATOMA n. gen. Type, *Pleurotoma novae-zelandiae* Reeve.

A shell with superficial resemblance to *Epideira* Hedley, to which genus its author has suggested it may be referred. There is really, however, no close relation between this shell and *E. striata* (Gray): the differences will at once be apparent to New Zealand workers when it is stated that *Bathytoma nodulirata* (M. & S.) is a true *Epideira*. The latter genus is doubtfully distinct from *Epaleis* Cossmann, proposed for a few Parisian Eocene species which differed from *Bathytoma* s. str. in practically the same details as Hedley gives for *Epideira*; the types of the two genera are extremely similar shells. However, Hedley's name may perhaps be retained in a sectional sense, since the austral species seem to have uniformly

* Hutton's name dates from 1877; the same combination had been previously employed by Packard (*Mem. Bost. Soc. Nat. Hist.*, p. 232, 1869). The New Zealand shell may be renamed *Belophos* (*Austrotoma*) *minor* nom. nov.

shorter canals than the more ancient *E. crenulata* (Lamk.) and its allies. *P. novae-zelandiae* Reeve has a narrower and deeper sinus than both these groups; it is not on the peripheral nodular row (which is never strong as in *Epideira*, and often quite obsolete), but just above it, in a rather smooth space, traversed always by at least one distinct spiral thread at the middle of the sinus. The spire is higher, the shell more slender, and the bead-rows much less conspicuous. The apex is absolutely different, being conic, polygyrate, and quite symmetrical, much taller than wide; the tip, though minute, not pointed but flatly depressed and slightly immersed, not at all bulbous. And, lastly, a radical difference is the possession by *Phenatoma* of a strong basal notch in the canal, giving rise to a prominent fasciole and carina, just as in *Belophos* and *Austrotoma*. On account, however, of the wide differences in embryo and anal notch, *Phenatoma* does not seem otherwise closely allied to the Pseudotominae. To *Phenatoma* may also be referred *Drillia cheesemani* Hutt. (*Bathytoma*), and *Pleurotoma plicatella* Hutt. (*Drillia*). Closely allied also is the group of shells centring round *Pleurotoma albula* Hutt.; these forms are very common in the New Zealand Tertiaries, and form an easily recognized division of *Phenatoma*, as follows:—

CRYPTOMELLA n. subgen. Type, *Leucosyrinx transeenna* Sut.

In common with the restricted forms these shells possess a basal notch and fasciole, but both these and the carina are weaker; the sinus and its traversing thread are the same, as also are the details of the aperture and the relative proportions. The species are of smaller size, and a highly typical feature is the development of a strong peripheral keel, instead of bead-rows and axial ribs, somewhat as in *Parasyrinx*; one of these usually sharply carinates the spire-whorls at the lower third or fourth, but thence often becomes obsolete, leaving the body-whorl rounded. The most important difference, however, is in the apex, which, though of the same essential construction, has only two much larger and stouter whorls, thus losing its polygyrate, pointed appearance, and becoming bluntly conical and a trifle asymmetrical. With the genotype I would associate the following species: *Drillia multiplex* Webster, *Defrancia excavata* Hutt. (*Genotia*), *Pleurotoma albula* Hutt. (*Bathytoma*), *P. subalbula* Murd., and *Bathytoma antecostata* Sut. Hedley has referred *P. albula* to his *Filodrillia*. This, as at present constituted, is a heterogeneous group, containing at least three diverse elements. None of these will satisfactorily receive *P. albula*; as in the case of *Phenatoma*, the presence of a basal notch, fasciole, and carina in the New Zealand shell outweighs superficial similarity of habit, and renders close relation improbable. *F. steira* Hedley is, from the figure, very much like a *Cryptomella*, but from neither the diagnosis nor the illustration can the presence of a basal notch be deduced. Nevertheless I think it will prove to be present in that, and possibly other, Australian species. It is worthy of note that *Inquisitor metcalfei* Angas seems to be an *Austrotoma*, closely related to the New Zealand *Drillia optabilis* M. & S.