NOTES ON SOME AUSTRALIAN SPECIES AND GENERA OF THE FAMILY BUCCINIDAE (NEOGASTROPODA)

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Plates 24 - 25

ABSTRACT

The genus *Engina* Gray is used for *Tritonidea australis* Pease, which has been included in *Maculotriton* Dall, a genus of the Muricidae. The species *Phos gracilis* Sowerby and *Cantharus unicolor* Angas are tentatively included in *Engina*. Related genera and subgenera are discussed and compared with this genus. *Prodotia* Dall is reduced to a subgenus of *Engina* and the synonymies of the two species in the subgenus and their Australian occurrences are given. *Caducifer* Dall is reduced to a subgenus of *Monostiolum* Dall and Australian records of two species are listed. *Ecmanis* Gistel and *Appisania* Thiele are considered to be synonyms of *Pisania* Bivona-Bernardi. Several previously recognised species appear to fall into the synonymy of *Pisania fasciculata* (Reeve), a common Australian species. *Jeannea* Iredale, *Sukunaia* Cernohorsky and *Taeniola* Dall are here recognised as subgenera of *Pisania*. A new genus and species, *Crassicantharus norfolkensis*, is described and the relationships of *Clivipollia* Iredale are discussed

INTRODUCTION

The buccinids are well represented in temperate latitudes where they often replace the nassariids and fasciolariids which dominate in tropical waters. A few buccinid genera such as *Cantharus* Röding, 1798 and *Engina* Gray, 1839, are conspicuous in warmer seas. In addition some less well known genera occur, some of which are discussed in this account.

This paper is largely the outcome of an attempt to clarify the relationships of a common N.S.W. species, *Tritonidea australis* Pease. This has been only partially successful because generic limits in the Buccinidae are particularly difficult to define. The shells, radulae and opercula have relatively few characters that allow for clear-cut taxonomic divisions. The status of some genera and subordinate taxa as set out below, is based on a combination of all the characters of the " hard parts " including the protoconch, teleoconch, radula and operculum.

There have been few attempts to examine the classification of the smaller species of the tropical Indo-Pacific Buccinidae and none of these have been particularly searching. During the course of this work it was found that a number of much needed changes had to be made and these are either indicated or dealt with where possible. It is not intended that this work be a full revision of any of the groups considered.

TAXONOMY

Hedley (1915) transferred *Phos gracilis* Sowerby, 1859, *Cantharus unicolor* Angas, 1867 and *Tritonidea australis* Pease, 1871 to *Maculotriton* Dall, 1904 and discussed the differences between these three Australian species. Subsequent writers have not questioned this generic placement. *Maculotriton* was introduced for *Triton bracteatus* Hinds, 1844. This genus was included in his Colubrariidae by Dall (1904) as a section of *Colubraria*.

In the same year Pilsbry and Vanatta (1904) showed that the radula of *M. bracteatus* was that of a muricid. Thiele (1929) made *Maculotriton* a subgenus of *Drupa* Röding, 1798, but most recent writers have given it full generic status in the Muricidae.

Hedley (1917) illustrated the radula, operculum and the external features of the head-foot of *M. australis*. Although he did not, at that time, comment on the familial placing of the genus, the radula he described is clearly buccinoid and later (1918) he placed *Maculotriton* in the "Fusidae."

The present investigation indicates that *australis* can be included in *Engina*. The two species that have been historically associated with *australis (gracilis* and *unicolor)* are considered in much less detail because they are known only from their shells.

Genus *Engina* Gray, 1839

Type species: (s.d. Gray, 1847) *E. zonata* Gray, 1839 (= *Purpura turbinella* Kiener, 1836).
Synonym: *Enzinopsis* Iredale, 1940 (type species (o.d.) *Engina gannita* Hedley, 1915).

Engina (Engina) australis (Pease, 1871)

Plate 24, fig. 1 - 2; Text fig. 1: 2; 2: 15 - 16, 24

1867 *Cantharus (Tritonidea) assimilis* Angas, *Proc. Zool. Soc.*, 1867: 187 (not of Reeve).
1871 *Tritonidea australis* Pease, *Amer. J. Conch.*, 7: 21.
1881 *Cantharus australis*. Tryon, *Man. Conch.*, 3: 160, pl. 73, fig. 269.
1917 *Maculotriton australis*. Hedley, *Proc. Linn. Soc. N.S.W.*, 41: 711, pl. 1, figs. 28 - 30.
1962 *Maculotriton australis*. Macpherson and Gabriel, *Mar. Molluscs Vict.*: 176, fig. 211.

As this species has not previously been fully described, a description is offered below.

Shell: Small, rather elongate bucciniform, spire slightly longer than aperture plus canal. Protoconch of 1½ whorls, the first whorl bulbous and slightly inrolled. Sculpture of teleoconch of regular axial folds, sometimes weak or absent on body whorl, these crossed by 8-12 spiral cords which increase in thickness only slightly where they cross the axials. Interstices variable in width, usually with an intermediate cord. Aperture with a short, open, slightly recurved posterior canal. Outer lip dentate within, with an external varix and weakly sinuate anteriorly. Posterior canal bordered by a rather weak labial and parietal denticle, the outer stronger (these are occasionally duplicated). Columella with 3 prominent plaits above neck of anterior canal and two minor ones anterior to these. Inner lip with several accessory wrinkles which do not run into aperture and occur with variable frequency and strength. Periostracum not obvious.

Radula: (Text fig. 1: 12) Central tooth relatively large, squarish, with 5 cusps, the outermost pair smaller than the other 3. Lateral teeth with bases extended outwards beyond outermost cusp. Two large cusps, the outer larger, the inner bearing a denticle on its inner surface. A small median cusp present, sometimes this reduced to a denticle (as in figured specimen).

Operculum: (Text fig. 2: 24) Simple, nucleus terminal, with small, oval muscle scar.

The shells of 2 typical specimens are illustrated (Plate 24, figs. 1 - 2).

This species is known from Port Fairy, Victoria (Pritchard and Gatliff, 1898: 274) and along the south-eastern coast as far north as Byron Bay, northernmost N.S.W. (C. 5293*). Shirley (1913) records this species from Murray Island but, like many of his records, this is obviously based on a misidentification. His (1911) record from Tweed Heads, just south of the northern N.S.W. border is possibly correct.

Discussion on the generic position of Engina australis and on the genus Engina.

The type species of *Engina, E. turbinella* (Kiener), a species living in the Caribbean, is a small broad shell (Plate 24, fig 8) that is very different from that of *Tritonidea australis.* Several other species of *Engina* have a more elongate shell and resemble *australis* in most major shell and radular features. The question of generic and specific groups within the *Engina* group will have to be dealt with more fully elsewhere but the following points of difference between *Engina* (sensu lato) and *australis* can be noted. None of the typical species of *Engina* have more than 5 primary spiral cords on the penultimate whorl, and most have less, which usually become strongly nodulous where they cross the axials. There are 9-12 primary cords on the penultimate whorl of *australis* and the axials are not rendered nodulous. Between the primary spirals lie several (up to 6) intermediate threads in most species of *Engina,* this being in sharp contrast to the 0-1 in *australis.*

The apertural features of *E. turbinella* are distinctive in having few (about 5) denticles on the outer lip, the posterior 3 usually fused into a single tooth. The posterior canal has strong labial and parietal denticles at its base but the canal extends out as a shallow groove along the outer edge of the posterior parietal wall.

The anterior canal is short, open and straight and there is a strong external varix on the outer lip, but no sinus. The parietal wall has several conspicuous denticles and the columellar has 2 plaits, the posterior one being very weak. Other species of *Engina* show essentially the same apertural features although these are modified with shell elongation. An extra denticle or two may be added to the outer lip and these do not tend to become fused. The posterior canal (i.e. the posterior edge of the aperture) extends only slightly beyond the denticles at its base and the anterior canal is often lengthened and sometimes slightly recurved. Essentially the same apertural structure is seen in *australis* as in the various elongate species of *Engina* but the denticles and teeth are more numerous and correspondingly weaker.

Only one specimen of *E. turbinella* available to me has a protoconch. This has $1\frac{3}{4}$ whorls, the first whorl smaller than in *australis.* Most other species of *Engina,* however, have an evenly conical protoconch of about $2\frac{1}{2}$ whorls. *Enzinopsis resta* Iredale, 1940 from Lord Howe Island has a protoconch of $1\frac{1}{2}$ whorls which resembles that of *australis* (Text fig. 2: 15, 16). The rest of the shell is very like *australis* in shape and build but has the apertural and sculptural features of *Engina.* The radula is almost identical in these two species and their opercula are very similar

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* Australian Museum registered number.

(cf. Text fig. 2: 23, 24). Whether this is a case of convergence or real relationship can only be decided when additional information is available. The protoconch similarity is probably related to the extralimital position of *resta* and *australis* — the development of the paucispiral protoconch in cooler waters being a well documented phenomenon (Thorson, 1950).

The radulae of a few species of *Engina* have been investigated. Orr (1962) figured the radula of *E. turbinella* and that of another specimen is shown here for comparison with the species under discussion (Text fig. 1: 10). Mörch (1859) (and later Barnard, 1959) described and figured the radula of the common Indo-Pacific species *E. mendicaria* (Linnaeus, 1758), showing that this group was different from otherwise superficially similar species in the family Columbellidae. Pilsbry and Lowe (1932) have described the radula of the West American *Engina strongi* Pilsbry and Lowe, and Habe (1943) described the radula of the Japanese species *E. menkeana* Dunker, (1860) which is shorter than, but otherwise very like, *E. submenkeana* (Pilsbry, 1901). This latter species appears to be a synonym of the common Queensland species *E. concinna* (Reeve, 1846) which is one of the most elongate species of *Engina*. Five radulae of this species were mounted and some variation was observed, one example being illustrated (Text fig. 1: 9). Only one had a minute denticle-like middle cusp on the lateral teeth, the others having only 2 large cusps. The central teeth of all specimens had 3 strong cusps outside of which were placed a pair of short cusps and, in two specimens, an additional pair of small denticles.

All species of *Engina* that have been examined have a radula that is similar to that of *australis* in having squarish, basically tricuspid central teeth, and bicuspid lateral teeth, which in some species develop a third minor cusp. The central teeth have a pair of minor cusps at the outer bases of the outer main cusps. Sometimes a weak denticle is developed on the inside face of the inner cusp on the lateral teeth (as in Orr's figure of *E. turbinella* and in *menkeana*) but this apparently is not a regular feature of the radula of typical *Engina* species.

Engina (Enzinopsis) gannita (Plate 24, fig. 6) is a peculiar species that, at first sight, suggests affinity with species of *Prodotia* (see below). The aperture is, however, like that of other species of *Engina*. *Enzinopsis* could possibly be used (as a subgenus) for most of the elongate species of *Engina* with convex whorls, regular spiral sculpture and simple labial denticles. Such a division would however, be largely artificial, and is thus not recommended, as this series appears to grade into the typical group remarkably well.

PLATE 24.

Figs. 1, 2. *Engina (Engina) australis* (Pease). Wooli, N.S.W. (C. 77135).

Fig. 3. *Engina ? gracilis* (Sowerby). Cronulla, N.S.W. (C. 77136).

Fig. 4. *Crassicantharus norfolkensis* n.sp. Norfolk Is. Holotype (C. 59418a).

Fig. 5. *Pisania (Jeannea) hedleyi* Iredale. Raoul Is., Kermadec Islands (C. 36693). *

Fig. 6. *Engina (Engina) gannita* Hedley. Darnley Is., Torres Strait. Holotype (C. 7468).

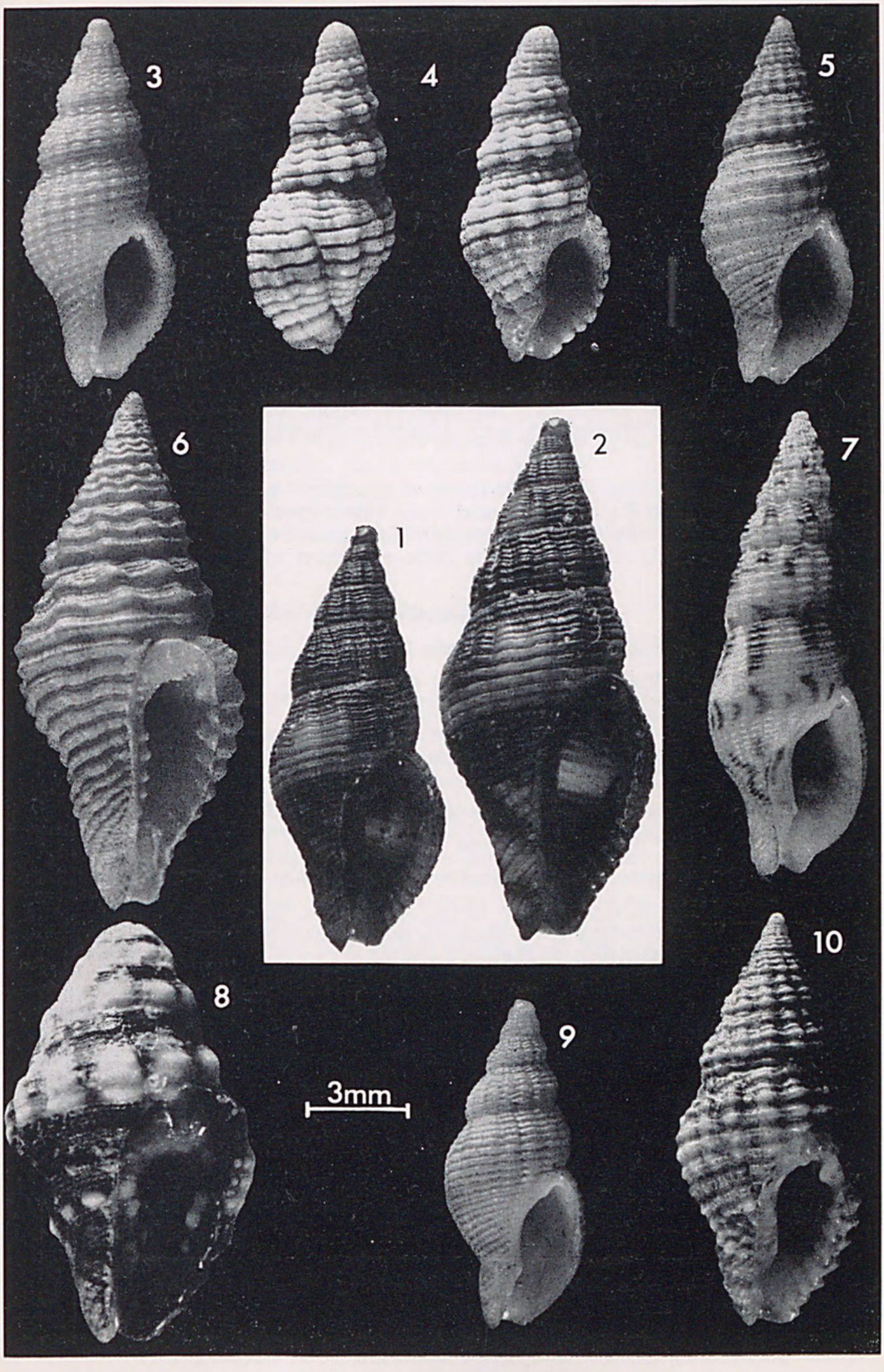
Fig. 7. *Monostiolum (Monostiolum) swifti* (Tryon). Hungry Bay, Paget Parish, S.E. coast, Bermuda, West Indies (Acad. Nat. Sci. Phil. No. 319019). *

Fig. 8. *Engina (Engina) turbinella* (Kiener). Camaricoa, Cuba (C. 77083). *

Fig. 9 *Engina ? unicolor* (Angas). Middle Harbour, Sydney, N.S.W. (C. 32444).

Fig. 10. *Engina (Engina) resta* (Iredale). Lord Howe Is. Paratype (C. 59643b). *

* specimens from which figured radulae obtained.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Trachypollia Woodring, 1928 (type species *T. sclera* Woodring) from the Miocene of Jamaica also appears to belong to *Engina* and may be another name that could be used for the "tall species." The protoconch of *T. sclera* has 3 "rapidly enlarging" whorls.

In conclusion despite the apparent dissimilarity between *australis* and *zonata*, *australis* can be regarded as a species of *Engina*, but cannot be satisfactorily separated in a distinctive subgenus on the information available.

Pusiostoma Swainson, 1840 (type species (s.d. Gray, 1847) *Columbella punctata* Lamarck, 1822 = *Buccinum discors* Gmelin, 1790) is usually cited as a synonym of *Engina* (e.g. Thiele, 1929; Wenz, 1938). The type designation by Gray, however, makes this name a synonym of *Pyrene* Röding, 1798 (type species *P. rhombifera* Röding, 1798 = *discors* Gmelin), both having the same type species. Iredale (1940) gave "*mendicaria* auct., but not of Linné" as the type of *Pusiostoma* and erected a new family name for this genus with which he intended to replace the then obscure *Engina*.

Olsson and McGinty (1958) have described a genus *Risomurex* for *Engina schrammi* Crosse, 1863 and some other species previously included in *Engina*. The apertural features are like those of *Engina* but the protoconch is strongly keeled and the radula is muricoid.

Engina? gracilis (Sowerby, 1859)

Plate 24, fig. 3

1859 *Phos gracilis* Sowerby, *Thes. Conch.*, 3: 91, pl. 222, fig. 33.
1915 *Maculotriton gracilis*. Hedley, *Proc. Linn. Soc. N.S.W.*, 39: 733, pl. 84, fig. 79.

This species is known only from N.S.W., extending from Kurnell, Botany Bay (C. 77270) to Catherine Hill Bay (C. 54153).

Engina? unicolor (Angas, 1867)

Plate 24, fig. 9

1867 *Cantharus (Tritonidea) unicolor* Angas, *Proc. Zool. Soc.* (1867): 110, pl. 13, fig. 2.

E? unicolor is represented in the Australian Museum collections only from N.S.W., extending from Kurnell, Botany Bay (C. 77269) to the Clarence River district (C. 77268).

E.? unicolor can be separated from *gracilis* by its shorter, slightly broader shell, less convex whorls, weaker axial ribs which are usually weak or absent on the body whorl (they are strongly developed in *gracilis*) and more numerous closer spaced spiral cords (9-11 in *unicolor*, 7-8 in *gracilis*). Both species sometimes develop intermediate spiral threads between the main cords, but this is more frequently the case in *gracilis*. Hedley's (1915) figure of *gracilis* shows the penultimate whorl with 9 spiral cords. In fact two of these cords are secondary threads that have been over-emphasised in the drawing.

Discussion on the generic position of E.? gracilis and E.? unicolor.

Phos gracilis and *Cantharus unicolor* closely resemble *australis* in most shell features but have a smooth parietal wall except for a single tubercle. These two species may belong to a distinct genus but until

their radulae are described they can be tentatively associated with *australis*.

Monostiolum swifti (Tryon, 1881) (Plate 24, fig. 7) from the West Indies (type species of *Monostiolum* Dall, 1904) has similar teleoconch sculpture and general features to *australis*, *unicolor* and *gracilis*. The spire is relatively taller (about $1\frac{1}{2}$ x height of aperture plus canal instead of about 1-$1\frac{1}{8}$ times), and the columella is smooth (as in the latter two species) except for a minute denticle above the canal. Dall (1904) describes the protoconch of *M. swifti* as being axially ribbed and having the tip immersed leaving an apical pit. Dall probably examined a decollated specimen because it actually has $1\frac{1}{2}$ whorls, the last $\frac{1}{2}$ whorl being carinated, the remainder strongly shouldered and oblique. Olsson (1967) describes the protoconch as being " somewhat bulbous of a single smooth whorl ".

The radula of *E. australis* differs from that of *M. swifti* in having the bases of the lateral teeth produced outwards and these teeth vary from being bicuspid to tricuspid. The central tooth of *M. swifti* (Text fig. 1: 8) is relatively smaller and does not have any denticles in addition to the 3 cusps. The radulae of *gracilis* and *unicolor* are not known but their shells differ from *Monostiolum* in having a simpler protoconch and a rather different build.

Subgenus *Prodotia* Dall, 1904.

Type species: (o.d.) *Phos billeheusti* Petit, 1853 = *Buccinum obliquicostatum* Reeve, 1846.

This subgenus is characterised by the peculiar style of the aperture which has a relatively long canal and weakly dentate lips. Like *Engina* s.s. the protoconch is small-tipped and sometimes multispiral and there is moderately strong axial and spiral teleoconch ornament. The operculum is simple, with an apical nucleus and an oval muscle scar.

Peile (1939) described the radula of *Buccinum marmoratum* Reeve, a typical species of *Prodotia*, which he placed in *Engina*. Whereas the shells of species of both *Prodotia* and *Engina* have some features in common, the relatively weaker sculpture and apertural ornament make the two species of *Prodotia* stand apart from typical *Engina*. There is, however, some general similarity with some species, notably *Engina gannita* Hedley as already noted. The radula differs from *Engina* s.s. in the outermost pair of cusps on the central tooth being better developed giving the tooth a true pentacuspid appearance. The lateral teeth each have 2 long cusps, the outermost much longer than the inner.

The radula of three specimens of *E. (P.) marmorata* were examined. Two of them from specimens collected at Taurama, near Port Moresby, Papua, wese identical and normal (Text fig. 1: 5). A specimen from Mauritius had a radula with the median cusp of each central tooth divided into two separate teeth but was otherwise identical. Peile (1939) also, described an aberrant radula in *marmorata* with the central cusp reduced to a vestige.

Only a single radula of *E. (P.) obliquicostata* was available, this being obtained from a specimen named *crosseanus* from Noumea, New Caledonia. This radula (Text fig. 1: 6), which is clearly a freak example, has some of the cusps on the central teeth subdivided, these subdivisions

being asymmetrical and varying a little in arrangement along the length of the ribbon. The basic tooth structure is the same as that in *marmorata;* the central teeth with 5 cusps, and bicuspid lateral teeth, their outermost cusps strongest.

Engina (Prodotia) obliquicostata (Reeve, 1846)

Plate 25, fig. 3 - 4; Text fig. 1: 6, 2: 17

1846 *Buccinum obliquicostatum* Reeve, *Conch. Icon.*, 3, *Buccinum*, pl. 12, sp. 91 a, b.
1846 *Buccinum gracile* Reeve, *Conch. Icon.*, 3, *Buccinum*, pl. 12, sp. 96.
1846 *Buccinum crocatum* Reeve, *Conch. Icon.*, 3, *Buccinum*, pl. 12, sp. 97.
1853 *Phos billeheusti* Petit, *J. Conch., Paris*, 4: 244, pl. 8, fig. 5.
1864 *Pisania billeheusti* var *artensis* Souverbie and Montrouzier, *J. Conch., Paris*, 12: 266.
1865 *Fusus crosseanus* Souverbie, *J. Conch., Paris*, 13: 160, pl. 5, fig. 6.

The number of species listed in the synonymy show the variability of this species. Considerable variation in size, colour, sculpture etc. occurs. Shells in the Australian Museum collections can be matched with the figures and descriptions of the type of each of the species names and no reasonable grounds for their separation can be found.

Reeve published three names on the same plate which apparently represent the same species. The first is chosen as the name for the species because it has numerical priority and there are no special reasons why the other figures should be chosen. *Pisania gaskelli* Melvill, 1891 *(J. Conch., Lond.*, 6: 406, pl. 2, fig. 5) and *Tritonidea neglecta* Sowerby, 1894, *(Proc. Malac. Soc.*, 1: 42, pl. 4, fig. 7) are possibly additional synonyms.

This species is distinguished by its protoconch of only $1\frac{1}{2}$-$1\frac{3}{4}$ whorls (Text fig. 2: 17), and strong axial ribs which extend with more or less equal strength from suture to suture and over the base. The spiral threads tend to be more regular than in *P. marmorata* and are typically stronger. In addition the shell is usually smaller and has a longer canal than *P. marmorata.* It is distributed throughout the tropical Indo-Pacific and in the Australian Museum there are specimens from eastern Queensland (Low Isles (C. 77165, 77166); Fitzroy Island (C. 77169); Hook Island (C. 77170)); and Long Island, Torres Strait (C. 77167, 77168).

Engina (Prodotia) marmorata (Reeve, 1846)

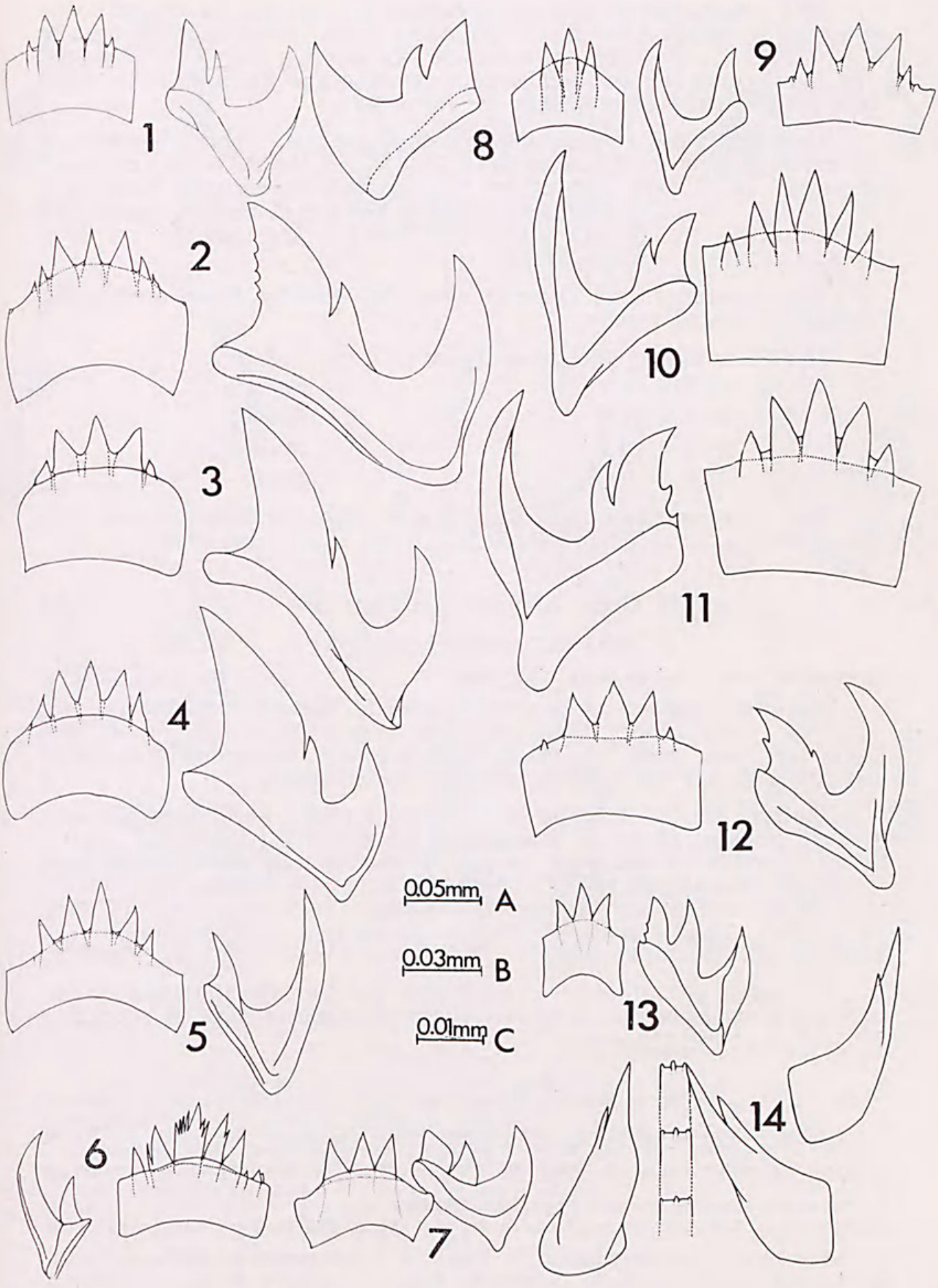
Plate 25, fig. 5; Text figs. 1: 5; 2: 18

1846 *Buccinum marmoratum* Reeve; *Conch. Icon.*, 3, *Buccinum*, pl. 12, sp. 95.

TEXT FIG. 1. Radular teeth.

1. *Pisania (Pisania) striata* (Gmelin). Marsa Sciroceo Harb., Malta, Mediterranean (C. 44347).
2. *Pisania (Pisania) ignea* (Gmelin). Michaelmas Cay, Queensland (C. 53314).
3. *Pisania (Taeniola) decollata* (Sowerby). Cook Islands, Pacific Ocean (C. 76288).
4. *Pisania (Pisania) fasciculata* (Reeve). Lindeman Island, Queensland (C. 58869).
5. *Engina (Prodotia) marmorata* (Reeve). Tuarama, near Port Moresby, Papua (C. 76287).
6. *Engina (Prodotia) obliquicostata* (Reeve). Noumea, New Caledonia (C. 4306).
7. *Pisania (Jeannea) hedleyi* (Iredale). Raoul Island, Kermadec Islands (C. 36693).
8. *Monostiolum (Monostiolum) swifti* (Tryon). Hungry Bay, Paget Parish, S.E. Coast, Bermuda, West Indies (Acad. Nat. Sci. Phil. No. 319019).
9. *Engina (Engina) armillata* (Reeve). North Keppel Island, Queensland (C. 70451).
10. *Engina (Engina) turbinella* (Kiener). Camaricoa, Cuba (C. 77083).
11. *Engina (Engina) resta* (Iredale). Lord Howe Island. Paratype (C. 59643b).
12. *Engina (Engina) australis* (Pease). Minnie Waters, Clarence River, N.S.W. (C. 72632).
13. *Clivipollia pulchra* (Reeve). Siassi Islands, New Guinea (C. 74829).
14. *Crassicantharus norfolkensis* gen. et sp. nov. Norfolk Island. Paratype (C. 59418b).

Fig. 1 - 5: Scale A; Fig. 6 - 9, 13: Scale B; Fig. 10 - 12, 14: Scale C.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0.05mm A
0.03mm B
0.01mm C

This species differs from the preceding in having a multispiral protoconch of 3½ whorls (Text fig. 2: 18), and a larger, usually slightly broader shell with the axial ribs much reduced or wanting above the shoulder. The spiral cords are usually alternatively weak and strong and the sculpture is typically weaker than in *obliquicostata*.

This species has a similar distribution to the last. There is a specimen from Minnie Waters, Clarence River, N.S.W. in the Australian Museum collection (C. 70011) and others from eastern Queensland; Low Isles (C. 77163, 77164); Fairfax Island, Bunker Group (C. 69053); North East collection (C. 70011) and others from eastern Queensland; Low Isles Herad Cay, Coral Sea (C. 69064).

Four specimens from Taurama, near Port Moresby, Papua were sexed with the following results.

Shell dimensions (Height x diameter)	Sex
36.0 x 14.2	Female
26.0 x 11.5	Female
24.0 x 10.0	Male
23.0 x 9.5	Male

This result suggests there may be a positive correlation of size with sex as seen in some other Buccinidae (Habe, 1950; Tiba, 1941).

Genus *Monostiolum* Dall, 1904

Subgenus *Caducifer* Dall, 1904

Type species: (o.d.) *Triton truncatum* Hinds, 1844.

This group appears to be closely allied to *Monostiolum* (see p. 255) which has place priority (both genera introduced on p. 136), and is here given subgeneric rank. It mainly differs in the multispiral protoconch and the very tall spire which is normally decollated.

The type species is found in Queensland (Kenn Reef, C. 68578) and is easily recognised by its orange and black mottled coloration, strong axial ribs and decollated spire. A very similar but more weakly sculptured species, *C. decapitatus* (Reeve, 1844) also occurs in much of the tropical Indo-Pacific and is known from Queensland (Two Isles, Cape Flattery (C. 41437), Palm Island (C. 9638), Michaelmas Cay, off Cairns (C. 53526)) and Western Australia (Houtmann Abrolhos Is. (C. 77260)).

The radula of both species (see Pilsbry and Vanatta, 1904) has simple tricuspid central and lateral teeth. The protoconch of the type species is tall and of about 3 whorls.

Genus *Pisania* Bivona — Bernardi, 1832

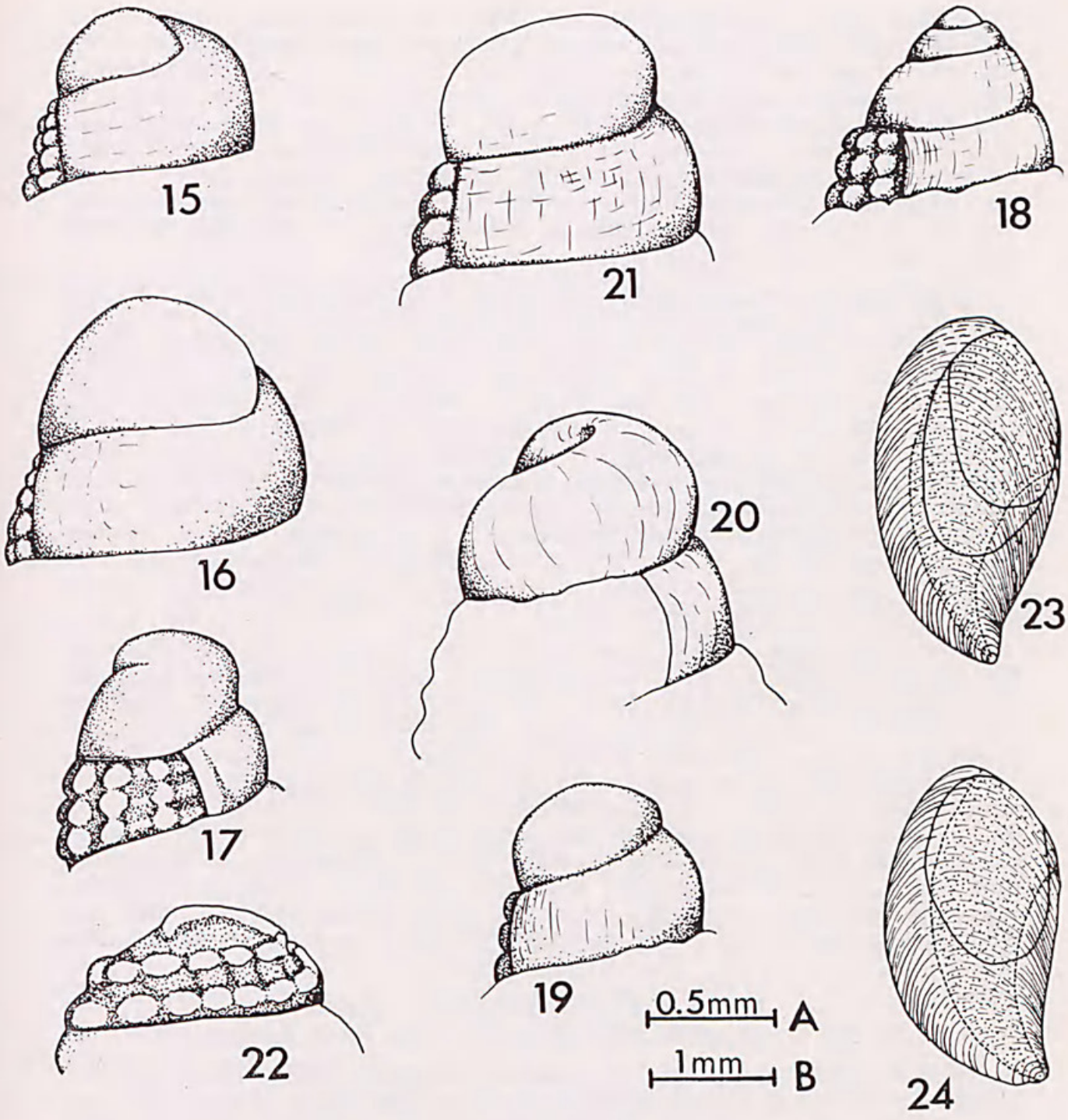
Type species: (s.d. Iredale, 1915) *P. striatula* Bivona, 1832, Opin. 740 *Bull. Zool. Nom.*, 2: 171 - 172 = *Voluta striata* Gmelin, 1790 (not *Murex striata* Gmelin, 1791 as stated by Rehder, 1963).

Synonyms: *Proboscidea* Schmidt (in Möller) 1832 (non Bruguiére, 1791) (type species *Buccinum igneum* Lin. (=Gmelin)).

Ecmanis Gistel, 1848 nom. nov. pro *Proboscidea* Schmidt.

Appisania Thiele, 1929 (type species *Pisania montrouzieri* Crosse, 1862 (= *fasciculata* Reeve, 1846)).

Appisania was introduced by Thiele as a subgenus of *Metula* H. and A. Adams, 1853. *Metula*, however, appears to have little relationship



TEXT FIG. 2. Protoconchs and operculae.

15, 16. *Engina (Engina) australis* (Pease). Wooli, N.S.W. (from specimens figured on Plate 24) (C. 77135).

17. *Engina (Prodotia)* obliquicostata (Reeve). Noumea, New Caledonia (C. 3962).

18. *Engina (Prodotia) marmorata* (Reeve). Low Isles, near Port Douglas, Queensland (C. 77163).

19. *Pisania (Pisania) ignea* (Gmelin). Samoa (C. 61162).

20, 21. *Pisania (Pisania) fasciculata* (Reeve). Palm Island, Queensland (C. 9649). Two views of same specimen.

22. *Crassicantharus norfolkensis* gen. et sp. nov. Norfolk Island. Paratype (C. 59418b).

23. *Engina (Engina) resta* (Iredale). Lord Howe Island. Paratype (C. 59643b).

24. *Engina (Engina) australis* (Pease). Minnie Waters, Clarence River, N.S.W. (C. 72632).

Fig. 15 - 22: Scale A; Fig. 23, 24: Scale B.

with *Pisania* and may belong to the family Colubrariidae. Thiele differentiated *Appisania* largely on radular characters, the lateral teeth having the inner cusp much larger than the outer (Text fig. 1: 4). Cernohorsky (1966) has described the radula of *P. montrouzieri* (= *fasciculata*) and this was originally illustrated by Thiele (1929). The radula of several specimens covering a range of colour forms was examined in the present study and no correlation with colour, or marked variation, was found. The small denticle on the inner cusp (= the medium cusp) varies in size and is occasionally very indistinct. This species is discussed in detail below.

The radula of *Pisania striata* (Text fig. 1: 1) (also figured by Troschel and Thiele, 1867) has 5 cusps on the squarish central tooth, the outer pair small in relation to the others. The lateral teeth have 2 large cusps, with one small cusp between them. Troschel and Thiele's figure shows these cusps subequal, the specimen here illustrated has the outer cusp stronger. Thus the only difference between the radula of *Pisania* and *Appisania* is the relative size of the outer cusps of the lateral teeth. Considering the variation observed in radular features, I can see no valid reason why *Appisania* should be maintained as a distinct genus or subgenus. Certainly there is nothing distinctive in the shell features between *striata* (Plate 25, fig. 1) and *fasciculata* and now that there is only one species of *Appisania* to consider (see below), its recognition as a "group of species" is no longer necessary.

Two specimens of *Pisania ignea* (Gmelin), the type species of *Ecmanis* Gistel, were available for radula extraction. One specimen from Michaelmas Cay, Queensland (Text fig. 1: 2) has serrations along the inside of the inner cusp of each lateral tooth. The central tooth has five main cusps and 2 small denticles at the outer bases of the outermost cusps. These denticles are not present in the radula of the second specimen, which was obtained by trawling off Broome, N.W. Australia; nor are the denticles on the inner cusp of the lateral teeth present. These radulae are very like that of *P. striata*. I cannot find any significant shell features that would allow for subgeneric separation of *ignea*, especially when the range of shell form in species related to *ignea* and *striata* is considered. Both *striata* and *ignea* (Text fig. 2: 19) have a paucispiral protoconch that is relatively smaller than that of *fasciculata*.

There appears to be at least 3 subgeneric groups of *Pisania* in the Pacific area and these are briefly contrasted with *Pisania* below.

Dall (1904) introduced *Taeniola* for *Triton decollatus* Sowerby, 1833 which was considered to be inseparable from *Pisania* by Pilsbry and Vanatta (1904). The sculpture in *T. decollatus* is composed of broad, flat spiral cords with narrow interstices and the early whorls also have axial ribs. This is quite unlike the sculpture seen in species of *Pisania* s.s. as Dall commented and it seems that *Taeniola* could hold subgeneric rank in *Pisania*. Other distinctive features include the markedly decollate spire, convex whorls, very strong varix (this is weak to medium in typical species of *Pisania*) and the inner lip raised over the fasciole.

The radula of *Pisania (Taeniola) decollata* (Text fig. 1: 3) is intermediate between that of *Pisania striata* (and *P. ignea*) and *P. fasciculata* in having the outer cusp of each lateral tooth about ½ the size of the inner. The middle cusp is very small, as in *P. fasciculata*. *P. (T.) decollata*, although having a wide Pacific distribution, has not been recorded from Australia.

Jeannea Iredale, 1912 (type species *J. hedleyi* Iredale) appears to contain only the type species which is from the Kermadec Islands north-east of New Zealand. *J. hedleyi* (Plate 24, fig. 5) is smaller than species of *Pisania* s.s. and has a barely discernible labial varix. Widely spaced, sharp spiral cords predominate over most of the teleoconch and they are rendered slightly nodulous at the points of intersection with the weak axials. Numerous fine interstitial threads lie between the main spirals. The inner lip and columella are smooth and there are long, weak lirations within the outerlip. The protoconch is rather loosely coiled, of 1½ whorls with the tip inrolled. There is nothing outstandingly different in the shell features that would separate this species from *Pisania* s.s. but the radula (Text fig. 1: 7) which was examined from two topotypes, is like that of *Buccinulum* Swainson, 1837 species (see Powell, 1929) with simple tricuspid central teeth of different shape to those seen in *Pisania* s.s. and the lateral teeth have three cusps of equal size.

The radular features suggest relationship with *Buccinulum* but the protoconch and teleoconch show affinity with *Pisania*. It is more probable that the relatively subtle characters seen in the radula were brought about by convergence than the rather more elaborate shell features. Thus *Jeannea* is here regarded as a subgenus of *Pisania*, from which it can be distinguished on radular features.

Sukunaia Cernohorsky, 1966 (type species *S. jenningsi* Cernohorsky) is very closely related to *Pisania* and barely distinguishable on shell features. The radula, however (see Cernohorsky, 1966) has a central tooth with only rudimentary cusps. As this appears to be the only distinguishing character from *Pisania*, *Sukunaia* should be regarded as a subgenus of *Pisania*. The type species has only been recorded from Fiji.

Pisania (Pisania) fasciculata (Reeve, 1846)

Plate 25, fig. 2; Text figs. 1: 4; 2: 20-21

1846 *Buccinum fasciculatum* Reeve, *Conch. Icon.*, 3, *Buccinum*, pl. 10, fig. 76.
1854 *Pisania crenilabrum* A. Adams, *Proc. Zool. Soc.*, (1854): 138.
1862 *Pisania montrouzieri* Crosse, *J. Conch., Paris*, 10: 251, pl. 10, fig. 5.
1876 *Pisania crenilabrum*. Smith, *J. Linn. Soc.*, 12: 541.
1901 *Pisania delicatula* Sowerby, *J. Malacol.*, 8: 101, pl. 9, fig. 2.
1929 *Jeannea crenilarum* (sic). Iredale, *Mem. Qld. Mus.*, 9: 288.
1962 *Jeannea delicatula*. Iredale and McMichael, *Aust. Mus. Mem.*, 9: 69.
1968 *Appisania sugimoto* Habe, *Venus*, 27 (3): 85, text fig. 1.

This species exhibits considerable colour and size variation between and within populations. I can see no reason why the names in the above synonymy should be considered valid species as they appear to represent mere colour forms which can be found grading into one another, even within a single population.

The adult shell always bears small crenulations on the outer lip which correspond to the weak spiral cords (which form the main sculpture) and within this lip shallow grooves run between the crenulations. There is a labial varix and the inner lip bears a single tooth posteriorly and another immediately above the short canal. The protoconch is asymmetrical, of about 2 whorls (Text fig. 2: 20-21).

This species is common on the Great Barrier Reef and in New Caledonia. It extends throughout the tropical Indo-Pacific to tropical East Africa. The type locality of *Pisania delicatula* Sowerby, was given as

" Bird Island, South Pacific." Hedley (1913) suggested that this may be Bird Island near Newcastle, N.S.W., but there are, he remarks, no less than 10 " Bird Islands " off the Australian coast. Probably, however, the specimens were collected in a more tropical location than the central N.S.W. coast.

Genus *Crassicantharus* gen. nov.

Type species: *C. norfolkensis* sp. nov.

GENERIC DIAGNOSIS: *Shell:* Small, elongate — buccinoid, solid, with strong spiral cords and axial ribs. Protoconch of 1 bicarinate whorl. Inner lip and columella smooth except for a parietal tubercle at the base of the posterior canal. Outer lip without a sinus, thickened and denticulate within. *Operculum:* oval, with an apical nucleus. *Radula:* Relatively small, lateral teeth strong, with small bases consisting of a single bifid cusp. Central teeth vestigial, narrow, with 3 denticles (Text fig. 1: 14).

REMARKS: The radular and protoconch features readily separate the new genus from any other in the Buccinidae.

Chauvetia Monterosato, 1884 (type species *Buccinum candidissima* Philippi) is similar to *Crassicantharus* in shell features (see Tiberi, 1868 for figures of the type species and related species) but *C. brunnea* (Donovan, (1804) has a distinctive radula and operculum (Woodward, 1899). The radula has a single cusp on the central teeth and the tricuspid laterals each have a long latero-basal projection. The operculum is broadly truncated at the apical end. Lebour (1937, p. 156) describes the egg capsules of *C. brunnea* as being lens-shaped and transparent.

Clathranachis Kuroda and Habe, 1954 (type species *Lachesis japonica* A. Adams, 1860) and *Ruthia* Shasky, 1970 (type species *R. mazatlanica* Shasky) are somewhat similar in shell features but have typical columbellid radulae.

Crassicantharus norfolkensis sp. nov.

Plate 24, fig. 4; Text fig. 1: 14; 2: 22

Shell: Small, elongate, solid, with strong spiral cords and axial ribs. Whorls of teleoconch about 5, subshouldered, sutures moderately impressed. Protoconch (Text fig. 2: 22) almost flat, of 1 whorl, tip only slightly raised, with 2 strong spiral ridges continuous with those of first whorl of teleoconch. These ridges are crossed by weak axial riblets which render the spiral cords slightly nodulous on the first $\frac{1}{2}$ whorl. The finer details of protoconch sculpture were not visible due to abrasion (only

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PLATE 25.

Fig. 1. *Pisania striata* (Gmelin). Marsa Sciroceo Harb., Malta, Mediterranean (C. 44347). *

Fig. 2. *Pisania fasciculata* (Reeve). Lady Musgrave Island, Bunker Group, Southern Queensland (C. 77137).

Fig. 3. *Engina (Prodotia) obliquicostata* (Reeve). Noumea, New Caledonia (C. 4306). *

Fig. 4. *Engina (Prodotia) obliquicostata* (Reeve). Long Island, Torres Strait (C. 77167).

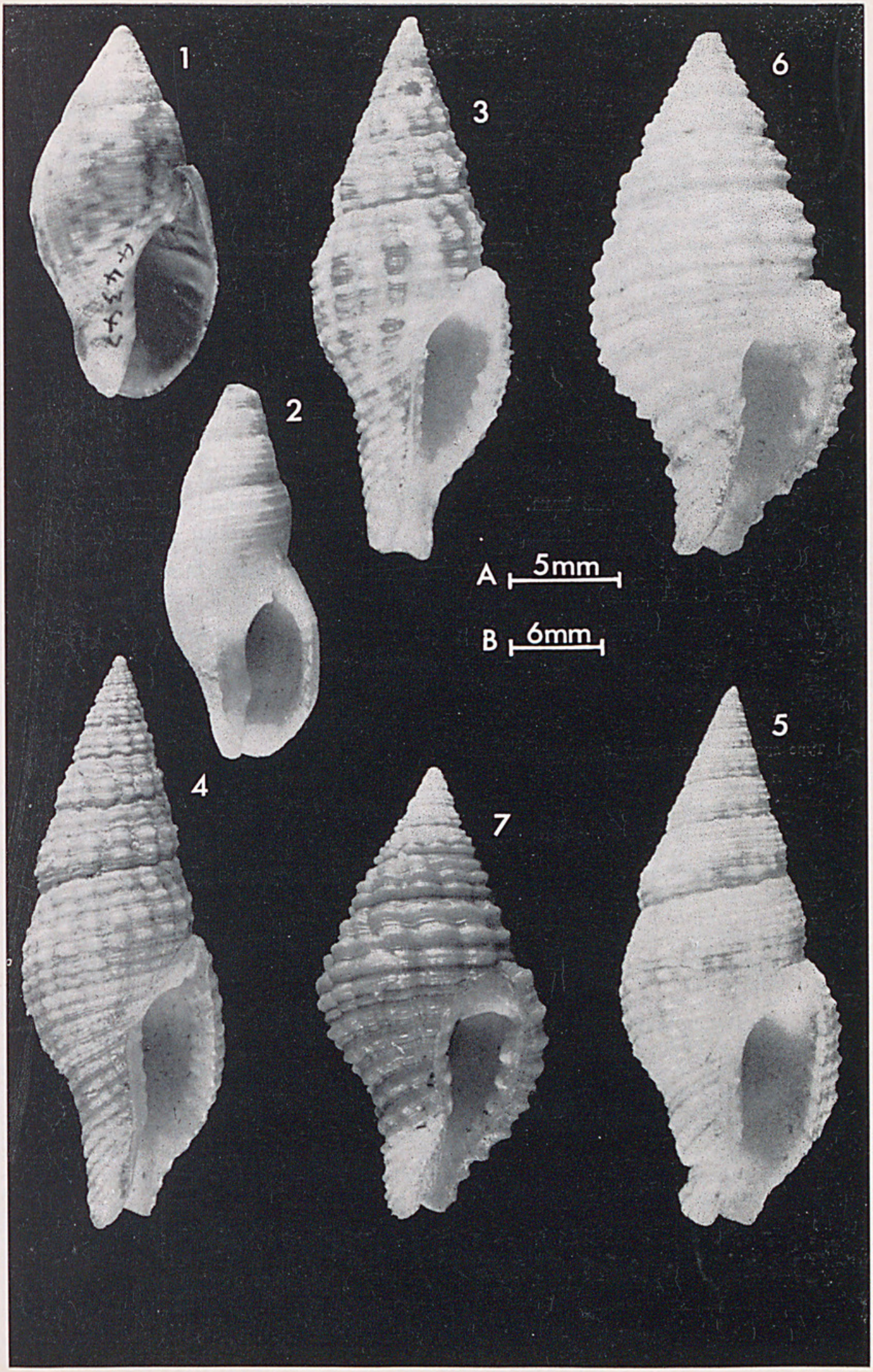
Fig. 5. *Engina (Prodotia) marmorata* (Reeve). Low Isles, near Port Douglas, Queensland (C. 77163).

Fig. 6. *Clivipollia imperita* Iredale. Sydney Hr., N.S.W. Holotype (C. 57848).

Fig. 7. *Clivipollia pulchra* (Reeve). Siassi Is., New Guinea (C. 74829). *

Fig. 1, 2: Scale A; Fig. 3 - 7: Scale B.

* specimens from which figured radulae obtained.


1
2
3
4
5
6
7
A 5mm
B 6mm

1 juvenile has the protoconch intact). Sculpture of teleoconch of white to yellowish, broad, flat, spiral ridges, with narrow, dark reddish-brown interstices. First whorl of teleoconch with 2 spiral cords crossing the axial ribs, the points of intersection slightly nodulous. Spiral increase to 4 on penultimate whorl and there are 11 on the body whorl and base. Sometimes an additional weak cord below periphery on body whorl. Axial ribs strong, 11-12 on body whorl. Fasciole prominent, inner lip and columella smooth, a large parietal tubercle at base of posterior canal. There is no sinus on the outer lip which is thickened with about 8 long denticles. There is no external varix. Anterior canal short, curved to left, and open.

Radula and operculum: As for generic diagnosis.

Head-foot: (from restored dried animal) with no dark pigment, with dense white blotches on foot. Head small; eyes prominent, at the bases of moderately long tentacles.

Height	10.25 mm.	Diameter	4.55 mm. (holotype)
	10.42 mm.		4.65 mm. (paratype)
	11.32 mm.		4.70 mm. (paratype)

Holotype: Norfolk Island; collected R. Bell (Australian Museum, Registered No. C. 59418a).

Paratypes: 8 — with above data (C. 59418b); 14 additional paratypes (specimens presented by C. Hedley) from the same locality (C. 31020).

Genus *Clivipollia* Iredale, 1929

Type species: (monotypy) *C. impertia* Iredale.

This genus was placed in the Fasciolariidae by Wenz, next to *Peristernia* Mörch, 1852, a genus which it closely resembles in most shell features. The type species has, however, an aperture like *Engina* with a row of prominent denticles inside the inner lip. There are a few tropical species which are obviously congeneric with *C. impertia* (Plate 2, fig. 6) which have been variously placed in *Peristernia, Engina* etc. These include *Ricinula pulchra* Reeve, 1846; *Turbinella carolinae* Kiener, 1841 (= *Rincinula bella* Reeve, 1846); and *Turbinella wagneri* Anton, 1838 (= *Turbinella crenulata* Reeve, 1847 (non Kiener, 1841), = *Purpura bucciniformis* Kiener, 1835).

C. impertia is known from only one specimen taken by the Sydney Harbour dredge "Triton". The shell is very faded and may possibly be sub-fossil. It is almost indistinguishable from *R. pulchra*, the radula of which was mounted from a specimen collected from the Siassi Islands, northern New Guinea (Plate 2, fig. 7). This radula (Text fig. 1: 13) has a different structure from that of typical species of *Engina*, a genus in which *pulchra* Reeve is often located. It has narrow central teeth with 3 large cusps and the lateral teeth have 3 cusps decreasing in size from the outer to the inner.

In view of the distinctive radular and shell features, this group appears to be fully worthy of generic status within the Buccinidae. It shares the features of both *Engina* and *Cantharus* Röding, 1798.

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