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NOTES ON THE GENERA *AMORIA* GRAY, 1855, AND
ZEBRAMORIA IREDALE, 1924,
(GASTROPODA: VOLUTIDAE), WITH DESCRIPTIONS
OF NEW SPECIES

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Plate 28. Figs. 1-7

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ABSTRACT

Some notes on the nomenclature, distribution and characteristics of several species of the genera *Amoria* Gray and *Zeboramoria* Iredale are given. Two new species of *Amoria* are described from eastern Australian localities.

INTRODUCTION

The genus *Amoria* Gray is one of the most varied groups of the Family Volutidae, with a number of elegant and richly coloured species, distributed around the coasts of Australia. The genus does not extend beyond Australian waters. *Amoria* is a group which appears to be in a state of active evolutionary divergence, as compared with other Volutidae, because of the number and variety of its species, the variation in morphology and wide geographic range of individual species, and the comparative closeness in characters of some pairs of species. A revision of the genus was published by Ludbrook (1954) in which many difficult taxonomic problems were solved, and for the most part her results are still acceptable.

However, recent research at various museums in Australia and overseas has enabled the determination of some points on which Ludbrook was uncertain, while in one or two minor instances her conclusions have been found to be incorrect. Further, the acquisition of much new material in this genus from a number of collectors during recent years has revealed the occurrence of some new species which are described below, and has provided better information on the distribution and morphology of some species. A number of Western Australian volutes were collected by the 1960 Hawaiian-Western Australian Expedition in the M.V. *Davina* and while these included a number of species of *Amoria*, a report on them will be published elsewhere. Particular thanks are due to Mrs. R. Kerslake, Mr. Clifton S. Weaver, Mr. and Mrs. W. Goode, Mr. T. Nielsen and Mr. F. McCamley, for their help in making specimens of animals and shells available for study. For convenience, the species are dealt with in the order adopted by Ludbrook (1954).

Genus *Amoria* Gray, 1855

Amoria Gray, 1855, p. 64. Type species by subsequent designation (Harris, 1897, p. 108). *Voluta turneri* "Gray" = Griffith and Pidgeon.

Subgenus **Amoria** Gray, 1855

Amoria canaliculata (McCoy, 1869)

Voluta (Amoria) canaliculata McCoy, 1869, (July), p. 34, pl. 3, figs. 1 and 2.

Voluta harfordi Cox, 1869 (September), p. 358, pl. 26, figs. 2a, b.

This species has been rediscovered in recent years by trawling and dredging in waters off Yeppoon and the Keppel Islands, Queensland, and at Lady Musgrave Island in the Bunker Group. Many fine specimens have been collected and these range in colour from pale shells with light reddish lines to deeply coloured pinkish red shells with deep red lines and bold encircling spots. The animal of a specimen from off Keppel Island is reddish purple in colour, with numerous cream spots which run together to leave a reticulation of reddish purple. The siphon is similarly coloured and bears slender, sub-equal appendages, approximately opposite each other. The radula consists of about 300 Y-shaped teeth, which differ from typical *Amoria* teeth in that the cusp is expanded into a blade-like plate, running backwards over the angle of the basal plate (fig. 1).

Amoria maculata (Swainson, 1822)

Voluta maculata Swainson, 1822, p. 11, Id., 1832, pl. 87.

Scaphella caroli Iredale, 1924, p. 258.

This species has long been known as *Amoria caroli*, the latter name having been introduced as replacement for *maculata* Swainson, which was thought to be preoccupied by *Voluta maculata* Meuschen, 1781. Since the latter work has now been placed on the Index of Rejected Works by the International Commission, Swainson's name becomes available once again and must be reinstated [as Weaver (1963) has already indicated].

A. maculata is one of the commonest species of the genus, occurring widely in Queensland, and has been obtained in quantity in recent years by prawn trawlers operating south of Fraser Island, where some fine shells of a salmon pink colour with deep bluish spots were found. Two records which require confirmation have been received at the Australian Museum recently. A young shell was said to have been collected on Woolgoolga Beach in northern New South Wales, while an adult shell was found at Lord Howe Island. Both these localities considerably extend the range of the species which was previously thought to be confined to Queensland north of Wide Bay. Another unusual colour variation has been obtained on St. Crispin Reef, off Cairns, Queensland, in which the spots are elongated into a wrinkled lineation, thus approaching *Amoria volva*. Some shells found on reefs near Cairns are almost completely lacking in the dark spots or maculations so characteristic of most populations of this species. However, in every other way they agree with *A. maculata* and must be regarded as colour variants only.

An animal of this species from 30 fathoms, 12 miles east of Fraser Island, Queensland, is spectacularly coloured in alternating reddish orange and cream radial bands around the edge of the foot, which split and anastomose to some extent on the body; the head is striped longitudinally, while the tentacles and proboscis are cross-striped in the same colour pattern. The siphon bears long appendages, of equal size, and the radula consists of about 137 typically Y-shaped teeth (fig. 2).

Amoria molleri (Iredale, 1936)

Relegamoria molleri Iredale, 1936, p. 314, pl. 23, fig. 10. Garrard, 1961, p. 21.

Garrard has recorded the rediscovery of this species in depths of about 100 fathoms off central New South Wales. Specimens were available for dissection from off Barrenjoey, Broken Bay, New South Wales, collected by Dr. A. Racek on the trawler *Challenge*. The animal is cream in colour, overlain with a lovely salmon pink decoration, in irregular reticulation, mainly parallel to the margin of the foot. The proboscis and siphon are irregularly striped in a longitudinal pattern, while the tentacles are prominently cross-striped with salmon pink. The siphon is rather short, stout, tapering to a point with comparatively long, stout, sub-equal appendages. The radula consists of about 125 typically Y-shaped teeth (fig. 3).

I am in agreement with Ludbrook that the genus *Relegamoria* Iredale should be placed in the synonymy of *Amoria*. Iredale claimed that "the apical whorls distinguish this species from *Amorena*, and also from *Amoria*, though it seems nearer the latter tropical genus than the former, the local genus of southern Australia". Iredale failed to elaborate this statement, and I can see no significant difference between *molleri* and other species of *Amoria* s.s., least of all in apical characters, while the radula is typical of *Amoria*.

Amoria spenceriana (Gatliff, 1908)

Voluta (Amoria) spenceriana Gatliff, 1908, p. 84, pl. 4.

This remains a rare species, known only from a few poorly localized specimens. While its colour pattern of a few dark, irregular markings on creamish-white shell is not outstanding, the species is exceptional in possessing only three columellar plaits. Apart from the specimens listed by Ludbrook, I noted only one additional specimen in the Museums visited by me. This was in the Royal Scottish Museum, Edinburgh.

Amoria volva (Gmelin, 1790)

Voluta volva Gmelin, 1790, p. 3457, based on Chemnitz, 1788, p. 143, pl. 148, figs. 1389-1390.

This species remains an enigma, as its identity and location are still uncertain. After centuries of misidentification, Ludbrook examined the Chemnitzian type and stated that it was not the Western Australian species now known as *grayi*, but was a species "close in shape to *A. turneri* and somewhat similar in colour pattern to *A. caroli* (Iredale). The small species *A. praetexta* also resembles *volva* in its colour pattern." Ludbrook speculated that the locality of the species might be New Guinea or north Australia, possibly Cooktown. The latter suggestion derives from the fact that any Queensland shells which reached Europe prior to 1800 must have been collected by Cook's expedition, making Cooktown and Possession Island, Torres Strait, likely localities. The British Museum specimens reported by Ludbrook have been examined and they do appear to represent a distinctive species, with a close relationship with *Amoria maculata (caroli olim)*. Should the two species prove to be synonymous, *volva* would have priority.

Ludbrook was incorrect in considering *Amoria grossi* Iredale, 1927, to be a gerontic specimen of *Amoria volva*. It has since been shown to be a distinctive species of the genus *Volutoconus* Crosse (see Abbott, 1958 and McMichael, 1960).

Amoria dampieria Weaver, 1960

Amoria (Amoria) dampieria Weaver, 1960, p. 1, 3, figs. 6 and 7, ex Cotton, 1949, p. 191, m.s. ("*Zebramoria zebra dampieria* Iredale").

It is necessary to clear up some of the confusion surrounding the name *Amoria* (or *Zebramoria*) *dampieria*. This name first appeared in literature in Cotton (1949, p. 191) and subsequently was listed again by Cotton (1957). On each occasion, it was attributed to Iredale, 1914, as a subspecies of *Zebramoria zebra* from Western Australia. Cotton has subsequently stated (pers. comm.) that he copied the name from labels in the South Australian Museum collection, though the actual source of these labels is not certain. No such name was ever published by Iredale, though he did record the species "*Zebramoria zebra* var." from the Montebello Islands, Western Australia (1914, p. 674). Iredale's specimens cannot be located now and their identity is uncertain. It seems unlikely that any specimens of *Zebramoria zebra* have ever been found in Western Australia, since the known range of the species is from eastern Victoria to south Queensland. During 1960, the Hawaiian Western Australian expedition in the yacht *Davina* collected many volutes from coastal waters of southern Western Australia, and among these was a small, striped volute which was at once identified with Cotton's "*dampieria*". I supplied information on the status of the name to Weaver, who was reporting on the collections in a series of articles in *Hawaiian Shell News*. Through a misunderstanding, Weaver published a photograph of a specimen of the shell together with a caption including the name "*Amoria (Amoria) dampieria* Iredale, 1914, nomen nudum". In addition, he gave the locality, measurements, and, on a subsequent page, brief descriptive notes. Since this publication appears to fulfil the conditions of availability (International Code, Articles 11 and 13) the name must date from this usage with Weaver as author. In order to regularize the matter, Weaver has agreed to republish the name with a proper description elsewhere. [*J. Malac. Soc. Aust.*, 7, pp. 28-31, 1962].

Amoria guttata sp. nov.

Pl. 28, top two figs.

Description: Shell of moderate size, slender, with short, conical spire, large body whorl, slightly shouldered, sutures only slightly impressed. Protoconch of $3\frac{1}{2}$ whorls, smoothly conical, polished and without sculpture; fawn coloured, with a white sutural band; slightly offset from the two adult whorls. Shell brown, with four darker brown encircling bands, and generally overlain with white markings; darker bands in positions as follows—one subsutural, one at shoulder, one half-way between shoulder and anterior end of shell, and one at the anterior end; white markings irregularly arranged, average size about 2 mm. by 1 mm., elongated in an anterior-posterior direction, and concentrated in the areas between the darker bands, though a few larger, spaced markings occur in the bands. Aperture slender, bluish-white, outer lip margined with light brown, inner lip with a thin glaze obscuring the colour pattern of the previous whorl; four strong, columellar plaits, the third from the anterior end continuing as the upper edge of the fasciole. Animal unknown.

Dimensions.—Holotype: Length 54.5 mm., maximum diameter 22 mm., length of aperture 41 mm. Paratype: Length 53 mm., maximum diameter 21 mm., length of aperture 37 mm.

Types and Type Locality: The holotype is in the Australian Museum, No. C. 63998, and a paratype is in the collection of Mr. C. Coucom, of Yeppoon, Queensland. Both shells were dredged by Mr. Tom Nielsen, of Yeppoon, in about 20 fathoms south of Cairns, Queensland.

Remarks: This is undoubtedly one of the most beautiful shells which have been found in recent years, and it is remarkable that such an elegant shell should have escaped detection until now. The description given applies only to the holotype, which is a recently-dead shell in good condition. The paratype is a worn shell, but otherwise agrees in most details. Two additional shells which are considered to be referable to this species have been seen. One, in the collection of Mr. R. Brown, of Yeppoon, Queensland, is a dead shell, trawled off Yeppoon, which bears a general resemblance to *Amoria guttata* in shape, size and colour, but differs in details of pattern. The colour is somewhat lighter, and the white linear markings are much larger, longer, and most extend right across the areas between the slightly darker bands. Some are continuous with the white markings on the bands, thus yielding a continuous white stripe which may be more than 20 mm. long. A second specimen, almost identical with Brown's shell, but somewhat discoloured through decomposition, is in the collection of Mr. J. Feros, of Evan's Head; it was dredged in 11 fathoms off South Keppel Island, Queensland. It may prove that these two shells are members of a species distinct from *A. guttata*, or they may represent a geographic subspecies. A decision must await the acquisition of a range of specimens.

Subgenus **Amorena** Iredale, 1929

Amorena Iredale, 1929, p. 180. Type species by original designation *Voluta undulata* Lamarck.

Amoria (Amorena) undulata Lamarck, 1804

Voluta undulata Lamarck, 1804, p. 157, pl. 12, figs. 1a, b.

Voluta angasii Sowerby, 1864, p. 271, based on Sowerby, 1844, pl. 48, fig. 29.

Voluta (Amoria) australiae Cox, 1871b, p. 643, pl. 52, fig. 1.

Scaphella moslemica Hedley, 1912, p. 145, pl. 43, figs. 29 and 30.

This is the commonest species of *Amoria*, extending from south Western Australia to central New South Wales, in shallow depths on the continental shelf. There is a notable amount of variation in shape, especially in the degree of shouldering, and the ground colour varies from almost white to deep orange-brown, with reddish-brown lines of fairly consistent pattern. The name *angasii* Sowerby (sometimes incorrectly attributed to Brazier) was given to the Tasmanian form of the species in the belief that it differed from the South Australian population, and some authors have attempted to use the names *undulata* and *angasii* as geographic races from South Australia and Tasmania respectively. However the type locality of *Voluta undulata* Lamarck is "Bass Straits and Maria Island, Tasmania" so that *angasii* is synonymous. In any case, there is no significant difference between shells from the two areas, apart from the generally deeper colouring of the Tasmanian shells, so that racial differentiation is not warranted.

The status of two forms listed by Ludbrook as synonyms without comment, viz. *australiae* Cox and *moslemica* Hedley, must be re-examined. The holotypes of both species are in the Australian Museum as well as several paratypes of *moslemica*. The latter came from a depth of 250 fathoms and was differentiated because of its "smaller, thinner shell with a smaller protoconch and having the spire whorls wrapped in a white sheet of callus". It is certainly true that shells from deep water off the New South Wales coast are more slender and less shouldered than southern forms, but this seems to be merely a function of latitude. The pattern of lines is identical with that of typical *undulata*, and the only character which might otherwise serve to differentiate *moslemica* (the white apical callus) is apparently a deep-water effect,

since shells from about 60 fathoms have the glaze partly developed, while those from about 40 fathoms lack it completely. Consequently, I regard *moslemica* as a deep-water ecophenotype only and agree with Ludbrook in relegating it to the synonymy of *undulata*.

The type of *V. australiae* Cox agrees with *A. undulata* in every way, except for the pattern of the brown lines. No shell identical with it has ever been found to my knowledge. It measures 60 mm. long and 27 mm. in maximum diameter, agreeing exactly with Cox's original figure, of which Tryon's (1882, pl. 26, fig. 73) and Sowerby's figures (1887, fig. 151) are both poor copies. Cox (1872, p. 16) suggested the Ninety Mile Beach, Victoria as its true locality. Two shells have recently been found by Mr. Neil Buckland on beaches near Eden, New South Wales. These are generally similar to Cox's type, but the number of longitudinal lines is less, and they are short, and not continuous for the full length of the body whorl. Radular teeth from one of these specimens (fig. 4) are similar to those of typical *A. undulata*, which has about 135 typically Y-shaped teeth (fig. 5). A third fully adult specimen from near Eden, in the collection of Mrs. W. Gilfillan, has similar markings but at the last portion of the body whorl near the outer lip and on the colelemellar lip of the aperture it displays the typical markings of *A. undulata*. It seems clear that these shells, as well as the type of *V. australiae* Cox, are mutants or aberrant colour forms only, and so *V. australiae* is correctly placed in the synonymy of *Amoria undulata* (Lamarck).

The animal of *Amoria undulata* is cream, with a reddish pattern of generally radiating lines, anastomosing and splitting, but fairly widely spaced. The head has two very large tentacles, large lateral lobes with prominent eyes. The siphon is stout, muscular, with large flattened appendages of equal size.

***Amoria (Amorena) sclateri* (Cox, 1869)**

Voluta sclateri Cox, 1869, pp. 358-359, pl. 26, fig. 3.

Voluta kingi Cox, 1871, p. 324, pl. 34, fig. 4.

The types of the two nominal species have been examined, and I agree with Ludbrook that they are synonyms, and that the species is distinct from *A. undulata*, though undoubtedly derived from it. Numerous pallid specimens of *A. undulata*, with the orange-brown lines scarcely visible, have been distributed to collectors as *A. sclateri*. However, the latter has no trace of coloured lines whatever, and its colour is usually a pale cream to white.

***Amoria (Amorena) exoptanda* (Reeve, 1849)**

Voluta exoptanda Reeve, 1849, pl. 10, fig. 22.

This well defined species was omitted by Ludbrook from her revision. It is still very rare, only a few specimens being known and these seldom perfect. Localities from which it has been recorded are as follows: Encounter Bay (Cotton, 1957), Yankalilla Bay (Aust. Mus. C30048), Port Lincoln (British Mus., Holotype), Middleton (U.S. Nat. Mus. 612466, Aust. Mus. C62133). All South Australia. A perfect specimen is in the National Museum of Victoria, unfortunately without precise locality.

Amoria (Amorena) benthalis sp. nov.

Pl. 28, bottom two figs.

Description: Shell small, robust, with short spire, the apex bluntly rounded, the suture glazed over; body whorl large, weakly shouldered. Protoconch of 2 whorls, smooth, highly polished, uniform creamish-brown, adult whorls $2\frac{1}{2}$, colour cream, with an ill-defined brown band just beneath the suture and two spiral bands of brown spots, one at the shoulder and one half-way between this and the anterior end of the shell, and with numerous fine, longitudinal reddish-brown lines spaced about 1 or 2 mm. apart, slightly undulating, with two peaks at the positions of the bands of brown spots; anterior end of shell suffused with brown. Aperture gaping, white to orange, with four strong plaits; fasciole weakly developed. Animal unknown.

Dimensions:

	Length	Maximum Diameter	Length of Aperture
Holotype	35.0 mm.	16.5 mm.	26.5 mm.
Paratype	29.5 mm.	15.0 mm.	23 mm.

Type Locality: 120 to 125 fathoms, off Cape Moreton, Moreton Island, Queensland.

Types: The holotype is in the Australian Museum, No. C. 63999, and paratypes are in the Australian Museum and the Bernice P. Bishop Museum, Hawaii.

Remarks: The new species resembles *A. (A.) undulata* in possessing undulating longitudinal lines of colour, but the undulations are not so acutely angled as in that species. In addition, the spiral bands of brown spots are not present in *A. undulata*, which is larger and does not range further north than Port Macquarie, New South Wales. The shells were trawled by Mr. W. Goode, of Redcliffe, Queensland; Mr. C. S. Weaver, of Honolulu, Hawaii, has kindly presented a fine specimen of this shell to the Australian Museum, which has been chosen as the holotype, while Mrs. R. Kerslake presented the two paratypes. One of the paratypes has the anterior end broken and could not be measured. Both are a little more squat and strongly shouldered than the holotype.

Genus **Zebromoria** Iredale, 1929

Zebromoria, Iredale, 1929, pp. 180 and 189. Type species by original designation, *Voluta zebra* Leach.

Remarks: Ludbrook ranked *Zebromoria* as a subgenus of *Amoria*, but the protoconch of both known species is so distinctive being elevated, pupiform, of several rounded whorls, that I regard the group as worthy of full generic rank. An earlier name for this genus is *Pilidia* Valenciennes (1863, p. 72) with type species by monotypy, *Voluta zebra* Leach. However, as the name is not recorded in Neave's *Nomenclator Zoologicus*, and has not been used by any subsequent author, it is a *nomen oblitum* and must be rejected under Article 23b of the International Code.

Zebromoria lineata (Leach, 1814)

Voluta lineata Leach, 1814, pl. 12, fig. 2.

This species has been clearly differentiated by Ludbrook from *Zebromoria zebra*, the radial ribbing of the spire of *lineata* being diagnostic. Ludbrook noted that there was a light colour variant in which the longitudinal lines were reduced or absent, and specimens of this form have been found commonly in Port Curtis in recent years. However, they do not represent a geographic race but are simply colour variants of no taxonomic significance. A specimen of this species from Dundowran, Queensland, was available for dissection, but as it was withdrawn deeply into the shell, it could only be extracted in pieces. The general coloration is of deep reddish black markings on a cream ground colour. Few details of the structure were obtained. The radula was extracted, however, and proved to have 130 Y-shaped teeth, similar to those of *Amoria* (fig. 6).

Zebramoria zebra (Leach, 1814)

Voluta zebra Leach, 1814, pl. 12, fig. 1.

Marginella radiata Lamarck, 1822, p. 356.

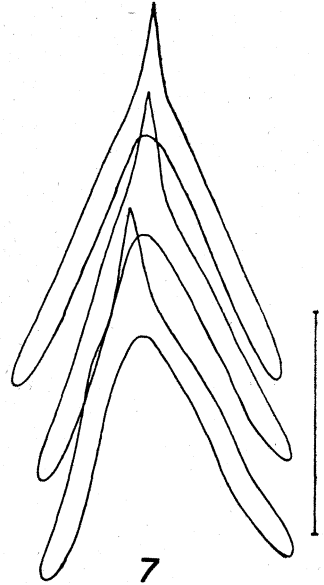
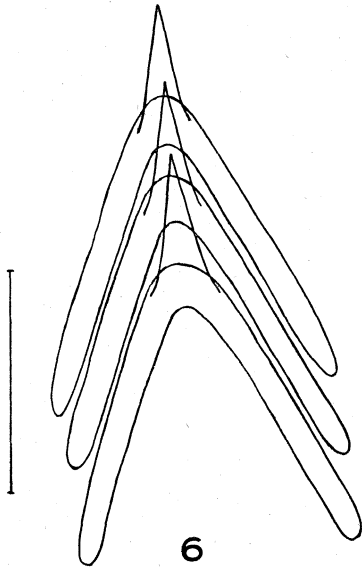
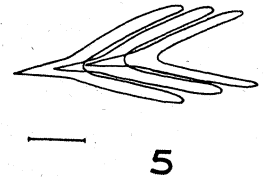
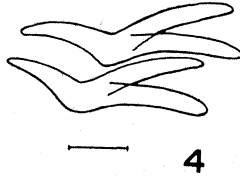
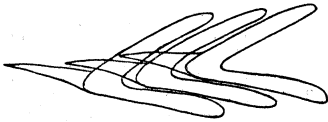
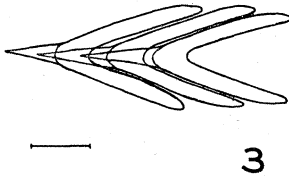
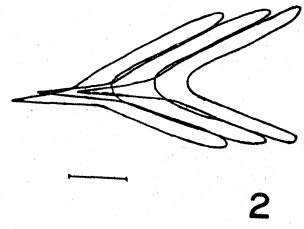
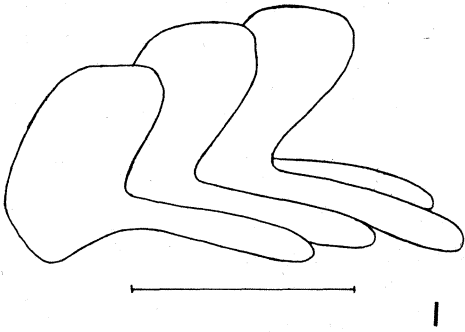
Voluta stragulata Schubert and Wagner, 1829, p. 11, pl. 217, fig. 3033.

The determination of *Voluta stragulata* as a synonym of this species is somewhat doubtful as the figure is very poor; however, the description, shape and size indicate that it is a *Zebramoria*, and it may well be *Z. zebra*. A specimen was available for dissection, trawled off Southport, Queensland. The foot is small, banded with fine, red stripes, branching and anastomosing on a cream background. The siphon is similarly coloured and bears long equal appendages. The head is rather small, with long thin tentacles. The radula consists of 153 Y-shaped teeth (fig. 7).

**EXPLANATION OF FIGURES**

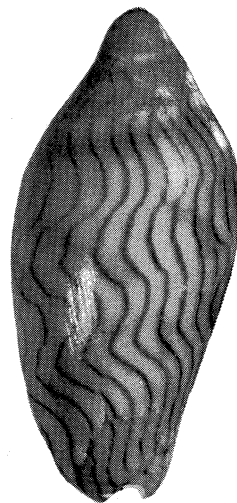
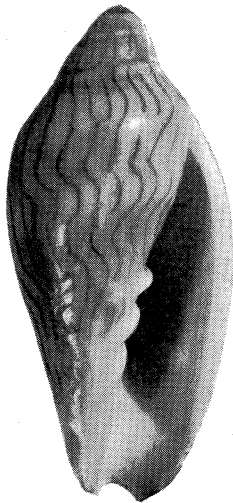
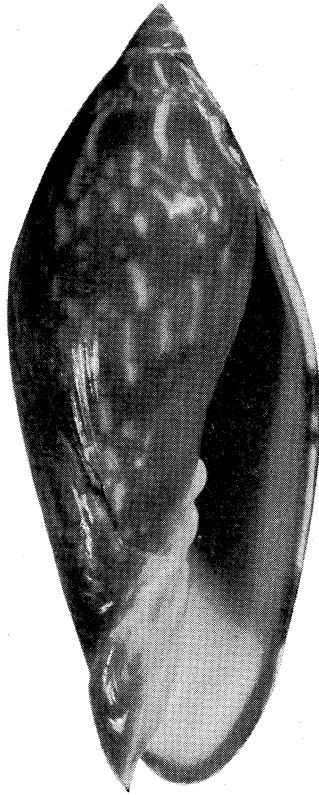
Radular teeth of *Amoria* and *Zebramoria*. The line adjacent to each figure represents a length of 0.1 mm.

- Fig. 1. *Amoria canaliculata* (McCoy). Off South Keppel Island, Queensland.
- Fig. 2. *Amoria maculata* (Swainson). East of Fraser Island, Queensland.
- Fig. 3. *Amoria molleri* (Iredale). Off Barrenjoey, Broken Bay, New South Wales.
- Fig. 4. *Amoria undulata* (Lamarck). Beach near Eden, New South Wales.
- Fig. 5. *Amoria undulata* (Lamarck). Off Barrenjoey, Broken Bay, New South Wales.
- Fig. 6. *Zebramoria lineata* (Leach). Dundowran, Queensland.
- Fig. 7. *Zebramoria zebra* (Leach). Off Southport, Queensland.



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EXPLANATION OF PLATE

Top: *Amoria guttata* sp. nov. Holotype, Aust. Mus. C.63998.

Bottom: *Amoria (Amorena) benthalis* sp. nov. Holotype, Aust. Mus. C.63999.