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LIOTIIDAE AND ALLIED MOLLUSCS FROM THE DAMPIERIAN ZOOGEOGRAPHICAL PROVINCE*

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(Figures 1-87)

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INTRODUCTION

This paper is based on two collections from Darwin, Northern Territory, which, as far as is known, are the only collections of small shells available from within the Dampierian Zoogeographical Province. The first collection was made by the author's son, John Laseron, from the beaches at Darwin during the war years, the second from a dredging in 17-20 fm of Pt. Charles, Darwin, by Mr. Mel Ward. As the field is so large it has been thought advisable to deal with these collections family by family rather than as a whole. Material from these collections has already been incorporated in papers dealing with both the Solanderian and Dampierian Provinces on the Cerithiopsidae, the Rissoinidae and Rissoidae, and the Ctiloceratidae (the last in co-authorship with Tom Iredale). The present paper, however, deals only with the Dampierian Province.

No species of Liotiidae has previously been recorded from within the Dampierian Province, but several species have been described from Torres Strait, where there is an overlap with the Solanderian fauna. The presence of some of these species at Darwin is not surprising, and shows them to be essentially Dampierian in range. One species from southern Queensland also occurs at Darwin, also a slightly divergent race of a Peronian species, the latter so far not recorded from any intermediate locality. With these exceptions all the species have been described as new. Generic revision has also been undertaken. All in all 28 forms are here reviewed and figured. Of these 7 have been previously described, 6 from Torres Strait and 1 from the southern Queensland coast. New species number 20 and in addition there is a new subspecies of a Peronian species. All have been divided into 17 genera of which 11 are proposed as new. None of these includes *Liotia* proper, which, however, is found on the Queensland coast, and will also probably be found in north Australia.

CLASSIFICATION

The limitations of Liotiidae as a family are not yet known. The genus *Liotia* Gray on which it is based is a heavy turbinated shell, relatively large, with strong cancellate sculpture, umbilicate, the aperture round and entire and surrounded by a heavy varix. The operculum, which separates it from the Turbinidae, is horny, with an external calcareous coat formed of separate, pearl-like, shelly particles spirally arranged. As the animals and opercula of very few species are known there is no data by which to arrive at the true classification of the majority of shells which at one time or another have been assigned to the family. It is probable that several distinct families are present, some of which may have little relationship with each other. For these reasons the term Liotiidae is here used in the widest sense, and is by no means considered to be the ultimate classification.

Earlier authors have adopted varying classifications. H. & A. Adams (1858) used Liotinae as a subfamily of the Trochiidae to contain such genera as *Liotia* and *Cyclostrema*, Umboniinae as another subfamily to include *Isanda*, *Chrysotoma* and others, while A. Adams' own genus *Teinostoma* was placed near *Neritula* in the Nassinae. Fischer (1887: 833) proposed a new family Cyclostrematiidae as distinct from Liotiidae to include *Cyclostrema* with various subgenera and *Teinostoma* (*Teinostoma*) of which *Moerchia* and *Cirsonella* were considered subgenera.

In Australia, Tate (1899) followed Fischer and used the two families Liotiidae and Cyclostrematiidae to cover Australian species, the former for heavy cancellate shells approximating to the true *Liotia*, the latter for small shells with depressed spires, thin to vitreous in texture, lightly sculptured or smooth, and generally umbilicate, though some with the umbilicus closed by a sheet of callus.

Cyclostrematiidae used in this way is rather unfortunate, for the true *Cyclostrema* is a heavy, cancellate shell, approximating to *Liotia*, though more depressed and without the heavy varix. Bush (1897: 99) recognized this when studying the American Atlantic species and states: "The family name Cyclostrematiidae constituted by Fischer should now be restricted to forms like the true *C. cancellata* Marryatt, and perhaps may prove to be closely related or synonymous with Liotinae as used by Adams and Chenu, Liotiidae as used by Tryon or Delphinuliidae as used by Fischer and Dall."

In the same paper the author (p. 107) introduced Vitrinellidae to include *Vitrinella* C. B. Adams and "all small, more or less hyaline, non-naereous species, varying in form, from those having a low spire and large umbilicus like *Circulus* to the higher spired genera like *Lissospira* and those with closed

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umbilicus like *Thassiella*": Again (p. 115): "There is a group of small, solid, nearly smooth, porcellanous shells which have been referred to *Ethalia*, *Calcelina*, *Teinostoma*, *Pseudorotella*, *Cirsonella* and *Dillwynia*. They all have the umbilical region wholly or in part covered with a callous deposit. The texture and callosity indicate closer affinity to the genus *Umbonium* Link (subfamily Umboniinae) rather than to the Vitrinellidae." Later American authors such as Bartsch (1907 and 1911) have used Vitrinellidae in the same sense.

In Australia again Hedley (1917) left the whole question in abeyance, and was content to use Liotiidae to cover all the debatable elements in the Peronian Province, with the exception of certain very minute, planoid, thin, sculptured shells. For these he accepted Orbitestellidae as introduced by Iredale in New Zealand (1917: 327). None of these has yet been recorded from north Australia, either Solanderian or Dampierian. The same course was followed by Powell (1946) for New Zealand shells and by Laseron (1954) when reviewing the Peronian species; also in the present paper.

The fact remains that throughout the world there is yet very little information on which to found a true classification. The minute size of many of the species makes investigation difficult. The majority have never been seen alive; nothing is known of their anatomy and life history, and even the operculum is rarely seen. Only long and painstaking research can solve many of the intricate problems involved. It is however suggested that from general characters, from the texture of the shells and their general facies, certain groups can be distinguished that, when further knowledge is gained, will prove to be several distinct families. Among these can be singled out as one the very minute genera *Liotella* and *Brookula* with their rounded whorls and sharp axial ribs. The curious genus *Liotropica*, described in this paper, seems unrelated to any other known shell. The exceedingly minute, algae-living *Helisalia* from the Peronian Province, with the appearance and texture of many land shells, almost surely belongs to a different family. The very thin, smooth, vitreous, transparent *Microdiscula* again seems to have little relationship with such genera as *Circlotoma* and *Caperella*, while *Callodia* and *Rotostoma* seem again different. A brief glance at the figured species of other parts of the world shows many parallel examples.

Generically and specifically the problem is a little less complicated. Shell characters are strong and well defined, and there is little variation in the species. Species are not difficult to determine, and they fall into distinctive small groups which have necessitated the proposal of a number of new genera, based mainly on general form, texture and type of sculpture. One or two of these have a general resemblance to European or Atlantic forms, but it is felt for reasons given in previous papers, that a too wide use of generic terms can be very misleading and lead to false conclusions on geographical distribution. Of the new genera proposed *Circlotoma* is the nearest to any extra Australian genus, and is not greatly different from *Circulus* Jeffreys, the type of which came from Sicily in the Mediterranean.

TYPES

All holotypes, paratypes and specimens illustrated have been placed in the Australian Museum.

DESCRIPTION OF SPECIES

Genus *Liochrysta*, gen. nov.

Type species: *Microtheca acidula* Melvill and Standen.

Shell of moderate size, turbinata, not heavy, sculpture both spiral and axial, the intersections rising into rounded gemmules, aperture oblique, peristome complete, the margins of the aperture thin without a varix, umbilicus deep, surrounded by a heavy basal rib or funicle.

Microtheca A. Adams was proposed with *Isanda crenellifera* A. Adams from Japan as type, and apart from the turbinata shape has little in common with *Liochrysta*. Compared with other genera *Liochrysta* differs from *Liotia* and *Austoliotia* by the thinner shell and absence of a varix, and from *Pseudoliotia* by the turbinata form.

Liochrysta acidula (Melvill and Standen)

(Figures 1-3)

Microtheca acidula Melvill and Standen, 1899: 177; pl. 10, figs. 10, 10a.

The type locality is Torres Strait. A number of specimens was sorted from the dredgings at 15-20 fm, Pt. Charles, Darwin, and also from the shore. The specimen illustrated has a maximum diameter of 6.2 mm and a minimum diameter of 5 mm. The abundance of the species at Darwin not only extends the range westwards but shows that it is truly Dampierian.

The characters are distinctive and it cannot be readily confused with any other Australian species. A notable feature is the large basal rib encircling the umbilicus.

Genus **Austroliotia** Cotton

Austroliotia Cotton, 1948 : 31.

Type species : *Liotina botanica* Hedley.

The type is a common Peronian species, and its generic position has always been open to doubt. *Liotina* Fischer (1885 : 831) is a European Eocene fossil, to which the Australian recent species *botanica* conforms in general characters. A feature in common not mentioned by Cotton is that the varix is heavy with an additional narrow rim on its face encircling the aperture. The form of the shell is depressed, the aperture free, twisted downwards and oblique, the sculpture is heavily cancellate and the umbilicus deep. Cotton describes the operculum as horny, multispiral, but with faint traces of granules.

In view of the great interval in time and distance the generic separation of Australian recent forms from those of the European Eocene is I think justified, and does not rule out any future discussion of their possible relationship.

Austroliotia botanica darwinensis subsp. nov.

(Figures 4-6)

The type locality of *Liotia botanica* Hedley (1914 : 710, pl. 81, figs. 46-48) is Sydney. The major diameter is given as 7 mm, but occasional specimens are still larger. In Hedley's Check List (1917) the species is listed under *Liotina* Fischer. A series from 15-20 fm off Pt. Charles, Darwin, after careful comparison with a series from Sydney, the type locality, cannot be separated specifically, but differ slightly by being uniformly smaller, and by having the axial ribs persistent throughout, whereas in typical *botanica* they become weakened, and on the base quite obsolete towards the aperture. In view of the extensive range some variation can be expected in the tropical specimens, sufficient to justify racial separation. So far the species has not been recorded from any intermediate locality. The major diameter of the specimen illustrated is 5 mm, its minimum diameter 4 mm.

Genus **Pseudoliotia** Tate

Pseudoliotia Tate, 1899 : 222

Type species : *Cyclostrema micans* A. Adams.

The characters of *Pseudoliotia* are the small, heavy shell with depressed spire and strong cancellate sculpture, the very oblique aperture with thickened margins but no varix, and the open, deep umbilicus. Tate describes the operculum as horny and multispiral.

The type locality of *C. micans* is South Australia. Several species occur in northern Australia, but Tate considered them all as variations of the one species.

Pseudoliotia gowllandi (Brazier)

(Figures 7-9)

Liotia gowllandi Brazier, 1874 : 672, pl. 83, figs. 1, 2.

There has been considerable confusion in the past as to the identity of this species. Tate (1899 : 223) reduced it to a variety of the South Australian *micans* which also ranges into New South Wales, and with which he synonymized the Peronian *speciosa* Angas. He used the term micromorphs to explain the difference in size, while differences in sculpture were attributed to individual variation. Later *speciosa* was restored by Hedley for the second Peronian species, but *micans* was generally used for specimens from Queensland, and so appears in Hedley's check list of Queensland mollusca (1909). Specimens in the Australian Museum from the Torres Strait, the type locality of *gowllandi*, are labelled as that species, but examination shows them to be the species here described as *P. tropica*.

The genus is very common at Darwin, both on the shore and in dredgings, and can readily be divided into four species, all of which are constant in size, form and sculpture. The difference in form can best be appreciated from the contour when laterally viewed, as can be seen from the figures now published. All differ from the two southern species by being less nodulose at the intersection of the spirals and axialia. Of the four the one here figured can alone approximate to the true *gowllandi*, and to that species it is with some doubt referred. Its size is very nearly the same, the maximum diameter 2.2 mm, the minimum diameter 1.8 mm, and the sculpture is practically the same. Unfortunately the type of *gowllandi* is in London, and the published figures show the axialia rather more numerous, and omit a figure of the lateral profile.

Features of *gowllandi*, apart from the form and size, are the vitreous and shining texture, the absence of fine spiral threads on or between the axial ribs, and the swelling of the axial ribs where they cross the spiral keels. Of the latter two are present on the upper surface of the whorls and three are visible on the base.

Pseudoliotia tropica sp. nov.

(Figures 10-12)

Shell small, very depressed, solid, vitreous, pure white. Protoconch naticoid, smooth and glassy, of about two whorls, the nucleus minute. Mature whorls three, increasing rapidly, flattened above and concave towards the suture, the spire visible when laterally viewed, nodulose at the sutures. Sculpture primarily of sharp, oblique axial ribs, rising and thickening slightly where they cross the upper spiral keel, below which they bend in to the peripheral keel, and from there evenly into the base. The axial ribs are crossed throughout, both above and on the base, by numerous, closely packed, spiral threads. Umbilicus round and deep. Aperture very oblique, thickened, with a secondary, sharp, raised inner rim. Maximum diameter 3 mm, minimum diameter 2.2 mm.

Localities.—Common in 15-20 fm, Pt. Charles, Darwin (Mel Ward), holotype and 9 paratypes selected; Darwin beaches (J. Laseron).

Remarks.—The species is also common in the Torres Strait area, where it has been labelled *goullandi*. Compared with that species it is uniformly larger, more depressed, has a different lateral contour and fewer spiral keels. The fine spiral threads also distinguish it from that and other species.

Pseudoliotia axialis sp. nov.

(Figures 13-15)

Shell small, subturbinata, not greatly depressed, solid, vitreous, pure white. Protoconch relatively large, naticoid, of two whorls, the nucleus relatively large. Mature whorls two, rounded, with a narrow concave area adjacent to the sutures. Sculpture primarily of strong, oblique, rounded, smooth axial ribs, about their own width apart, and separated by deep channels. Spiral threads absent. On the upper surface one strong, rounded spiral keel parallels the suture. This is crossed by the axial ribs, where they thicken, and then cross a concave depression to thicken again on the periphery, thence evenly across the base to terminate abruptly on the margin of the umbilicus which is round and deep. Aperture very oblique, entire, the margins thickened, with a narrow, raised, secondary aperture within. Maximum diameter 2.5 mm, minimum diameter 2.1 mm.

Locality.—Darwin beaches (J. Laseron), holotype and one paratype selected.

Remarks.—This is the deepest of all the species, and is easily recognized by the strong, smooth axial ribs, and the presence of only one spiral keel.

Pseudoliotia liliputia sp. nov.

(Figures 16-18)

Shell minute, depressed, spire just visible laterally, solid, vitreous and white. Protoconch naticoid, of about $1\frac{1}{2}$ whorls, rounded, smooth and vitreous, nucleus relatively large. Mature whorls two, rounded, concave near the suture. Sculpture of strong, rounded, oblique axial ribs, separated by deep furrows, rising where they cross the spiral keels into rounded nodules. The spiral keels are prominent and rounded, one on the summit parallel to the suture, two even keels on the periphery, giving the shell a distinct lateral profile, and two more on the base, the lowest bordering the deep, round umbilicus. Aperture as in other species very oblique, entire, the margin thickened and with a secondary, thin, raised inner aperture. Maximum diameter 1.5 mm, minimum diameter 1.2 mm.

Locality.—Darwin beaches (J. Laseron), common, holotype and eight paratypes selected.

Remarks.—This is the smallest of the species so far described. In form and sculpture it approaches nearest to *P. goullandi* as here interpreted, but it differs not only in size but in the number and disposition of the spiral keels, the two peripheral keels giving it a distinctive lateral contour.

Genus **Discreliotia** gen. nov.

Type species: *Discreliotia radians* sp. nov.

Shell small, solid, turbinata, aperture oblique, peristome entire, margins reflected, without a varix, umbilicus closed by callus and bordered by a heavy double rib which covers nearly half the base. Sculpture discrepant, the upper portion nearly smooth except for a spiral keel, one half of the base with heavy axial ribs, the other half towards the aperture occupied by the heavy funicular rib.

The turbinata form, closed umbilicus and the curious discrepant sculpture are the main characteristics of this genus.

Discreliotia radians sp. nov.

(Figures 19-21)

Shell small, solid, turbinate, white and opaque. Protoconch naticoid, of two whorls, smooth and glassy. Mature whorls three, descending in sharp steps, the earlier whorls flattened above with vertical sides. Sculpture discrepant, the upper surface flattened adjacent to the sutures, thence a sharp spiral keel, below which the surface descends in a concave curve to a narrow platform above a sharp peripheral keel. Faint spiral threads fill this space. On the base half the surface is filled by from 9 to 10 strong, rounded axial ribs, about their own width apart, converging into the closed umbilicus. The axial ribs disappear about half way to the aperture, to be replaced externally by another sharp, spiral keel, equally prominent with the peripheral keel. Below is another strong, rounded basal rib or funicle which surrounds and completely fills what would be the umbilical cavity. Aperture oblique, the margins truncate, a secondary rounded aperture within with a raised outer rim and thickened within. Maximum diameter 3.5 mm, minimum diameter 2.9 mm.

Locality.—15-20 fm off Pt. Charles, Darwin (Mel Ward), holotype and six paratypes.

Remarks.—The remarkable sculpture of this novelty is so distinctive that it cannot be confused with any other known species.

Discreliotia serrata sp. nov.

(Figures 22-24)

Shell small, solid, turbinate, white. Protoconch naticoid, of two whorls, smooth and glassy. Mature whorls three, similar in form to those of *D. radians*. Sculpture of one sharp keel on the summit of the whorl, with two equal keels on the periphery, the spaces between concave and nearly smooth, but the keels slightly serrated, particularly near the aperture. Base without the strong axial ribs of *D. radians* which are replaced by faint axial threads. The strong basal rib or funicle bordering a closed umbilical depression is, however, crossed by ill-defined axials. Umbilical cavity shallow, closed by a tongue of callus from below the inner margin of the aperture. Aperture oblique, as in *D. radians* with a secondary rim developed within the truncate margins. Maximum diameter 3.5 mm, minimum diameter 2.8 mm.

Locality.—15-20 fm off Pt. Charles, Darwin (Mel Ward), holotype.

Remarks.—In form and aperture this is nearly identical with *D. radians*, but the two peripheral keels are persistent to the aperture, and the basal axial ribs are absent except where they indent the basal rib surrounding the umbilical cavity. A minute species from Funafuti, *Liotia parvissima* Hedley (1899: 554, fig. 57) conforms in form and partially in sculpture with both *radians* and *serrata*, but has a heavy varix and a deep umbilicus.

Genus **Lioprora** gen. nov.

Type species: *Liotia rostrata* Hedley.

Shell small, discoidal, flat above and rounded below, sculpture both axial and spiral, widely umbilicate, peristome completed by a heavy band of callus on the body whorl, outer margin of aperture terminating in a heavy solid spur or beak, to varix, aperture oblique.

This is another of the peculiar Australian shells which will not readily fit into any known genus. Hedley in his descriptions of such new Queensland species more than once expressed doubts of their generic identity, but was content to assign them either to *Liotia* or *Teinostoma*, where they were equally out of place. The rostrate aperture of *Lioprora* should alone be sufficient to establish its generic identity.

Lioprora rostrata (Hedley)

(Figures 25-27)

Liotia rostrata Hedley, Aug. 1900: 502, pl. 26, figs. 4-7.

The type locality is off Cape York, Torres Strait. The specimen here figured is one of two collected at Darwin (J. Laseyron) and extends the range westwards, at the same time showing the species to be a constituent of the Dampierian fauna. Its maximum diameter is 3 mm and the minimum diameter 2.5 mm. The Darwin specimens agree very well with Hedley's excellent figure and description, and the characters as outlined in the generic description leave no doubt as to its identity.

Genus **Circumstella** gen. nov.

Type species: *Liotia devexa* Hedley.

Shell small, flat above with a low, turreted spire, sculpture primarily of strong spiral keels, axial sculpture also present, aperture detached, oblique, twisting downwards, with a heavy double varix. Umbilicus deep, rendered stellate by sharp, angular ribs, separated by deep pits, which descend right within the cavity. The last character is very distinctive and gives a decided facies to the genus.

Circumstella devexa (Hedley)

(Figures 28-30)

Liotia devexa Hedley, 1901: 18, pl. 2, figs. 4-6.

The type was dredged in Torres Strait, and a series from 15-20 fm off Pt. Charles, Darwin, now extends its range well into the Dampierian Province. The specimen figured has a maximum diameter of 4.5 mm and a minimum diameter of 3.8 mm. Again the characters as outlined in the generic description, particularly the large stellate umbilicus, are so distinctive that its recognition is very easy.

Genus **Liotella** Iredale

Liotella Iredale, 1914: 442

Type species: *Liotia polypleura* Hedley.

Minute shells, depressed, often coiled in one plane, whorls round, apertures without a varix, round and oblique, often quite free, umbilicus wide, sculpture of sharp axial ribs encircling the whorls, fine spiral threads or striae sometimes present.

The genus is so far known only from New Zealand and Australian waters. The description of a number of species by Laseron (1954) from the Peronian Province shows that the group is a large and complex one, and a further subdivision may yet be necessary. Within the genus one small group of three species seem closely allied, and could perhaps form the basis of still another genus. These are *Liotella pulcherrima* (Brazier) from Sydney, the Queensland species *Liotia anxia* Hedley (1909: 437, pl. 39, figs. 43-45), and a new species *Liotella elegans* now described from Darwin. All have flattened spires, very fine sculpture, with the aperture quite detached and twisting downwards.

Liotella elegans sp. nov.

(Figures 31-33)

Shell exceedingly minute, spire depressed below the surrounding whorls, uncoiled in later stage, white. Whorls three, round. Sculpture of fine, rounded, axial ribs, about their own width apart, completely surrounding the whorls, about 35 on the body whorl, no spiral sculpture detected. Aperture round, free and detached, twisted downwards and oblique, margins thin. Umbilicus wide and shallow. Maximum diameter .6 mm.

Locality.—Darwin beaches (J. Laseron), holotype.

Remarks.—This species is closely related to the Peronian *L. pulcherrima* (Brazier) and the Solanderian *L. anxia* (Hedley), but has an even more depressed spire and slightly coarser sculpture. In size it is amongst the smallest shells known.

Genus **Liotropica** gen. nov.

Type species: *Moerchia introspecta* Hedley.

Shell minute, solid, coiled loosely in one plane, the whorls flattened and angled with the wide, flattened base, widely umbilicate, sculpture finely axial, the aperture with a prominent varix, free and so twisted downwards as to be almost in the plane of the base.

Moerchia or *Morchia* (Adams uses both spellings) was described as a subgenus of *Cyclostrema* with *C. obvilata* A. Adams from Japan as type (A. Adams, 1863: 74). Though most of the characters of *Liotropica* conform to *Moerchia* it is separated by the flattened whorls, flattened base and extremely twisted aperture. It has such a distinctive facies that it may later be necessary to transfer it to a new family.

***Liotropica introspecta* (Hedley)**

(Figures 34-36)

Moerchia introspecta Hedley, 1907: 493, pl. 20, figs. 47-49.

The type locality is 17-20 fm off Masthead Island, Queensland, the major diameter of the type 2.25 mm, the minor diameter 1.6 mm. Three specimens from Darwin (J. Laseron) are slightly smaller, the maximum diameter of that figured being 1.8 mm, the minimum diameter 1.4 mm. Otherwise they conform in all characters despite the great extension of the range. Hedley's excellent figures and description leave little to be added, and the very distinctive form makes it easy to recognize.

Genus *Cirelotoma* gen. nov.Type species: *Cirelotoma rotata* sp. nov.

Shell small, depressed to discoidal, of thin to medium texture, aperture oblique, thin and without a varix, peristome incomplete, but sometimes made continuous by a thin callus on the body whorl, inner margin reflected to form a pillar, umbilicus round and deep. Sculpture predominantly of spiral keels, axial sculpture when present faint, but sometimes making one or more of the keels slightly serrate or tuberculate.

Among the American Atlantic fauna Bush (1897) uses *Circulus* Jeffreys for a somewhat similar group of shells, and Bartsch (1907 and 1911) uses the same genus widely for species from the West American Pacific species. From the illustrations some of these have little relationship with each other. From Darwin five species are assigned to *Cirelotoma*, but though all conform to the characters given, they too show different facies which, as more species are discovered, may necessitate further generic revision. This applies particularly to the two species here discussed as *C. planorbis* sp. nov. and *C. venusta* (Hedley).

***Cirelotoma rotata* sp. nov.**

(Figures 37-39)

Shell small, solid, depressed, white. Protoconch with a minute nucleus, and about $1\frac{1}{2}$ flat, smooth, glassy whorls, mature sculpture beginning gradually. Mature whorls three, rounded, the spire depressed but visible laterally, sutures slightly channelled. Sculpture of eight evenly spaced, rounded spiral ribs, five visible from above and four from below. Aperture without a varix, oblique, the peristome incomplete, but with a band of callus on the body whorl, the margins thin, indented by the keels, inner margin slightly reflected, umbilicus wide and deep. Maximum diameter 2.5 mm, minimum diameter 2.2 mm.

Localities.—Darwin beaches (J. Laseron), holotype and 14 paratypes selected; also abundant in the dredgings 15-20 fm off Pt. Charles, Darwin (Mel Ward).

Remarks.—This is one of the commonest species at Darwin, and may be considered a definite unit of the Dampierian fauna.

***Cirelotoma callusa* sp. nov.**

(Figures 40-42)

Shell small, solid, subtrubinate, white and translucent. Protoconch flat with a minute nucleus, of about $1\frac{1}{2}$ smooth, glassy whorls, mature sculpture beginning gradually. Mature whorls three, rounded, sutures channelled. Sculpture of about 14 narrow, rounded spiral keels, evenly spaced, about 10 visible from above, and 5 to 6 below the periphery where they become very faint, remainder of base smooth and shining. Aperture oblique, peristome completed by a band of callus on the body whorl, outer margin thin, inner margin, ill-defined and rounded, merging into a smooth callus on the body of the shell. Umbilicus round, narrow and deep. Maximum diameter 3.5 mm, minimum diameter 3.2 mm.

Locality.—Darwin (J. Laseron), holotype and one paratype.

Remarks.—Compared with *C. rotata* this is a larger shell, less depressed in shape, with finer sculpture, a smaller umbilicus, and a slightly different aperture. Of the Australian species it is the nearest to the type species of *Circulus* Jeffreys *C. duminyi* (Requien) which was described from Sicily.

Circlotoma venusta (Hedley)

(Figures 43-45)

Liotia venusta Hedley, 1901 : 17, pl. 3, figs. 1-3.

The type locality is Darnley Island, Queensland, the dimensions given : major diameter 4.9 mm, minor diameter 3.8 mm. A number of specimens from 17 to 20 fm, Pt. Charles, Darwin (Mel Ward) agree very well with the type, the one figured having a maximum diameter of 5.4 mm and a minimum diameter of 4.2 mm. *C. venusta* and *C. transculpta*, sp. nov., are evidently allied, though differing in details of form and sculpture. Together they form a group within *Circlotoma* distinguished by the presence of axial sculpture. It is surprising that Hedley did not give a new generic name to his species as he remarks : " This species is not like the typical *Liotia* ; it possibly belongs to *Microtheca* A. Adams, a genus not sufficiently elaborated by its author for satisfactory use ".

Circlotoma transculpta sp. nov.

(Figures 46-48)

Shell small, moderately solid, depressed, the spire just visible laterally, white. Protoconch naticoid, nucleus small, of about two whorls, smooth and glossy, mature sculpture beginning gradually. Mature whorls three, flattened above, sutures deep, margins rounded. Sculpture predominantly spiral, the flattened portion above with a median thin keel, the bordering keel stronger. Below this the spirals are sharp, closely packed, and cover the base to the margin of the deep, round umbilicus. Axial sculpture is present, breaking the upper marginal keel into sharp serrations, evenly spaced, and about 25 to the whorl. Apart from these, fine axial threads cover the whole shell, and on the base particularly make the sculpture minutely clathrate. Aperture oblique, peristome incomplete, a thin line of callus on the body whorl, outer margin thin and indented by the sculpture, inner margin straight and slightly reflected. Maximum diameter 3.5 mm, minimum diameter 2.9 mm.

Locality.—17-20 fm off Pt. Charles, Darwin (Mel Ward), holotype.

Remarks.—In general form this approaches *C. callusa*, but is more depressed and differs also in the sculpture and aperture.

Circlotoma planorbis sp. nov.

(Figures 49-51)

Shell small, very flat, spire depressed below the body whorl, texture thin, vitreous and translucent. Whorls three following a minute nucleus. Sculpture of sharp spiral keels, six in all, one midway on the upper surface, two peripheral and three on the base. The uppermost keel is sharp and raised, descending with a steep, concave surface to the suture. A similar concave space separates it from the peripheral keel. The two peripheral keels are subequal, the basal keels are slight except the one encircling the wide, deep umbilicus. Aperture oblique, polygonal, the margins thin, indented by the sculpture, the peristome incomplete with a faint line of callus on the body whorl, inner margin slightly reflected. Maximum diameter 3 mm, minimum diameter 2.5 mm.

Locality.—17-20 fm off Pt. Charles, Darwin (Mel Ward), holotype and one paratype.

Remarks.—Though conforming to the characters of the genus as defined, the thin, translucent texture suggests it may have other relationship. It is the flattest of the species here discussed, and the form and sculpture are distinctive.

Genus Moeniatoma gen. nov.

Type species : *Moeniatoma diamura* sp. nov.

Shell small, solid, white and translucent, flattened above, aperture descending, oblique, peristome complete, margins thin, the base with a deep round umbilicus bordered by a very heavy double rib or funicle. Sculpture of a few, sharp spiral keels.

This again is one of the curious little Australian genera which will not fit into any of the older recognized genera. The complete peristome and heavy basal rib distinguish it from such genera as *Circlotoma* and *Caperella*.

Moeniatoma diamura sp. nov.

(Figures 52-54)

Shell small, very depressed, moderately solid, white, vitreous and translucent. Protoconch of a small, rounded, glassy nucleus, followed by about $2\frac{1}{2}$ mature whorls. Mature whorls angulated, a sharp, raised spiral keel on the summit, descending concavely to the suture, and with a steep, concave surface to a sharp peripheral keel. Base excavate below the peripheral keel with two further sharp, basal keels combining to form a large rib or funicle surrounding the round, deep umbilicus. Aperture oblique, the peristome complete, margins uniformly thin. Maximum diameter 2.9 mm, minimum diameter 2.3 mm.

Locality.—Darwin (J. Laseron), holotype.

Remarks.—The texture, simple sculpture, and the large basal rib which gives a distinctive lateral contour are all good recognition points. There is no other Australian species with which this can readily be confused.

Genus **Callodix** Laseron**Callodix** Laseron, 1954 : 16

Type species : *Callodix solida* Laseron.

The type is a Peronian species, and the characters considered generic were the small, depressed shell with fine spiral sculpture and the greatly developed striate callus covering the base and extending posteriorly above the aperture upon the spire. The discovery of a second species at Darwin, now described as *C. conica*, extends the range of this genus well around Australia, and it is probable that the same or further species will be found in intermediate localities.

Callodix conica sp. nov.

(Figures 55-57)

Shell minute, solid, broadly conical, white and translucent. Whorls three, body whorl rounded, nearly flat above, sutures very shallow. Sculpture of fine, closely packed spiral cords, evenly spaced, about their own width apart. Aperture rounded, oblique, outer margin thin, inner margin thickened by a heavy callus which spreads over the umbilical area in a thick plate crossed by fine threads, and upwards on the spire, the covering threads there coincident with the sculpture, to merge eventually into the earlier whorls. Maximum diameter 1.7 mm, minimum diameter 1.3 mm.

Locality.—Beach at Darwin (J. Laseron), holotype.

Remarks.—Compared with the type species *C. solida*, the more conical shell and the even greater development of the extraordinary callus at once distinguish this novelty, and there is no other known species with which it can readily be compared.

Genus **Tholostoma** gen. nov.

Type species : *Tholostoma carinata* sp. nov.

Shell minute, turbinate, fairly solid, vitreous in texture, translucent, the whorls domed above but with peripheral keels, other sculpture faintly spiral, umbilicate, aperture oblique with thin margins, the peristome completed by a layer of callus on the body whorl.

This is another minute gasteropod whose systematic position is uncertain. Most of the characters as defined conform to *Caperella*, but the turbinate form and the domed whorls give it a very different facies, and there is probably little real relationship.

Tholostoma carinata sp. nov.

(Figures 58-60)

Shell minute, turbinate, fairly solid, vitreous, white and translucent. Whorls four, including a small naticoid protoconch indistinguishable from the mature shell. Whorls domed above, excavate below, the sutures deep. Sculpture of two strong, narrow, equal, rounded peripheral keels, separated by a slightly concave area, with four faint, spiral keels on the base surrounding the narrow but deep umbilicus. Very faint spiral threads also occur on the upper portion of the whorls, and adjoining the suture there is a row of faint axial nodules. Aperture oblique, the peristome completed by a thick band of callus on the body whorl, margins thin. Maximum diameter 1.3 mm, minimum diameter 1 mm.

Locality.—Beaches at Darwin (J. Laseron), holotype and one paratype.

Remarks.—The turbinate form, domed upper surface of the whorls and the strong peripheral keels should aid the future recognition of this species, and there is no other Australian species with which it can readily be compared.

Genus *Caperella* gen. nov.

Type species : *Teinostoma orbitum* Hedley.

Shell of medium size, flat and discoidal, fairly solid, porcellanous, white, sutures shallow. Aperture as in *Circlotoma* oblique, the peristome incomplete, a line of callus on the body whorl, but the reflected inner margin produced into a spur which overhangs and may partially fill the round deep umbilicus. Sculpture when present very fine, of spiral threads crossed by faint growth lines. Weak axial ribs may be present on the earlier whorls.

Hedley (April, 1900) assigned the type species to *Solariorbis* Conrad as a subgenus of *Teinostoma*. A. Adams, an American group with somewhat similar characters. *Teinostoma*, sensu stricto, has a smooth, highly polished shell, an elongated aperture and a thick callus covering the whole of the umbilical area.

***Caperella orbitum* (Hedley) ?**

(Figures 61-66)

Teinostoma (Solariorbis) orbitum Hedley, Apr. 1900 : 96, pl. 3, figs. 13-15.

This species is identified with some uncertainty, as all the Darwin material is slightly worn and shows minor variations from the type. The type came from Torres Strait and the species is also found on the north Queensland coast. The main differences of the Darwin specimens are in the degree of angulation at the periphery of the whorls, in the development of the basal spur and to a slight extent in the obliquity of the aperture. Tentatively they may also be divided into two series, but more and better material is needed to decide if the difference is sufficient to justify racial or specific separation.

Figs. 61 to 63 are of a specimen from 15-20 fm off Pt. Charles, Darwin, its maximum diameter 5.3 mm and minimum diameter 4.5 mm. In this specimen the characters of the base, the spur and nearly closed umbilicus correspond closely to typical *orbitum*, but the peripheral angulation is very marked, and there is a distinct but narrow keel. Several specimens from the shore collections are very close to this, but show only a trace of the peripheral keel. From these another series of shore specimens can be separated by having no peripheral keel at all, the whorls are practically rounded, the umbilicus is more open owing to a lesser development of the basal spur, the aperture is not so oblique and its outer margins are thicker and truncate. One is here figured (figs. 64 to 66). Its maximum diameter is 5 mm and the minimum diameter 4.2 mm. The sculpture is sometimes very faint, but is uniformly of fine spiral threads crossed by axial threads with slight axial ribs on the earlier whorls.

***Caperella umbilicata* sp. nov.**

(Figures 67-69)

Shell of medium size, solid, depressed, flattened above, rounded below, white. Protoconch distinct from mature shell, of three whorls, nucleus minute, smooth, glassy and rounded. Mature whorls three, flattened above, rounded below, angled at the periphery, sutures shallow. Sculpture of numerous, low, rounded spiral ribs separated by narrow furrows, about twelve visible from above, with as many more on the base. These are crossed by fine axial threads, and on the earlier whorls by low, broad axial ribs. On the base the spiral ribs persist into the round, deep umbilicus. Aperture very oblique, peristome incomplete, outer margin thin, inner margin reflected and produced as a narrow spur bordering the open umbilicus. Maximum diameter 4.1 mm, minimum diameter 3.5 mm.

Locality.—15-20 fm off Pt. Charles, Darwin (Mel Ward), holotype and three paratypes.

Remarks.—This species is very close to *C. orbitum* in both form and sculpture, but the peripheral angulation is constant, as is the large, open umbilicus. The latter character is considered of sufficient importance to warrant specific separation.

Genus *Peripitoma* gen. nov.

Type species : *Peripitoma vitrea* sp. nov.

Shell small, fairly solid, depressed turbinata, vitreous and translucent, smooth and polished, umbilicus large and deep. Aperture oblique, peristome incomplete, a heavy callus on the body whorl, a shallow channel on the base from the aperture to within the umbilicus.

In general form *Peripitoma* resembles *Caperella*, but it is quite smooth and lacks the basal spur. It also corresponds in form to the minute southern genus *Lissotesta*, but is much heavier and more solid.

Peripitoma vitrea sp. nov.

(Figures 70-72)

Shell small, depressed turbinate, fairly solid, vitreous, translucent, white. Whorls four, including a small nucleus, evenly rounded to the sutures and below to the deep broad umbilicus the margin of which is angled. Sculpture absent, the surface smooth and shining. Aperture oblique, peristome incomplete, but joined by a thick band of callus on the body whorl, margins truncate, without a varix, the inner margin angled where it is indented by a wide, shallow, spiral furrow which at first borders and then extends within the umbilicus. Maximum diameter 3.5 mm, minimum diameter 2.8 mm.

Locality.—Darwin (J. Laseron), holotype and four paratypes.

Remarks.—The only known Australian species with which this can be compared are members of the southern genus *Lissotesta*, which all have thin, fragile shells and are more turbinate in shape. The peculiar basal furrow is also distinctive.

Genus **Rotostoma** Laseron**Rotostoma** Laseron, 1954 : 15

Type species : *Ethalia brazieri* Angas.

Rotostoma was proposed for minute, solid, white, smooth and highly polished shells approximating the true *Teinostoma* A. Adams, with a callus covering the umbilical area, the aperture very oblique and without a varix, the peristome incomplete but a heavy band of callus on the body whorl. The basal callus is not as heavy as in *Teinostoma*, the aperture is shorter and not angulate. From *Callomphala* Adams & Angas it differs chiefly by the absence of a varix. When something is known of the animal this group of genera may well prove to be quite a separate family.

Rotostoma impleta sp. nov.

(Figures 73-75)

Shell very small, depressed, solid, vitreous, white and translucent. Protoconch with small globose nucleus, followed without break by the three mature whorls. These are rounded, tightly coiled without sculpture, smooth and highly polished, sutures very shallow and hardly distinguishable. Aperture oblique, the margins thin and even, peristome incomplete, but connected by a heavy band of callus on the body whorl, this callus spreading over the base and filling the umbilicus which is marked by a very shallow depression. Maximum diameter 2.2 mm, minimum diameter 1.7 mm.

Locality.—Darwin beaches (J. Laseron), very common, holotype and about forty paratypes selected.

Remarks.—This resembles the type species *R. brazieri* (Angas), which is a Peronian form, in general characters, but is much more depressed, and lacks the faint spiral sculpture on the summit of the whorls.

Genus **Circulter** gen. nov.

Type species : *Circulter acuta* sp. nov.

Shell small with a depressed, disc-like form, acutely angled at the periphery, texture thin, vitreous and translucent, surface smooth and polished, aperture only slightly oblique, extended, triangular, peristome incomplete, margins thin, inner margin straight and slightly reflected, umbilicus narrow and deep.

With other small, very thin, glassy shells of flattened form the systematic position of *Circulter* is very uncertain, and until something is known of the animal and operculum this must remain in abeyance.

Circulter acuta sp. nov.

(Figures 76-78)

Shell minute, very depressed, disc-like and involute, vitreous, thin and fragile, white and translucent. Whorls four, including the protoconch which is indistinguishable from the mature shell but has a minute nucleus. Mature whorls flattened and very slightly rounded above and below with a very acute peripheral keel, the sutures slightly channelled. Sculpture absent, the surface smooth and shining. Umbilicus narrow, round and deep. Aperture an elongated triangle, peristome incomplete, outer margins thin, inner margin straight, sharply angled anteriorly slightly reflected bordering the umbilicus. Maximum diameter 1.9 mm, minimum diameter 1.6 mm.

Locality.—Darwin beaches (J. Laseron), holotype and two paratypes.

Remarks.—The smooth, fragile, disc-like shell with its acutely angled periphery and triangular aperture should make the future recognition of this species easy.

Genus *Microdiscula* Thiele*Microdiscula* Thiele, 1912, Deutsch Sud. Pol. Exped., 12: 199Type species: *Microdiscula vanhoffeni* Thiele.

Shell small, very thin and fragile, transparent, flattened, involute, smooth, the aperture more or less oblique, peristome incomplete, the umbilicus wide and shallow.

The type is a subantarctic species from Kerguelen, its shell characters conforming to the European *Skenea* from which Thiele separated it by the radula. In the absence of further data three Peronian species were attributed by Laseron (1954) to *Microdiscula*, and now three additional species from Darwin are rather doubtfully added. The only difference in shell characters is that the Darwin species all have the apertures more oblique. From the subantarctic to the tropics is rather an unusual range for a genus, and it is probable that further knowledge will show the relationship to be more apparent than real.

Microdiscula involuta sp. nov.

(Figures 79-81)

Shell minute, flat, coiled in one plane, partially involute, the spire completely visible from below, very thin and fragile, vitreous and transparent. Whorls four, including a minute nucleus, rounded, sutures deep. Sculpture absent, the surface smooth and shining. Base concave rather than umbilicate, all the earlier whorls visible. Aperture oblique, peristome incomplete, but a thin line of callus on the body whorl, the margins thin. Maximum diameter 1.9 mm, minimum diameter 1.6 mm.

Locality.—Darwin beaches (J. Laseron), holotype and one paratype.

Remarks.—Of the three species here described and of the Peronian species *M. fragilis* Laseron, this is the most involute, and shows less difference between the upper and lower surfaces of the shell.

Microdiscula planorbis sp. nov.

(Figures 82-84)

Shell relatively large, very flat, coiled nearly in one plane, the spire descending so that the upper margin of the aperture is just below the summit of the preceding whorl, very thin, colourless and transparent. Whorls four including a small nucleus, rounded, oval in section, the sutures deep. Base broadly umbilicate, with steep inner sides, the earlier whorls showing within. Aperture very oblique, subangled below, the peristome incomplete, but with a thin line of callus on the body whorl, margins thin. Sculpture absent except for microscopic growth lines, the surface shining. Maximum diameter 4 mm, minimum diameter 3.5 mm.

Locality.—Darwin beaches (J. Laseron), holotype and one paratype.

Remarks.—This is the largest of the Australian species and is also the most compressed.

Microdiscula augmenta sp. nov.

(Figures 85-87)

Shell minute, depressed, the spire descending slightly so that the upper margin of the aperture is just below the summit of the preceding whorl, the earlier whorls just visible when viewed laterally, very thin, vitreous, colourless and transparent. Whorls four including a minute nucleus, increasing rapidly so that the body whorl is relatively large, rounded, sutures not deep. Sculpture absent, the surface smooth except for microscopic growth lines. Base widely umbilicate, earlier whorls partly hidden. Aperture very oblique, relatively large, peristome incomplete, a line of callus on the body whorl, margins thin, inner margin nearly straight. Maximum diameter 2 mm, minimum diameter 1.7 mm.

Locality.—Darwin beaches (J. Laseron), holotype and two paratypes.

Remarks.—Apart from the difference in contour this species can be readily distinguished from the others here discussed by the relatively large body whorl and aperture. Reference to the figures will show the differences between the species much better than mere description.

NEW GENERA

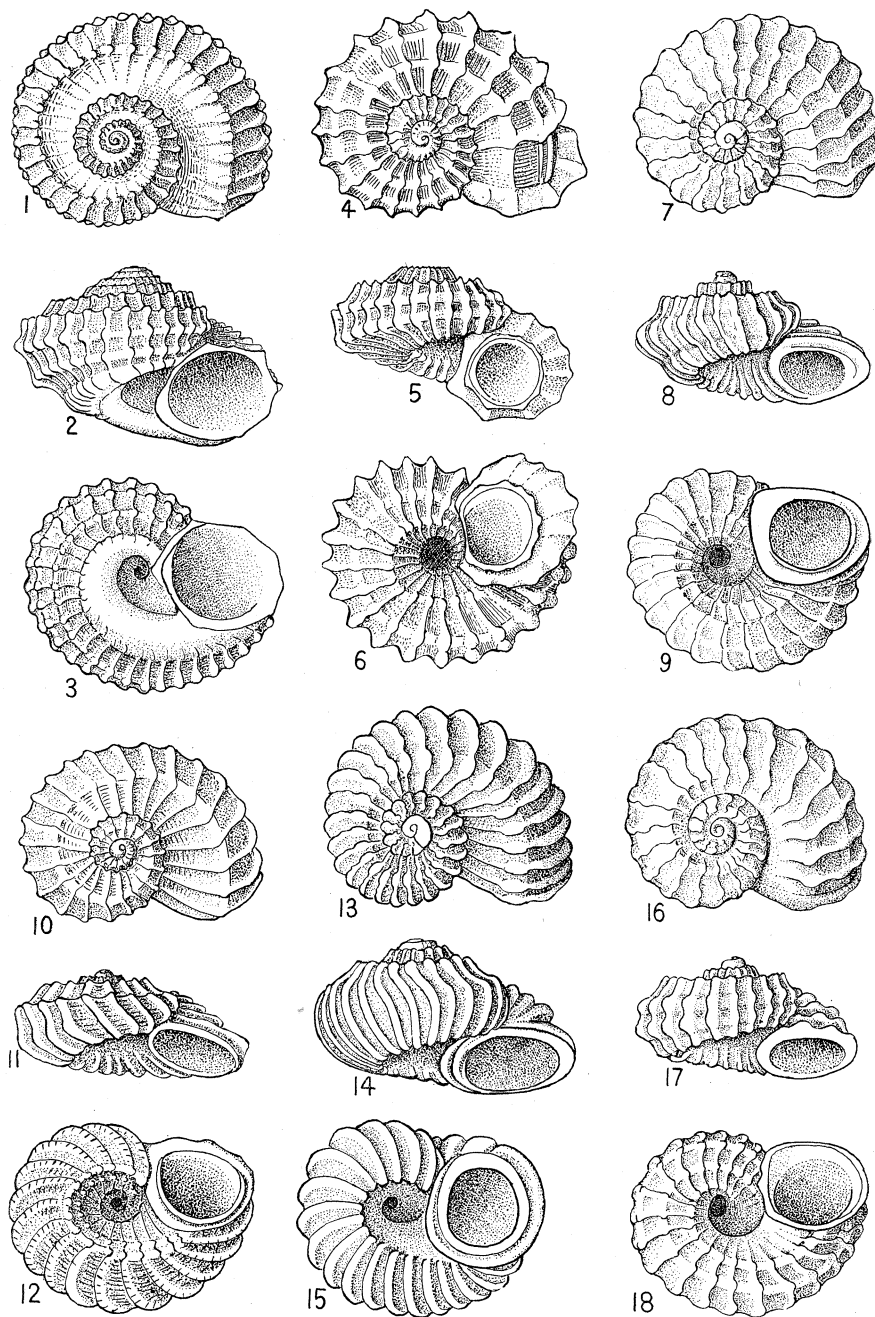
The following new generic names have been proposed in this paper: *Caperella*, *Circlotoma*, *Circumstella*, *Circulter*, *Discretiota*, *Liochrysta*, *Lioprora*, *Liotropica*, *Moeniatoma*, *Peripitoma*, *Tholostoma*.

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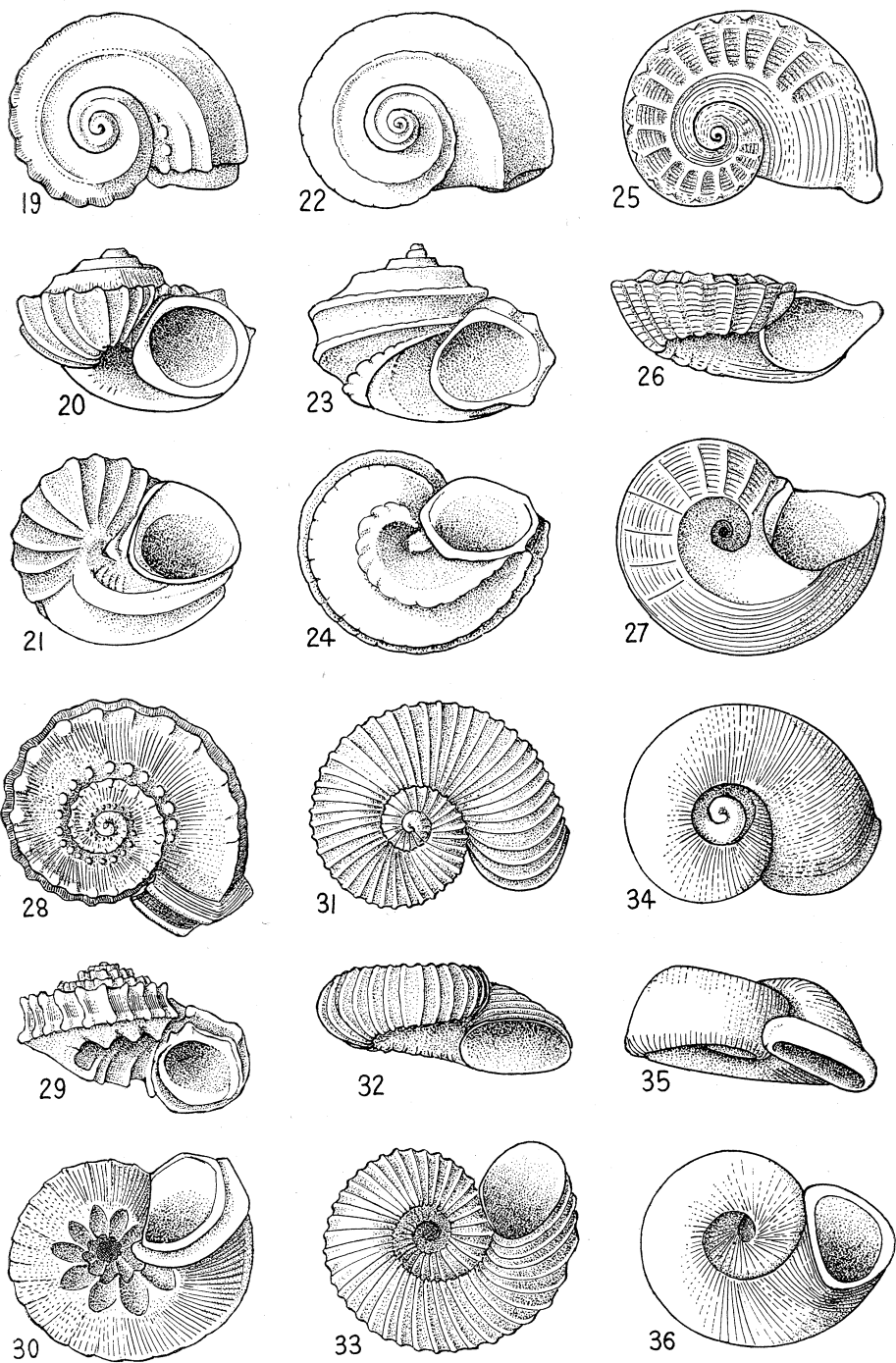
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FIGURES 1 TO 18

C. F. LASERON DEL.

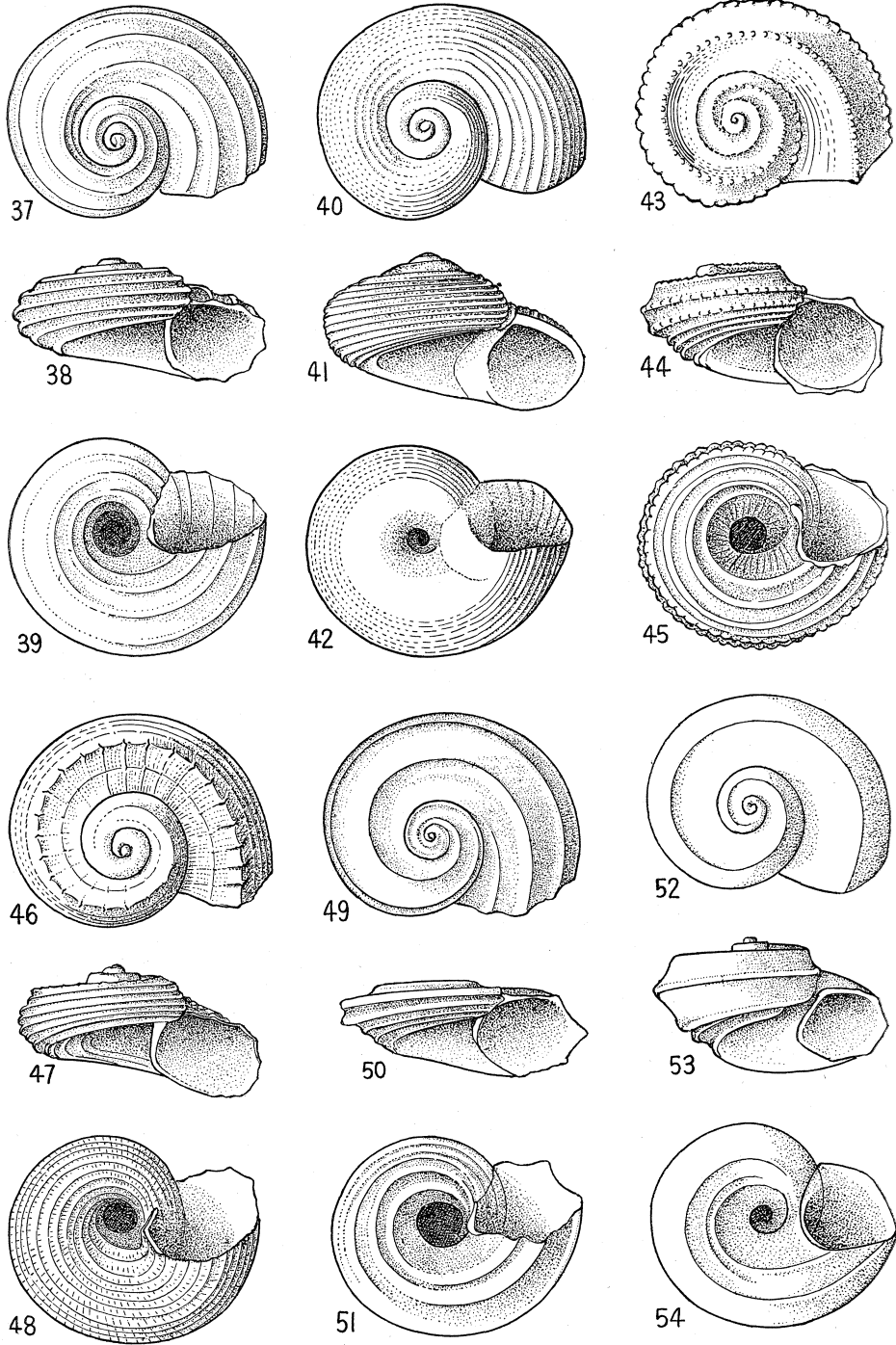
1-3, *Liochrysta acidula* (Melvill and Standen); 4-6, *Austroliotia botanica darwinensis*, subsp. nov., Holotype; 7-9, *Pseudoliotia gowlandi* (Brazier); 10-12, *Pseudoliotia tropica*, sp. nov. Holotype; 13-15, *Pseudoliotia ariatis*, sp. nov. Holotype; 16-18, *Pseudoliotia liliputia*, sp. nov. Holotype.



FIGURES 19 TO 36

C. F. LASERON DEL.

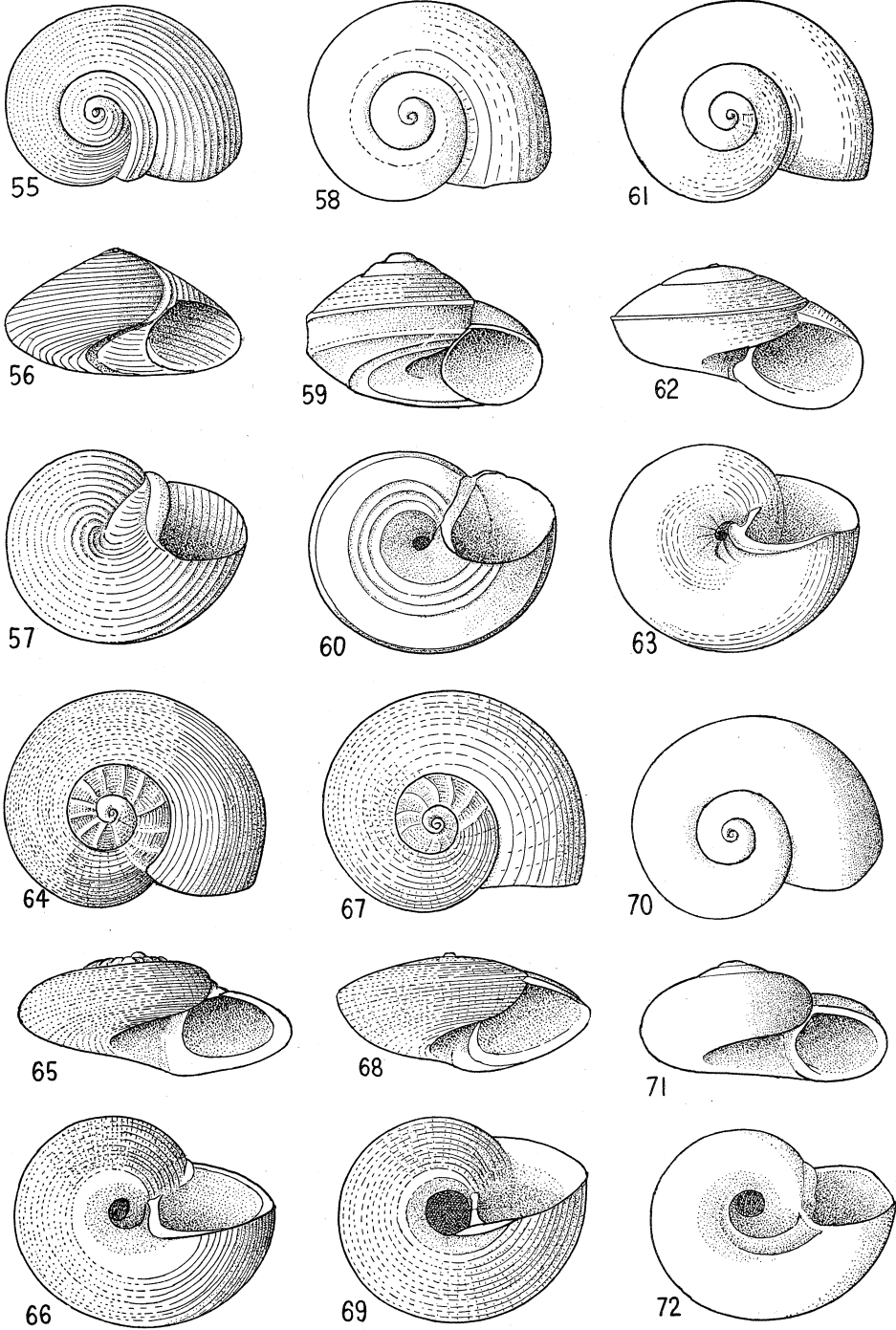
19-21, *Discreliotia radians*, sp. nov. Holotype; 22-24, *Di crelicia serrata*, sp. nov. Holotype; 25-27, *Lioproa rostrata* (Hedley); 28-30, *Circumstella deveza* (Hedley); 31-33, *Liotella elegans*, sp. nov. Holotype; 34-36, *Liotropica introspecta* (Hedley).



FIGURES 37 TO 54

C. F. LASERON DEL.

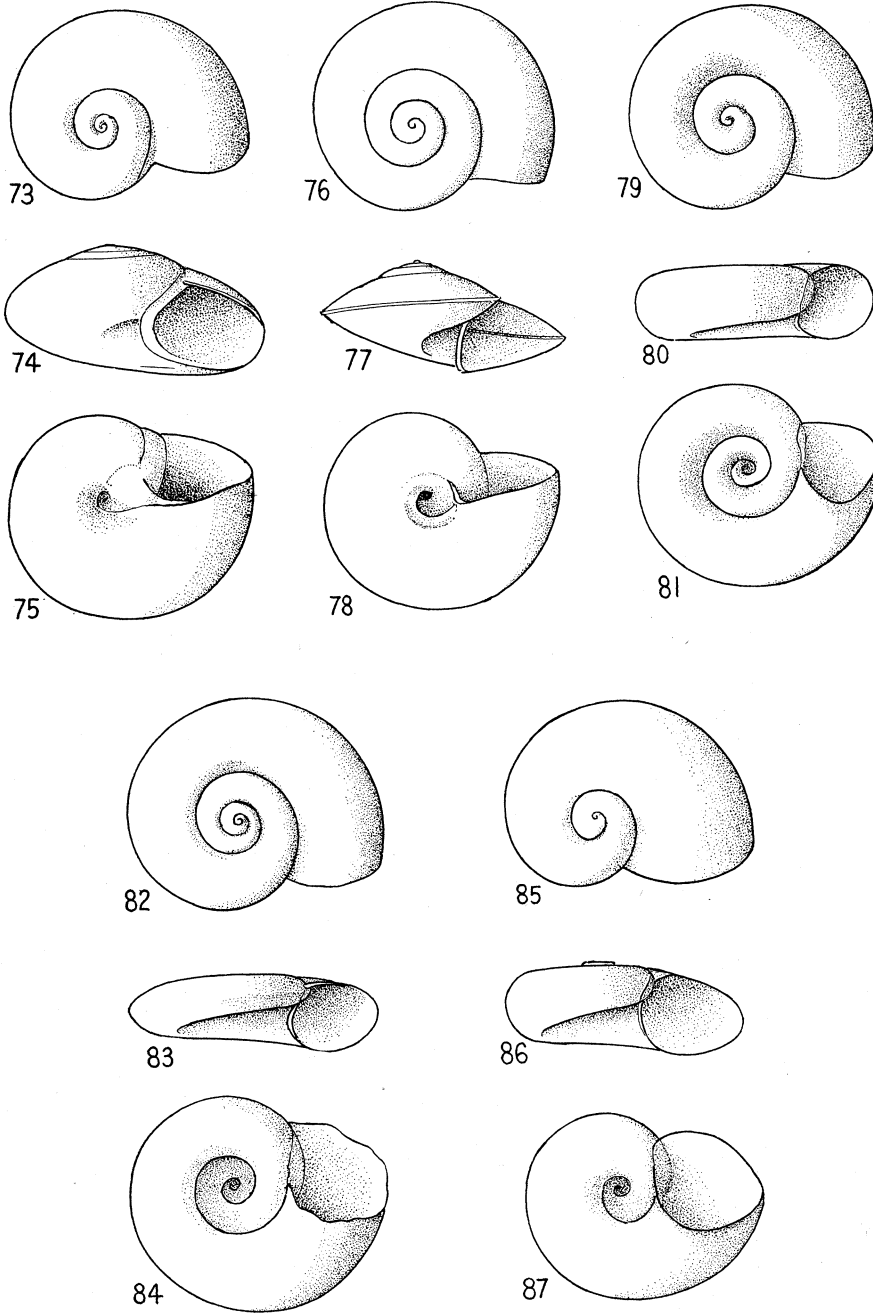
37-39, *Circlotoma rotata*, sp. nov. Holotype; 40-42, *Circlotoma callusa*, sp. nov. Holotype; 43-45, *Circlotoma venusta* (Hedley); 46-48, *Circlotoma transculpta*, sp. nov. Holotype; 49-51, *Circlotoma planorbis*, sp. nov. Holotype; 52-54, *Moeniatoma diamura*, sp. nov. Holotype.



FIGURES 55 TO 72

C. F. LASERON DEL.

55-57, *Callodix conica*, sp. nov. Holotype; 58-60, *Tholostoma carinata*, sp. nov. Holotype; 61-63, *Caperella orbitum* (Hedley)?; 64-66, *Caperella orbitum*, another specimen; 67-69, *Caperella umbilicata*, sp. nov. Holotype; 70-72, *Peripitoma vitrea*, sp. nov. Holotype.



FIGURES 73 TO 87

C. F. LASERON DEL.

73-75, *Rotosoma impleta*, sp. nov. Holotype; 76-78, *Circulter acuta*, sp. nov. Holotype; 79-81, *Microdiscula involuta*, sp. nov. Holotype; 82-84, *Microdiscula planorbis*, sp. nov. Holotype; 85-87, *Microdiscula augmenta*, sp. nov. Holotype.