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"THE AUSTRALIAN ZOOLOGIST."

The Council of the Royal Zoological Society of New South Wales has decided that, commencing with this Volume (VIII.), "The Australian Zoologist" shall be published at intervals, as material and funds permit. The size of the page will be reduced to agree with that of the "Records of the Australian Museum," but this will be effected by reducing the margin and not the text.

The Society's Annual Report and Balance Sheet, Reports of the Sections, and other routine matters, hitherto included in this journal, will be published in octavo form, and entitled, "Proceedings of the Royal Zoological Society of New South Wales"; such Proceedings to be issued in the month of August in each year, and supplied to all members and associate members without extra charge. Where available, nature notes and short popular papers on subjects relating to Australian zoology will be included in the Proceedings.

JUN 5 '33

THE BEES OF AUSTRALIA.

By T. D. A. Cockerell.

(Continued from vol vii., part iv., p. 324.)

Halictidae subfamily Sphecodinae.

Inquiline or parasitic bees, the females without the caudal furrow of *Halictus*. In most species the abdomen is red, but some are entirely black. The basal nervure is strongly arched, as in *Halictus*. Tongue in our species very short.

Sphecodes profugus Cockerell.

Female about 9 mm. long; head and thorax black, abdomen dark chestnut red, black at apex; head large, broader than long; wings moderately dusky, stigma and nervures very dark brown. Male about 7 mm. long, much less bulky, abdomen lighter red; flagellum robust and long, the joints nodose beneath. Mackay, Queensland (Turner). Type in British Museum. Allied to a species of New Guinea (*S. biroi* Friese). *S. profugus* has been taken as far south as Brisbane (Hacker).

Colletidae.

The typical genus, *Colletes*, reaches southern South America and South Africa, but is not present in Australia. Vachal in 1909 proposed a subfamily, *Diphaglossinae*, having for its type the South American genus, *Diphaglossa* Spinola. He recognised the existence of genera of this group in Australia and South America, and it may now be added that there are genera in South Africa. The ancestral or basic type of this subfamily has three cubital (submarginal) cells, but genera have evolved which possess only two. Such are *Pasiphaë* Spinola in South America, *Scrapter* Lepeletier and Serville in South Africa, and *Notocolletes*, *Euryglossidia* and *Andrenopsis* in Australia.

(A.) Genera with two cubital cells.*

Paracolletes-like bees, with hairy head and thorax; marginal cell obtuse or truncate at end; stigma small; face of male yellow. .. .. *Andrenopsis* Cockerell.

Paracolletes-like hairy bees; male flagellum very long and slender; head and thorax black, abdomen green; male face not yellow, but densely covered with appressed hair; legs and venter of abdomen greatly modified; stigma long and narrow; marginal cell ending rather obtusely. .. .. *Notocolletes* Cockerell.

More *Euryglossa*-like bees, rather slender and often small; marginal cell narrow or pointed at end; stigma large. .. .. .. *Euryglossidia* Cockerell.

By some mischance, in the table in Australian Zoologist, vi., p. 148, *Euryglossina* is printed in place of *Euryglossidia*. In Genera Insectorum, 1923, Meade-Waldo includes *Euryglossidia* in *Prosopidinae*, separating it from *Euryglossa* in his table by the cubital cells being both long, subequal, and the basal nervure gently arched. He gives an excellent coloured figure of *E. rectangulata*, which is the genotype. This species resembles in appearance the South African *Scrapter semirufa* Cockerell, and shows no material difference in the venation and general structure of the body, ex-

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* *Paracolletes abnormis* Ckll. sometimes has only two cubital cells, and the type of *P. vitrifrons* Sm. has only two cubitals.

cept that the metathorax is of a different type. It appears to be a fact that *Scrapter* and *Euryglossidia,* inhabiting South Africa and Australia respectively, are very closely related, and must have had a common origin from a bee of the same general type. I interpret this as indicating that this type of bee was once widespread over the world, but now remains only in certain southern regions.

ANDRENOPSIS Cockerell.

The genus was originally based (Trans. Amer. Ent. Soc., xxxi., 1905, p. 363) on a male *A. flavorufus* in the British Museum, labelled "Australia."

Andrenopsis flavorufus Cockerell.

Male about 10.5 mm. long; mandibles (except apex), labrum, clypeus and supraclypeal area yellow; scape yellow suffused with red; hind margins of abdominal tergites broadly ferruginous; tarsi light yellow. The Australian Museum has it from Sydney, collected by C. Gibbons.

Andrenopsis velutinus Cockerell.

Kojarena, W.A. (*Nicholson*). Female about 6 mm. long; head and thorax black, abdomen black and chestnut red. (Rec. Austr. Mus., xvii., p. 212).

Andrenopsis wilsoni Rayment.

Bogong High Plains (5,000 ft.), Victoria (*F. E. Wilson*). (Proc. Roy. Soc. Victoria, xliii., 1930, p. 51). Mr. Rayment kindly sent me this insect for examination, and I noted: Male about 8 mm. long; mandibles bidentate; clypeus mainly honey colour, keeled; supraclypeal area elevated, shining; scape light yellowish ferruginous; basal nervure meeting the oblique nervulus; second cubital cell long, receiving first recurrent nervure far from base.

EURYGLOSSIDIA Cockerell.

Euryglossidia australiensis (Dalla Torre).

Described by Smith as *Scrapter bicolor,* from a specimen in the collection of Sir John Lubbock. The specific name had been used by Lepeletier and Serville for an African species. Head and thorax black: abdomen ferruginous, with the base fuscous, and tergites 2 to 4 with lateral fuscous spots; tibiae and tarsi ferruginous. Transferred to *Euryglossidia* by Meade-Waldo.

Euryglossidia cyanescens Cockerell.

Kojarena, W.A. (*Nicholson*). Female about 5.5 mm. long; head and thorax black; abdomen with first three segments very bright ferruginous red, with a faint purple lustre, the second tergite with an oval black spot on each side; remaining tergites dark with a strong bluish or blue-green lustre, the apical tuft of hair black. Allied to *E. simillima,* but known by the red tibiae. Type in Australian Museum.

Euryglossidia eraduensis Cockerell.

Eradu, W.A. (*Nicholson*). Female about 9 mm. long, or rather less; dark green, the clypeus black, and the entirely dull mesothorax almost black; spur of anterior tibia with a broad lateral translucent plate, and beyond that four sharp lateral spines. Type in Australian Museum.

Euryglossidia ichneumonoides (Cockerell).

W. Australia. Male about 7 mm. long, looking like a small ichneumonid; head and thorax black, legs and abdomen yellowish ferruginous; wings hyaline. The abdomen has a purple lustre. Type in British Museum.

Euryglossidia mastersi Cockerell.

King George's Sound, W.A. (*Geo. Masters*). Female 9 mm. long; head and thorax black, abdomen chestnut red, with a purple lustre; wings reddish hyaline. Very near *E. purpurascens,* but clypeus convex, not flattened on disc; scutellum more closely punctured, with no median depression; anterior tibiae red; nervures much paler; stigma shorter. Type in Australian Museum.

Euryglossidia nigrescens Cockerell.

Geraldton and Eradu, W.A. (*Nicholson*). Male nearly 6 mm. long, very slender, with narrow abdomen and extremely long antennae; head and thorax black; abdomen very dark brown, faintly greenish, the hind margins of tergites 2 to 4 more or less pallid; wings hyaline. Female more robust; face broad, with conspicuous white hair at sides; antennae short, the flagellum clear ferruginous beneath except at end; apex of abdomen with dark fuscous hair. Type in Australian Museum.

Euryglossidia purpurascens Cockerell.

Yallingup, W.A. (*R. E. Turner*). Male about 8.5 mm. long; black, the abdomen dark rich chestnut red, suffused with purple, the basal segment dark; antennae black, extremely long. Female about 9 mm. long, with short antennae; sides of second tergite with a large dark spot. Distinguished from *E. ichneumonoides* by the brownish wings, and from *E. rectangulata* by the fuscous (instead of ferruginous) nervures. Type in British Museum.

Euryglossidia rectangulata Cockerell.

Victoria (*French*). Female about 8 mm. long; head and thorax black, quite hairy; abdomen very bright chestnut red, with a large round black spot on each side of second tergite; femora black, with the knees ferruginous; tibiae and tarsi ferruginous, more or less suffused with dusky; tegulae ferruginous; wings pale reddish. Male much more slender, the abdomen claviform, slender basally, variably suffused with black, and with a faint purple lustre; clypeus covered with white hair. Type in British Museum.

Euryglossidia simillima (Smith).

Swan River, W.A. Female with the aspect of a *Sphecodes*; head and thorax black, abdomen ferruginous; flagellum fulvous beneath; wings hyaline. The two last tergites are blue-black, the apex with black pubescence. Transferred to *Euryglossidia* by Meade-Waldo. Type in British Museum.

Euryglossidia viridescens Cockerell.

Geraldton, W.A. (*Nicholson*). Female about 6.5 mm. long; head and thorax black, the very large dullish area of metathorax slightly greenish; abdomen ferruginous, with fourth tergite and beyond dark olive green, and the red tergites with a transverse dusky subapical band; sides of second tergite with a large oval black spot; apical tuft brown. Type in Australian Museum. The black spots at sides of second tergite are equally evident in the species of the African genus *Scrapter* which have a red abdomen; for example, *S. rufiventris* (Friese).

NOTOCOLLETES Cockerell.

Notocolletes heterodoxus Cockerell.

"Gawter, D.S. Austr.," which may mean Gawler Range. Male nearly 11 mm. long; head and thorax black; abdomen dark dull blue-green; head,

thorax and abdomen with long erect very pale ochreous-tinted hair, not forming bands on abdomen; appressed hair of face shining like a plate of polished silver in certain lights; hind margin of fifth sternite elevated and greatly thickened in middle; sixth sternite with a great thickened elevation. Type in British Museum. Among the genera with three cubital cells, this most resembles *Goniocolletes,* which also has greatly modified legs in the male. There is a curious resemblance between *Notocolletes* and the South African *Parapolyglossa* Brauns, but as the details of the greatly modified legs differ conspicuously in the two genera, I suppose the modifications to have arisen independently, yet also as the expression of a tendency latent in the whole group, and in that sense ancestral.

(B.) Genera with three cubital cells.

The genera of this series are greatly in need of revision, which must be based on structural studies of both sexes of many species. F. Smith recognised a series of genera, which he named *Anthoglossa, Paracolletes, Leioproctus, Dasycolletes, Lamprocolletes, Stenotritus* and *Gastropsis* (*Oestropsis,* preoccupied). In 1905 I united the second, third, fourth and fifth under the name *Paracolletes,* finding that the supposed generic characters did not hold in a long series of species. *Anthoglossa* is also practically confluent with *Paracolletes,* though it represents a rather distinct group. In 1929 (Mem. Queens. Mus., p. 311) I suggested the possibility of restoring *Leioproctus* (to include *Lamprocolletes*) for the larger part of the present *Paracolletes,* characterised by the well developed stigma. I gave lists of species which would then fall in *Paracolletes* and *Leioproctus. Lamprocolletes* has the third cubital cell much less elongated than in *Leioproctus* proper, receiving the second recurrent nervure very near the end. This difference can hardly be considered generic. The type of *Leioproctus* is from New Zealand, but similar species occur in Australia.

In the present paper, I continue to use *Paracolletes* in the broad sense, leaving it to some future Australian student to produce a sound generic revision which we can all adopt.

Stenotritus and *Gastropsis* were not recognised as Diphaglossine or Colletid. As I stated in Ann. Mag. Nat. Hist., March, 1929, p. 358, there can now be no doubt that *Gastropsis* consists of males of *Stenotritus.* Smith placed *Stenotritus* after *Andrena,* remarking that he could not describe the tongue, as some one had extracted it from the type. The genus consists (in the female) of robust *Andrena*-like bees, the principal characters described by Smith being in the legs: "The inner spine at the apex of the posterior tibiae, as well as the single one at the apex of the anterior and intermediate pairs, toothed like a comb, and very long, bent and acute at the apex; the posterior legs furnished with a floccus and scopa." The second recurrent nervure was described as reaching the third cubital cell in the middle. *Gastropsis,* based on a male, was noteworthy for the conical abdomen, giving the insect the appearance of a bot-fly. In 1904 (Canad. Entomologist, p. 304) I discussed *Gastropsis,* remarking on the broad second cubital cell and obsolete stigma (characters also of *Anthoglossa plumata*); third antennal joint very long; face narrow, with large eyes; area of metathorax very long and narrow; abdomen very hairy, rather tapering, with two terminal spines, which are sometimes folded back, and then not easily seen. The basal nervure falls far short of the nervulus. I remarked on the general resemblance to the Peruvian *Megacilissa vestita* Smith, but quite erroneously supposed the genus to be related to *Meliturga,* which resembles it in the abdominal spines of the male, in the eyes (though in *meliturga* male they converge above) and the long third antennal joint.

The genera may be divided into three tribes, Stenotritini, Phenacolletini and Paracolletini.

STENOTRITINI.

Stenotritus Smith.

Stenotritus elegans Smith.

Sydney, N.S.W. The type of the genus. Head and thorax black, abdomen greenish; hair at apex of abdomen rufo-fulvous. Last antennal joint of female compressed, so as to appear pointed from one direction, rounded from another. Area of metathorax produced apically, so as to form a broad band passing down metathorax. A female in bad condition, from Tennant's Creek, Central Australia (Field) shows olive green tints on the mesothorax in front, and the first recurrent nervure joins second cubital cell a little before the middle, instead of a little beyond it as in type *S. elegans*. For the present this form is regarded as a variety of *S. elegans*, but good material might show it to be a distinct species.

Stenotritus elegantior Cockerell.

Queensland, probably collected by Turner. Female about 16 mm. long; similar to *S. elegans*, but head and thorax above metallic, with rich purple and green tints; hair of face and front fulvous, of cheeks white, contrasting; scape entirely bright ferruginous.

Stenotritus glauerti (Rayment).

Yorkrakine, W.A. Female 21 mm. long; peacock green, with peacock-blue about the head; scape royal-blue; no fringe on abdominal tergites.

Stenotritus nigrescens (Friese).

Central Australia, collected by the famous botanist, v. Müller. Male 15 mm. long, like *S. pubescens*, but thorax with a broad black transverse band; tergites 2 to 5 blackish-brown haired; legs entirely blackish-brown. Friese remarks on its great resemblance to *Meliturga clavicornis*.

Stenotritus pubescens (Smith).

Champion Bay, W.A. (H. Du Boulay) and S. Australia. The type of *Gastropsis*. Black, densely clothed with ochraceous pubescence; legs pale ferruginous, the middle femora behind, and the hind femora, dark fuscous or black; abdomen submetallic.

Stenotritus pubescens splendidus (Rayment).

Geraldton, W.A. Male 14.5 mm. long; antennae entirely pale ferruginous; abdomen broader, the tergites and thorax completely hidden under excessively dense pale greenish-buff hair; legs brown.

Stenotritus smaragdinus Smith.

Champion Bay, W.A. (H. Du Boulay). Like a very large, bright green *Andrena*. Female with third antennal joint very long; mesothorax with much white plumose hair; area of metathorax reduced to a very minute basal nearly equilateral triangle (thus very different from that of *S. elegans*); second cubital cell extremely broad. Type in British Museum.

Subgenus MELITRIBUS Rayment.

This includes species in which the large eyes of the males converge above. For a full description see Entomologist, January, 1906, p. 15. Rayment, in Proc. Roy. Soc. Victoria, 1930, p. 61, gives *S. victoriae* as the type of the genus, but in the previous volume, p. 218, issued earlier in the same year, he cites *M. greavesi*, and this must hold. He gives a good plate showing *M. greavesi* and various details of its structure.

Stenotritus (*Melitribus*) *greavesi* (Rayment).

Bungulla, W.A., on flowers of *Callistemon* (T. Greaves). Male about 16 mm. long; "the white hair of the metathorax and the first and second abdominal segments is combined as a wide median band across the black shining body, and is suggestive of *Megachile lucidiventris*."

Stenotritus (*Melitribus*) *victoriae* (Cockerell).

South Australia and Victoria. Type in British Museum. Male about 15.5 mm. long; black, shining, and punctured; face very narrow, covered with long light yellow hair; anterior margin of clypeus with two shining dentiform processes; area of metathorax finely granular, triangular, with all the angles greatly produced and acute; hair of thorax yellowish white, except on hind part of mesothorax and scutellum, where it is black or fuscous; apical plate of abdomen truncate. A supposed variety from W. Australia (Froggatt) has the abdomen and anterior part of mesothorax with a greenish lustre; mesothorax with much black hair, except on the anterior third, where it abruptly changes to yellowish white.

Stenotritus (*Melitribus*) *victoriae rufocollaris* (Cockerell).

Mallee, V. (Davey). Male about 14 mm. long; face and front covered with bright ferruginous hair; first three antennal joints clear ferruginous; mesothorax and scutellum somewhat metallic; anterior part of mesothorax with bright fox-red hair, abruptly separated from the black of the hinder part.

Subgenus *Ctenocolletes* Cockerell.

Female large; anterior and middle tibial spurs with very long spines, on anterior spurs well spaced (not small and crowded as in *S. elegans*); stigma practically obsolete; basal nervure falling far short of nervulus; second cubital cell quadrate, extremely broad, much broader than high, receiving first recurrent nervure toward the base. (Ann. Mag. Nat. Hist., March, 1929, p. 358.).

Stenotritus (*Ctenocolletes*) *nicholsoni* Cockerell.

Kojarena, W.A. Nicholson). Type in Australian Museum. Female about 20 mm. long; black, quite without metallic tints; face covered with white hair; thorax densely covered with long hair, clear white on mesopleura and tubercles, on dorsum very pale ochreous, with two transverse black bands; tergites 2 to 4 with fulvous bands; apex of abdomen with copper-red hair. The two transverse bands on thorax resemble those of *Caupolicana hirsuta* Spinola, from Chile.

PHENACOLLETINI.

PHENACOLLETES Cockerell.

Bees closely resembling wasps allied to *Tachytes*; pubescence very short and like that of a wasp, the plumosity only visible under the compound microscope; abdomen free from hair, except a very fine pruinosity, and shaped like that of a *Tachytes* or Bembicid; stigma small and narrow; first cubital cell, on cubital nervure, at least as long as the other two combined; second cubital cell almost square, receiving first recurrent nervure at end of its first third; basal nervure falling slightly basad of nervulus.

Phenacolletes mimus Cockerell.

Turtle Bay. N.W. Australia (J. J. Walker). Male about 14 mm. long; black, with the large scutellum red varying to black; labrum with a shining elevated C.; face broad, the eyes practically parallel, slightly diverging be-

low; flagellum thick, the middle joints broader than long; area of metathorax large, shining, with a deep basal pit.

PARACOLLETINI.

Cladocerapis Cockerell.

Allied to *Paracolletes,* but male antennae with joints of flagellum having processes directed forward, on upper side, and large branches bearing little filament-like processes, often forked, on under side; area of metathorax smooth and shining, with an obscure transverse ridge; basal nervure meeting nervulus; first recurrent nervure joining middle of second cubital cell.

Cladocerapis bipectinatus (Smith).

Sydney, N.S.W. Male black, shining; wings hyaline; legs obscurely testaceous; abdomen obscurely metallic. Hacker records it from Queensland (Caloundra and Bribie Island).

TRICHOCOLLETES Cockerell.

Allied to *Paracolletes,* but with conspicuously hairy eyes. The females collect pollen from *Daviesia.*

Trichocolletes daviesiae Rayment.

Heathmont, V., visiting *Daviesia* (Rayment). Hair of face very dense, reddish-gold; abdominal bands glistening golden; antennae black, with red scape.

Trichocolletes dowerinensis Rayment.

Dowerin, W.A., visiting *Daviesia* (Rayment). A narrow species; abdomen coarsely punctured, tergites with pallid margins and long black hair, except on first two tergites; where it is dark fulvous; clypeus and labrum fulvous.

Trichocolletes nigroclypeatus Rayment.

Daylesford, Victoria, visiting *Daviesia* (Rayment). Female about 12.3 mm. long; clypeus naked, with a tuft of hair at each side. The male is hard to separate from *T. venustus,* but the genitalia are different.

Trichocolletes tenuiculus Rayment.

Canowindra, N.S.W. (M. Dwyer). Male about 12 mm. long, female 14 mm.; scape blackish; a tuft of hair in middle of clypeus; abdominal bands very dull and narrow. The tibiae are ferruginous. Males of this and *T. daviesiae* visit *Hardenbergia.*

Trichocolletes venustus (Smith).

Lower Plenty, S.A. Female black, the abdomen with a silky gloss; face densely clothed with long pale golden hair; scape red; tibiae red; margins of tergites with narrow golden bands, thinly hairy. It is also known from Queensland; a specimen from Hobart, Tasmania, lacks the first intercubitus on the right side. Rayment records it from Western Australia. It visits *Daviesia.*

Rayment (Victorian Naturalist, December, 1929) figures the head and genitalia of *T. venustus* and the head of *T. nigroclypeatus.*

GONIOCOLLETES Cockerell.

Paracolletes-like bees, with the male legs excessively modified; anterior tarsi with the basitarsus narrow, pale and flat, more than twice as long as the rest of the tarsus; middle femora with the lower half beneath excavated, as though a large piece had been bitten out, the basal end of the excavation

furnished with a large tooth; hind tibiae strongly bent, with only one spur visible, that small and pale; hind basitarsi with a tooth-like prominence beneath.

The female is not known, but *Paracolletes ruficornis* (Smith) shows several points of similarity.

Goniocolletes morsus Cockerell.

New South Wales. Type in American Museum of Natural History. Male about 13 mm. long; black, clothed with long yellow hair, dense and golden on the face; face broad; lower edge of clypeus broadly whitish; scape black, flagellum red, blackish above at base; wings yellowish; tarsi pellucid yellowish; very broad margins of tergites pellucid shining testaceous. The Australian Museum has it from S. Australia. It is the type of the genus. *Dasycolletes curvipes* Friese is a synonym.

Goniocolletes pallidus Cockerell.

Hermannsburg, Central Australia (H. J. Hillier). Type in British Museum. Male about 11.5 mm. long; abdomen light ferruginous, hind margins of tergites broadly hyaline; flagellum dusky red, almost black above.

NODOCOLLETES Rayment.

Rayment (Jour. Roy. Soc. W. Australia, xvii., p. 164) has proposed this genus to include those species of *Paracolletes* (in the broad sense) which have a dentate process on the postscutellum. The stigma is inconspicuous. I have catalogued the species below under *Paracolletes*; they are the following:—

N. dentatus Rayment (type of genus), *N. subdentatus* Rayment, *N. diodontus* (Ckll.), *N. vigilans* (Smith), as listed by Rayment. The postscutellum has a stout sharp spine in *Paracolletes phanerodontus* Ckll., and in *P. subvigilans* Ckll. it has a very prominent obtuse tubercle, which is not bifid. *P. sexmaculatus* Ckll. has a mammiform median tubercle on postscutellum. *P. microdontus* Ckll. has a small but distinct tubercle on postscutellum.

ANTHOGLOSSA Smith.

Smith based this genus on *A. plumata;* six species are listed in Hacker's Catalogue. *A. plumata* (female) is a comparatively large bee, with the second cubital cell extremely broad, not contracted above; pygidial plate large; clypeus densely punctured; mandibles elbowed outward; abdomen with hair-bands.

Smith later added *A. sericea* (female), which has the second cubital cell greatly contracted above; clypeus shining, with widely separated punctures; mandibles ordinary; hind margins of tergites white, without hair-bands.

The male in the British Museum ascribed to *A. plumata* has the same venation as the female, but the hind margins of tergites white as in *A. sericea*. It has the face densely covered with long bright orange-red hair, and the scape and hind tibiae and tarsi red.

It has become increasingly difficult to recognise *Anthoglossa* as a genus, but when the genera are revised, it may be found to stand, with a modified definition.

Anthoglossa aureotincta Cockerell.

Perth (H. W. J. Turner). Type in British Museum. Female about 13 mm. long; closely allied to *A. sericea*, but differing by the antennae (which are black, the flagellum obscurely brownish beneath), dark brown tegulae,

black legs and pale chocolate coloured apical tuft of abdomen. The hind margins of first four tergites are pale orange-golden.

Anthoglossa cygni Cockerell.

Swan River. Type in British Museum. Female about 15.5 mm. long; abdomen without bands; hair on fifth and apical tergites brown-black.

Anthoglossa dives Cockerell.

Yallingup, W.A. (Rowland Turner). Type in British Museum. Female about 16 mm. long; male 16 mm., the face densely covered with very bright golden-fulvous hair. Distinguished (female) from *A. aureotincta* by being larger, with largely red legs. Both are separated from *A. hackeri* by the golden band on first tergite.

Anthoglossa hackeri Cockerell.

Mt. Tambourine, Q. (Hacker). Female about 14 mm. long, structurally like *A. aureotincta,* but differing by the absence of a band on first tergite, dark hair of upper part of head, and dusky wings. Antennae and legs black.

Anthoglossa plumata Smith.

W. Australia. Type in British Museum.

Anthoglossa sericea Smith.

Described from a female in the collection of Sir John Lubbock. My account above is based on the specimen in the British Museum. Smith's description includes the following items: Sides of the face with a line of snow-white pubescence, on the vertex it is slightly fuscous; anterior margin of the clypeus and the mandibles rufo-piceous, the tips of the latter black; flagellum fulvous beneath; tibiae and tarsi rufo-piceous; tegulae pale testaceous; wings subhyaline; abdomen covered with a short changeable reddish pile, apical margins of the tergites narrowly testaceous; fifth tergite fringed with fulvous pubescence, as well as the sides of sixth, the segment itself being rufo-testaceous.

Paracolletes Smith.

In Trans. Amer. Ent. Soc., xxxi. (1905), pp. 344-349, I have given a table based on Smith's types in the British Museum, I concluded that the venational characters supposed to distinguish several genera did not hold good. The bees look like *Colletes* or *Andrena.* The hind spur of hind tibia may be pectinate with rather numerous fine long teeth, as in *P.* (or *Dasycolletes*) *rubellus*; or may be minutely ciliate, at first glance appearing simple, as in *P.* (or *Dasycolletes*) *metallicus.* These differences in the spur parallel those found in *Halictus.*

In the following table I have included species of *Trichocolletes* and *Anthoglossa.*

1. Eyes hairy; hind margins of abdominal tergites pallid; male with face covered with golden hair, and scape clear red; females with white hair on face, pale fulvous on vertex; first cubital cell short as in *Anthoglossa* .. .. *Trichocolletes venustus* (Smith). (The eyes also show hair in *P. thornleighensis* Ckll.)
   Eyes not hairy (excepting in *P. thornleighensis*) .. .. .. 2.
2. Male legs greatly deformed; middle femora with a large tooth below, hind tibiae strongly bent; face covered with golden hair; scape black, but flagellum red beneath .. .. *Goniocolletes morsus Ckll.* (See also *G. pallidus* Ckll.).
   Male legs not thus deformed .. .. 3.

3. First cubital cell below relatively short, not or hardly as long as 2 plus 3; second cubital broad; abdomen with broad golden tegumentary bands . . . . 4.
(Very large, about 17 mm. long, with bright red moss-like hair on thorax above . . . . *maximus* Ckll.)
First cubital cell longer, often much longer than 2 plus 3. 5.
4. Face with white hair; female (Queensland) . . *Anthoglossa hackeri* Ckll.
Face with bright orange hair; last antennal joint broad and flat; male (W. Australia) . . . . *Anthoglossa dives* Ckll.
(By analogy with *T. venustus*, these might be sexes of one species, but *hackeri* has basal nervure falling conspicuously short of nervulus, while in *dives* it meets nervulus.)
The following supplementary table of *Anthoglossa* will be useful:
Larger; second cubital cell extremely broad, not contracted above; clypeus densely punctured; abdomen with hair-bands (female). Male with face covered with bright orange red hair; scape red; hind margins of tergites white . . . . *A. plumata* Smith.
Abdomen of female without hair bands . . . . 1.
1. Second cubital cell greatly contracted above; clypeus shining, with widely separated punctures; mandibles ordinary (strongly elbowed outward in female *plumata*); hind margins of abdominal tergites white . . . . *A. sericea* Smith.
Differs by having hair on fifth and apical tergites brown-black; female about 15.5 mm. long (Swan R.) . . . . *A. cygni* Ckll.
(See also *A. aureotincta* Ckll., female about 13 mm. long; and *Paracolletes marginatus* Smith appears to be allied.)
5. Black species, with hind margins of tergites evidently discolored. (See also *P. carinatifrons* Ckll.) . . . . 6.
Otherwise . . . . 11.
6. Stigma subobsolete . . . . 7.
Stigma well developed . . . . 8.
7. Abdomen with narrow pale golden bands; hind tibiae and tarsi of male red; face of male with golden hair, of female with white; first cubital cell relatively short, suggesting *Anthoglossa;* third cubital long, produced . . *Paracolletes* (or *Anthoglossa*) *marginatus* Smith.
(Here also may be sought:
Scape swollen, clear red; flagellum short and thick; face densely covered with red-gold hairs *P.* (or *A.*) *chrysostomus* Ckll.
Caudal fibria fulvous; abdominal bands white; clypeus highly polished, with few punctures . . . . *P.* (or *A.*) *marginatus lucidus* Ckll.
P. m. lucidus differs from *A. sericea* Sm. by the dark tegulae, and absence of "short changeable reddish pile" covering abdomen; but it agrees with *sericea* in the fulvous caudal tuft, and smooth shining clypeus with reddish margin.)
Abdomen with broad pale golden tegumentary bands; third cubital cell not elongated; male, the long flagellum red beneath . . . . *P. rebellis* Ckll.
8. Hair of head and thorax bright fox-red; stigma clear red; hind tibiae (female) with an extremely large and broad pale fulvous scopa . . . . *waterhousei* Ckll.
Hair of head and thorax not thus bright, or not red; smaller species . . . . 9.
9. Second cubital cell parallel-sided; female flagellum very short . . . . *helichrysi* Ckll.

Second cubital cell narrowed above .. .. 10.

10. Third cubital cell much elongated; sides of front above finely punctured, not polished .. .. *sigillatus* Ckll.
(An allied but smaller species is *P. nomiaeformis* Ckll.)

Third cubital cell little elongated; sides of front above smooth and polished .. .. *thornleighensis* Ckll.

11. Abdomen red, or at least in large part .. .. 12.
Abdomen not red .. .. 20.

12. Stigma subobsolete; mostly larger species .. .. 13.
Stigma well developed .. .. 15.

13. Clypeus shining black; mandibles red, black at end; female (W. Australia) .. .. *erythrurus* Ckll.
Clypeus more or less yellow; males .. .. 14.

14. Yellow on clypeus trilobed; scape black .. .. *nigrocinctus* Ckll. (*Tenuicinctus* Ckll.)
Clypes all yellow; scape red .. .. *callander* Ckll.
(Abdomen black and red, see *rufibasis* Ckll.)

15. Scutellum with much black hair; lateral black spots on second tergite (Victoria) .. .. *platycephalus* Ckll.
Scutellum without black hair .. .. 16.

16. Face densely covered with golden hair, hiding the surface .. .. 17.
Face not covered with golden hair .. .. 18.

17. Second cubital cell parallel-sided, receiving recurrent nervure near base; flagellum red at tip (Victoria) .. .. *fimbriatinus* Ckll.
Second cubital cell narrowed above, receiving recurrent nervure not so near base (N.S.W.) .. .. *fimbriatinus* Ckll., variety.

18. Male; flagellum long, all black, crenulate .. .. *platycephalus* Ckll.
Females; venter of abdomen with pure white hair .. .. 19.

19. Thorax above with yellow hair; front and sides of face with white hair; clypeus with a median keel (S.A.) .. .. *gallipes* Ckll.
Thorax with white hair; clypeus not keeled (N.S.W.) . *truncatulus* Ckll.
(See also:
Thorax above with rich fulvous hair; front with fulvous hair, sides of face with very pale yellowish hair; clypeus very coarsely rugose, not keeled; end of abdomen with very dark fuscous hair (all pale in *gallipes*); abdomen below with broad creamy-white bands; length about 14 mm. .. .. female of *fimbriatinus* Ckll.
Clypeus shining, very coarsely punctured, with no median keel; hair at apex of abdomen light brown; flagellum bright red beneath except at base; scopa of hind legs white .. .. *abdominalis* Smith (female).
Abdomen dusky chestnut with purple suffusion; female about 7.5 mm. long .. .. *cyaneorufus* Ckll.)
(*P. rufoaeneus* Friese is allied.)

20. Region of scutellum covered with a dense patch of orange hair; black species, with very large stigma (Kuranda) .. *flavomaculatus* Ckll.
Without such a patch of orange hair .. .. 21.

21. Sides of thorax above with large pear-shaped patches of dense felt-like orange hair; black species, with large stigma; female .. .. *irroratus* Smith.
Thorax not thus ornamented .. .. 22.

22. Without blue or green tints (a suggestion of metallic colour on abdomen of *leai, tuberculatus, tuberculatus insularis,* and *metallescens*) .. 23.
Abdomen at least partly metallic .. 55.

23. Stigma subobsolete; comparatively large, robust species. 24.
Stigma distinctly developed or large .. 28.

24. Flagellum entirely ferruginous; eyes green; thorax with fulvous hair; male .. *ferricornis* Ckll.
Flagellum not, or not all, red; eyes not green .. 25.

25. Abdomen with three narrow silver-white hair-bands; female .. *tenuicinctus* Ckll.
(*P. advena* Sm. is allied.)
Abdomen without such bands .. 26.

26. Anterior tibiae black, dark red on inner face; apical hair of abdomen pale grey; female .. *latifrons* Ckll.
Anterior tibiae red .. 27.

27. Female; very robust; hair of thorax above pale fulvous. .. *crassipes* Smith.
Male; less robust .. *crassipes* Smith.
(See here also *P. robustus* Ckll., which runs to *tenuicinctus,* but apical plate of female abdomen much broader, with no median raised line; hair of thorax above white tipped with black.)

28. End of abdomen broadly clothed with extremely bright orange-red hair .. *callurus* Ckll.
(The variety *nigrior* Ckll. has no white collar on mesothorax in front.)
End of abdomen not thus ornamented .. 29.

29. (Tegulae very bright apricot colour; but abdomen distinctly metallic .. *launcestonensis* Ckll.)
Tegulae not so coloured .. 30.

30. Females .. 31.
Males .. 40.

31. Abdomen with distinct white or whitish hair-bands .. 32.
(Small, with thin bands on tergites 3 and 4 .. *nicholsoni* Ckll.)
Abdomen without such bands .. 35.

32. Clypeus with a strong median keel; hair of fifth tergite pale fulvous .. *andreniformis* Ckll.
Clypeus without a keel .. 33.

33. Mandibles bright red in middle, and tip of flagellum red; small species .. *halictiformis* Ckll.
Mandibles not thus red; larger species .. 34.

34. Larger and more robust . *advena* Smith (*worsfoldi* Ckll. is a subspecies.)
Smaller and less robust, but very closely allied; abdomen faintly green (Tasmania) .. *subviridis* Ckll.
(See also *P. albovittatus* Ckll., very shiny; white hair-bands broad.)

35. Robust species; hair of head and thorax above fulvous with admixture of black; tubercles with conspicuous light fulvous hair; stigma small .. *fervidus subdolus* Ckll.
Otherwise; hair of thorax above not thus fulvous .. 36.

36. First recurrent nervure joins second cubital cell about middle; scutellum has black hair .. 37.
(The scutellum has white hair in *P. nicholsoni* Ckll.)
First recurrrent nervure joins second cubital cell much before middle .. 39.

37. (Abdomen hardly punctured, more or less metallic . *metallescens* Ckll.)
(It is hardly punctured, dull, not metallic, in *P. philonesus* Ckll., about 9.5 mm. long, from Lord Howe Island.)
Abdomen distinctly punctured, not metallic .. .. 38.

38. Clypeus flat and shining .. .. *incanescens* Ckll. (compare also *speculiferus* Ckll.)
Area of metathorax transversely striate; hind margins of tergites reddened .. .. *carinatifrons* Ckll.

39. Postscutellum with a tubercle .. .. *tuberculatus* Ckll. and subsp. *insularis* Ckll.)
(See also *P. opaculus* Ckll., clypeus dull and regulose.)
Postscutellum without a tubercle .. .. .. *nitidulus* Ckll. and *leai* Ckll.
(*P. melanurus* Ckll., rather resembling a smallish black *Halictus,* has somewhat the aspect of *P. nitidulus,* but venation more as *P. incanescens,* with marginal cell much elongated.)

40. Flagellum light orange ferruginous beneath; very small species with very clear wings; the type has only two cubital cells, but another specimen has the usual three .. .. *abnormis* Ckll.
(Compare here *P. aurescens* Ckll. length about 11 mm.) and *P. aurifrons* Smith.)
Flagellum dark .. .. 41.

41. Flagellum strongly crenulated, like an ibex horn .. .. .. 42.
Flagellum ordinary .. .. 43.

42. Rather large species, with dusky wings .. .. *sexmaculatus* Ckll.
Very small species, with almost clear wings .. .. *ibex* Ckll.
(*P. atronitens* Ckll., if sought here, is of the larger size, with almost clear wings.)

43. Very small species .. .. 44.
Medium sized species .. .. 45.

44. Mandibles red; thorax with white hair above and below; apical tergites with broad reddish margins .. .. *minutus* Ckll.
Mandibles dark .. .. *pusillus* Ckll.
Mandibles red; flagellum dark, very short .. .. *tropicalis* Ckll.

45. Clypeus polished and shining; first recurrent nervure joining second cubital cell at or near middle .. .. 46.
Clypeus not polished, or wholly hidden by hair .. .. 47.

46. Wings strongly brownish; much long black hair on front, vertex, and thoracic dorsum .. .. *obscurus* Smith.
Wings clear; hair of thorax above white; clypeus with a low median ridge .. .. *incanescens* Ckll.
(Compare also *P. speculiferus* Ckll. and *P. perpolitus* Ckll.)

47. Sides of face with triangular patches of dense silvery white hair; first recurrent much before middle of second cubital cell. 48.
Sides of face without such patches .. .. 49.

48. Larger; anterior femora black above; tubercles tufted with fulvous hair .. .. *leai* Ckll.
Smaller; anterior femora light red above; tubercles fringed with white hair .. .. *nitidulus* Ckll.

49. Face and front densely covered with silver-white hair (W. Australia) .. .. *argentifrons* Smith.
Face and front not thus covered with white hair .. .. .. 50.

50. Sides of face with black hair, middle of face with long white hair (New Zealand) .. .. 51.

Sides of face without black hair, or if some blackish, face with ochraceous hair . . . . 52.

51. Middle of front shining . . . . *monticola* Ckll.
Middle of front dull . . . . *hudsoni* Ckll.

52. Face with white hair; vertex with long black hair; second cubital cell very broad below, receiving recurrent nervure in middle (W. Australia) . . . . *atronitens* Ckll.
Face with pale yellowish or fulvous hair . . . . 53.

53. Anterior tibiae pale ferruginous in front; face and front entirely covered with pale yellow hair . . . . *euphenax* Ckll. (according to Rayment, this is the male of *P. advena* Smith.)
Anterior tibiae not ferruginous in front . . . . 54.

54. Larger (anterior wing almost 9 mm.), wings brownish . . . . *nigrofulvus* Ckll.
Smaller; wings not brownish . . . . *thornleighensis* Ckll.
(Compare here *P. rudissimus* Ckll., with tubercle on postscutellum, and mesothorax and scutellum dull, with sculpture like *P. rudis* Ckll., and margins of tergites brown.)

55. Thorax black, but abdomen more or less metallic . . . . 56.
Thorax and abdomen metallic . . . . 76.
Thorax partly black, partly metallic; head metallic; abdomen green banded; postscutellum with a bidentate process . . . . *diodontus* Ckll. (*vigilans* Smith is allied.)

56. Stigma obsolete; large species; male . . . . *crassipes* Smith.
Stigma well developed . . . . 57.

57. Tegulae bright apricot colour; female . . . . *launcestonensis* Ckll.
Tegulae not thus coloured . . . . 58.

58. Males . . . . 59.
(cf. also *providus* Sm., about 7 mm. long.)
Females . . . . 66.

59. Hind tibiae and tarsi light ferruginous . . . . *providellus bacchalis* Ckll.
(This is very small; the much larger *P. castaneipes* has face covered with appressed silver white hair.)
Hind tibiae and tarsi black, or (*castaneipes*) deep chestnut red, or somewhat reddish . . . . 60.

60. Face covered with long black hair . . . . 61.
Face with light hair . . . . 62.

61. Head large, clypeus polished (Tasmania) . . *chalybeatus* (Erichson)
(My *chalybeatus* and *obscurus* males, both from Mt. Wellington, are certainly one species.)
Head small, clypeus dullish (New Zealand) . . . . *vestitus* Smith.

62. All the tibiae dark chestnut red; face covered with appressed silvery hair . . . . *castaneipes* Ckll.
(Compare here *P. helmsi* Ckll., face with long outstanding hair, and *P. semiviridis* Ckll.)
Tibiae not thus red . . . . 63.

63. Sides of face with triangular patches of silver-white tomentum (Australia) . . . . 64.
Sides of face without such patches (New Zealand) . . . . 65.

64. Postscutellum tuberculate; abdomen bluish . . . . . . *tuberculatus* Ckll.
Postscutellum not tuberculate; abdomen not bluish; rather larger species, face with long white hair, vertex with black hair. *leai* Ckll.

(These two species are very closely allied. They have the first recurrent nervure joining second cubital cell well toward base; hind margins of tergites reddish, with purplish tints.)

65. Abdomen greenish tinged; female antennae testaceous beneath .. .. *metallicus* Smith.
Abdomen black .. .. *boltoni* Ckll.

66. Large species, with brilliant golden-green abdomen, and red hair on thorax above .. .. *megachalceus* Ckll.
Smaller, quite different species .. .. 67.

67. Second cubital cell receiving recurrent nervure conspicuously before middle .. .. 68.
Second cubital cell receiving recurrent nervure at middle, or *Viridicinctus* var.) distinctly beyond .. .. 70.

68. Large robust species; wings strongly brownish; head and thorax above with much black hair; face very broad; clypeus well punctured; postscutellum with a spine (W. Australia) .. .. .. *subvigilans* Ckll.
(Similar, but with steel blue abdomen .. *phanerodontus* Ckll.)
Smaller, less robust species .. .. 69.

69. Postscutellum with a sharp tubercle .. .. *tuberculatus* Ckll.
Postscutellum without a tubercle; clypeus with a median ridge; mesothorax highly polished on disc (punctured and not thus polished in *tuberculatus*) .. .. *leai* Ckll.

70. Wings strongly brownish; head and thorax above with much black hair; abdomen hardly metallic .. .. *metallescens* Ckll.
Wings clear, or of slightly brown (*maorium*), abdomen very distinctly green .. .. 71.
(Compare here *P. providus* Smith, hair at apex of abdomen white at sides, instead of all black or dark sooty.)

71. Scutellum entirely covered with black hair (New Zealand) 72.
Scutellum with dark and light hair (Australia) .. .. .. 73.

72. Clypeus with a median ridge, and a sulcus on each side of it .. .. *maorium* Ckll.
Clypeus ordinary .. .. *boltoni* Ckll.

73. A well defined patch of whitish tomentum, angulate mesad, at sides of mesothorax in front of tegulae .. .. .. *humerosus cyanurus* Ckll.
No such patches of tomentum .. .. 74.

74. Abdomen dullish; sides of second tergite without visible punctures under a lens; stigma clear ferruginous; rather small species .. .. *viridicinctus* Ckll., variety.
(*P. amabilis* Smith is allied. *P. pavonellus* Ckll. also falls here, but has abdomen peacock green, hind tibiae and tarsi red, hind tibial scopa pale clear reddish; it is much smaller than *P. boroniae.*)
Abdomen more shining; sides of second tergite visibly punctured under a lens .. .. 75.

75. A tuft of dull fulvous hair in front of each tegula .. .. *hackeri* Ckll.
No such tufts; abdomen more polished, oily-appearing, not so strongly punctured .. .. *providus* Smith.
(*P. versicolor* Smith resembles *providus*; it has a narrower abdomen.)
(*P. chalybeatus* (Erichson) was considered by me to be *P. providus*, but it is not Erichson's species as understood by Smith. A specimen determined as *P. chalybeatus* does not appear to differ from *P. obscurus*. Erichson's description is unsatisfactory.)

76. Apex of abdomen with bright orange-ferruginous hair; abdomen brilliantly coloured; stigma well developed .. .. *turneri* Ckll. (compare also *elegans* Smith.)
Apex of abdomen without such hair .. .. 77.
77. Abdomen splendidly purple; small species; clypeus black, sides of face and front green .. .. *ornatissimus* Ckll.
Abdomen pale rosy purple, with golden tints; stigma light ferruginous .. .. *semipurpureus frenchi* Ckll.
Abdomen otherwise coloured .. .. 78.
78. Tarsi clear ferruginous .. .. 79.
Tarsi not thus red (type of male *bicolor* has hind legs partly red) .. .. 80.
79. Abdomen golden green (Mackay) .. .. *cupreus semipurpureus* Ckll., variety a. (1910).
Abdomen dark blue green (N.S.W.) .. .. *cupreus semipurpureus* Ckll.
(This species appears very variable, and is probably composite. The type of *semipurpureus* has the abdomen brilliant crimson-purple. See here also *P. amabilis* Smith, thorax above with short fulvous hair; abdomen green; legs partly red. *P. amabilis* var. *rufipes* Ckll., male, has the hind femora and all tibiae and tarsi red.)
80. Males .. .. 81.
Females .. .. 83.
81. Second cubital cell receiving recurrent nervure well before middle; small species with strongly punctured shining green mesothorax .. .. *caeruleotinctus* Ckll.
(Rather large species with rough blue mesothorax, and stout spine on postscutellum .. .. *dentiger* Ckll.)
Second cubital cell receiving recurrent nervure at or near middle; mesothorax darker and bluer .. .. 82.
82. Sides of face steel blue; tegulae black .. .. *carinatus* Smith.
Sides of face green; tegulae fulvous (Swan R.) .. .. *plumosus* Smith (*bicolor* Smith)
The difference in tegulae is more apparent in the females. In Trans. Amer. Ent. Soc., 1910, I had:
Abdomen broader, shining steel blue .. .. *plumosus* Smith.
Abdomen narrower, duller, dark purple .. .. .. *bicolor* Smith, var. a.
P. bicolor var. a. is separated from *P. plumosellus* Ckll. by the abundant black hair on vertex, scutellum and hind part of mesothorax. *P. plumosellus* has the legs very dark reddish; hair of head and thorax abundant, dull white, with a little yellowish tint, on scutellum greyish; antennae wholly dark; abdomen with strong purple lustre, hind margins of tergites dark reddish.
P. melbournensis Ckll. (male from Ararat, V.) is very like *plumosus*, but hair of head and thorax strongly fulvous tinted, black on vertex and disc of thorax; face (including clypeus) green; abdomen green.
83. Abdomen olive green or golden green .. .. 84.
Abdomen dark or steel blue, or (*carinatus*) blue green .. 87.
84. Hair of mesothorax fulvous; smallish species .. .. 85.
Hair of mesothorax at least largely dark or black .. .. 86.
85. Scutellum black; abdomen golden green .. .. *mimulus* Ckll.
Scutellum green .. .. .. *melbournensis* Ckll., var. (or ? *mimulus* var.)
86. Smaller; hair of mesothorax partly fulvous; wings paler .. .. *melbournensis* Ckll.

Larger; hair of mesothorax black; wings darker .. *sexmaculatus* Ckll.
87. Postscutellum with a conspicuous dentiform or spiniform tubercle .. .. 88.
(*P. vigilans* Smith has a bidentate process.)
Postscutellum without such a tubercle .. .. 89.
88. Larger; clypeus little metallic, extremely rough; a conspicuous band of white hair between scutellum and mesothorax .. *dentiger* Ckll.
(A little metallic colour on thorax; distinguished from *dentiger* by the smooth polished abdomen .. .. .. *phanerodontus* Ckll.)
Smaller; clypeus strongly metallic; abdomen very brilliant .. .. *megadontus* Ckll.
89. Head and thorax green, abdomen purple; basal nervure joins nervulus; stigma narrow and lanceolate .. .. *plumosus* Sm. (*bicolor* Sm.).
Abdomen shining dark green; metathorax transversely carinate .. .. *carinatus* Smith.

The following table is based on specimens in the Australian Museum:—

Abdomen banded, red and black .. .. 1.
Abdomen otherwise .. .. 2.
1. Very small; only two cubital cells .. .. .. *Andrenopsis velutinus* Ckll.
Three cubital cells; face with orange hair .. .. *P. rufibasis* Ckll.
2. Fifth tergite densely covered with bright light red hair; thorax dorsally with short black hair .. .. *callurus nigrion* Ckll.
End of abdomen otherwise .. .. 3.
3. Face densely covered with orange or fulvous hair .. .. .. 4.
Face not so covered .. .. 5.
4. Scape swollen, clear red .. .. *chrysostomus* Ckll.
Scape red, not swollen; all tibiae red .. .. .. *marginatus* Smith, male.
Scape black, flagellum red beneath .. .. *velutinus* Ckll.
5. Abdomen metallic .. .. 6.
(With a dense patch of yellowish hair at each side of scutellum .. .. *bicristatus* Ckll.)
Abdomen not metallic .. .. 14.
6. Wings dilute fuliginous except at base; second cubital cell receiving recurrent nervure before middle; thorax very slightly metallic; postscutellum with a bidentate process; scopa of hind tibiae black behind and pure white in front .. .. *diodontus* Ckll.
(Abdomen faintly green, see *opaculus* Ckll.)
Wings not thus fuliginous, or if moderately so, first recurrent nervure joins second cubital cell much nearer base .. .. 7.
7. Thorax metallic .. .. 8.
(Robust, with clear red tegulae; abdomen little metallic .. .. *nigroclypeatus hardyi* Ckll.)
Thorax black .. .. 10.
8. Postscutellum with a long spine .. .. *dentiger* Ckll.
Postscutellum without a spine .. .. 9.
9. Robust, with coarse black hair on thorax above .. .. *carinatus* Smith.
At least some light hair on thorax above .. .. *plumosus* Smith.
10. Abdomen yellowish green, dorsally with long hair, hind margins of tergites pallid .. .. *megachalceus* Ckll.
Abdomen not thus hairy .. .. 11.
11. Male; hind basitarsi long, red .. .. *helmsi* Ckll.
Females .. .. 12.

12. Hind tibiae clear red .. .. *pavonellus* Ckll.
Hind tibiae black .. .. 13.
13. Larger (about 14.5 mm.); second tergite polished and hardly punctured at sides .. .. *phanerodontus* Ckll.
Smaller; second tergite finely and closely punctured at sides .. .. *chalybeatus* Erichson.
14. Female; very small; hind tibial scopa loose, all white; second cubital cell small and narrow .. .. *nicholsoni* Ckll.
Larger, or else males .. .. 15.
15. Males with ibex-like antennae .. .. *ibex* Ckll.
Otherwise .. .. 16.
16. Very small male; anterior legs partly red .. .. *pusillus* Ckll.
Not so small; if smallish male, anterior legs black .. .. .. 17.
17. Large hairy male, with hind margins of tergites broadly pallid; antennae very long; anterior legs largely red .. .. .. *rebellis* Ckll.
Otherwise .. .. 18.
18. Male; abdomen dull; postscutellum tuberculate .. .. *rudissimus* Ckll.
Females .. .. 19.
19. Very shiny species, with more or less fulvous hair on thorax .. *leai* Ckll.
Otherwise .. .. 20.
20. Abdomen with narrow white tegumentary bands; eyes not hairy .. .. *marginata lucida* Ckll.
Abdomen without such bands .. .. 21.
21. Abdomen highly polished, with rather broad white hair-bands on tergites 2 to 4, interrupted on 2 and 3 .. .. *albovittatus* Ckll.
Abdomen with narrow white hair-bands .. .. 22.
Abdomen without hair-bands .. .. 23.
(Abdomen with bases of tergites very broadly white-pruinose, apices broadly black; hair of head and thorax black and white .. .. *microdontus* Ckll.)
22. Larger and more robust; second cubital cell hardly narrowed above; wings brownish .. .. *robustus* Ckll.
Smaller and less robust; second cubital cell strongly narrowed above .. .. *advena* Sm.
23. Clypeus dull, very densely punctured; abdomen slightly greenish; postscutellum with a short tooth .. .. *opaculus* Ckll.
Clypeus shining .. .. 24.
24. Clypeus polished, with a median raised line .. .. .. *carinatifrons* Ckll.
Clypeus with no such line .. .. 25.
25. Wings brownish; second cubital cell broad at base, greatly contracted above (Lord Howe Island) .. .. *philonesus* Ckll.
Second cubital cell narrow, moderately contracted; middle basitarsus broadened (King George's Sound) .. .. *metallescens* Ckll., variety.
Second cubital cell broad, hardly contracted; sides of abdomen beneath with pure white hair; tibial scopa strongly contrasting, black and white .. .. *metallescens* Ckll.

The following table is based on specimens in the American Museum of Natural History, received from Dr. H. Friese:

Abdomen red; male .. .. *rufoaeneus* Friese.
Abdomen not red .. .. 1.
1. Thorax metallic .. .. 2.
Thorax black .. .. 7.

2. Mesothorax and scutellum with very bright red hair; thorax dark bluish green; female .. .. *friesei* Ckll.
Mesothorax and scutellum without such red hair, or if quite red, abdomen yellowish green .. .. 3.
3. Abdomen with golden and rosy tints; female .. *semipurpureus* Ckll.
Abdomen with strong purple tints .. .. 4.
Abdomen green .. .. 5.
4. Male; flagellum red beneath .. .. *festivus* Ckll.
Females .. .. *plumosus* Smith.
5. Larger, about 10 mm. long, with red hair on thorax above. *mimulus* Ckll.
Smaller, or hair of thorax above not distinctly red .. .. .. 6.
6. Female; scutellum green .. .. *melbournensis* Ckll.
Male (Ararat, V.) .. .. *melbournensis* Ckll.
7. Eyes hairy; legs red; male .. .. *Trichocolletes venustus* Smith.
Eyes hairy; legs black; female .. .. *thornleighensis* Ckll.
Eyes not hairy .. .. 8.
8. Stigma obsolete .. .. 9.
Stigma well developed .. .. 11.
9. Abdomen with narrow whitish bands (Sydney, N.S.W.) .. .. *marginatus* Smith.
Abdomen with hind margins of tergites broadly dark reddish .. .. 10.
10. Female (Adelaide) .. .. *crassipes* Smith.
Males (Sydney and Melbourne) .. .. *crassipes* Smith.
11. Legs greatly modified; hind basitarsi with a prominent angle; head and thorax covered with long bright fulvous hair; male .. .. *Goniocolletes morsus* Ckll.
Legs ordinary .. .. 12.
12. Head and thorax with long fulvous hair; hind margins of tergites red; female (Waikana Bay) .. .. *fulvescens* Smith.
Head and thorax not thus fulvous haired .. .. 13.
13. Mesothorax very densely and coarsely punctured; area of metathorax triangular, highly polished; wings dilute brown .. *ventralis* Friese.
Mesothorax not thus strongly and coarsely punctured .. 14.
14. Small, not over 9 mm. long .. .. 15.
much larger .. .. 17.
15. Female; femora dark; mesothorax closely punctured . *perminutus* Ckll.
Males; femora red .. .. 16.
16. Smaller; abdomen purplish, hardly punctured .. .. *providellus caerulescens* Ckll.
Larger; abdomen not purplish, distinctly punctured .. .. *punctiventris* Friese.
17. Scopa of hind tibiae large, light fulvous on outer side; female ("New Holland") .. .. *maorium* Ckll.
Scopa not thus fulvous .. .. 18.
18. Smaller, anterior wing 6.7 mm.; abdomen shining blue-green; female .. .. *versicolor* Smith.
Considerably larger .. .. 19.
19. Mesothorax dullish, closely punctured, posterior disc shining .. .. *chalybeatus* Erichson.
Mesothorax polished, shining .. .. *franki* Ckll.

Paracolletes abdominalis Smith.

Champion Bay, W.A. Abdomen red; first recurrent nervure joins second cubital cell slightly before its middle; basal nervure meeting nervulus on outer side. Type in British Museum. Among the species which Smith placed in *Paracolletes,* the second recurrent nervure joins third cubital cell very near its end in *crassipes, abdominalis* and *fervidus;* far beyond middle, but some distance from end in *marginatus;* a little beyond middle in *nitidus.*

Paracolletes abnormis Cockerell.

Alexandria, N. Austr. (W. Stalker). Type in British Museum. Male about 6 mm. long; black, with dull white hair, the face and front densely covered with long shining white hair; flagellum pale ferruginous beneath; abdomen without hair-bands. Some specimens have only two cubital cells.

Paracolletes advena (Smith).

Described as *Andrena advena.* Scutellum with black plumosa hair; tergites 2 to 4 with narrow silvery marginal hair-bands; face very broad; stigma subobsolete. The nest is described by Rayment, Jour. Roy. Soc. W. Australia, xvii., p. 161.

Paracolletes albopilosus Rayment.

Perth, W.A. (T. Greaves). Male about 10 mm. long; black, with white hair; thin bands of white hair on bases of tergites 1 to 3; caudal tuft black. Allied to *P. punctatus, P. incanescens, P. cinereus* and *P. argentifrons.* (Journ. Roy. Soc. W.A., xvi., p. 50.)

Paracolletes albovittatus Cockerell.

Eradu, W.A. (Nicholson). Type in Australian Museum. Female about 9 mm. long; differs from *P. subviridis* by abdomen not at all greenish, and the hair-bands are much wider than in *P. subviridis* or *P. advena.*

Paracolletes amabilis (Smith).

Queensland. Female with hind tibiae and middle and hind tarsi red (hind tibiae not red in male); clypeus and supraclypeal area black, rest of face and front green. I have considered *Lamprocolletes metallicus* Smith to be the male of *P. amabilis.* This species is much smaller than *P. cupreus* Smith.

Paracolletes amabilis rufipes Cockerell.

Berowra, N.S.W. (T. G. Campbell). Male less than 8 mm. long; head dark blue green, but middle of front yellowish green, clypeus black; antennae entirely black; anterior and middle knees, hind femora, and all the tibiae and tarsi deep chestnut red.

Paracolletes andreniformis Cockerell.

Yallingup. W.A. (Turner). Type in British Museum. Female about 13 mm. long; robust, black, with black and white hair; thorax with white hair in front and behind, at sides and beneath, but mesothorax (except anteriorly) and scutellum with thin black hair; tergites 2 to 4 with interrupted white hair bands.

Paracolletes antennatus (Smith).

Swan River, W.A. Type in British Museum. Male flagellum orange, largely blackened above, last joint all black, shaped like an incisor tooth, with one surface shining; depressed margins of tergites hyaline. Specimens

have been taken on Swan River in recent years by Newman and Glauert, as recorded by Rayment.

Paracolletes apicalis Cockerell.

Swan River, W.A. (J. S. Clark). Female about 8 mm. long, slender for a female; head, thorax, legs and antennae black; abdomen largely chestnut red; apical plate very broad, red in middle.

Paracolletes argentifrons (Smith).

Swan River, W.A. Larger than *P. nanus,* face covered with white hair, dorsum of thorax with black hair; first recurrent nervure joining second cubital cell not far from base.

Paracolletes atronitens Cockerell.

Yallingup, W.A. (R. Turner). Type in British Museum. Male about 10 mm. long; allied to *P. chalybeatus* and *P. obscurus.* Area of metathorax with a basal depressed transversely striated band, limited by a transverse ridge. No hair-bands on abdomen.

Paracolletes aurescens Cockerell.

Bribie Is., Q. (Hacker). Male about 11 mm. long; allied to *P. colletellus,* but much longer. The long flagellum (which is not moniliform) is light fulvo-ferruginous beneath.

Paracolletes aurifrons (Smith).

Adelaide, S.A. Type in British Museum. Abdomen hairy, the margins of the tergites not obviously pallid; first recurrent nervure joining second cubital cell far before the middle.

Paracolletes bicolor (Smith).

Swan River, W.A. Head and thorax green; abdomen deep blue; hind legs partly red. A variety is described in Trans. Amer. Ent. Soc., xxxvi., p. 201. It has the vertex and mesothorax strongly green; legs almost without red. See also Ann. Mag. N. Hist., July, 1914, p. 47, concerning the variation of this species.

Paracolletes bicristatus Cockerell.

Tooloom, N.S.W. (Hacker). Type in Queensland Museum. Female about 8 mm. long. Known by the bands of pale fulvous or whitish hair on each side of scutellum. Wings hyaline; stigma large, dark reddish.

Paracolletes bimaculatus (Smith).

W. Australia, the type from Swan River. Abdomen chestnut red, with a large round black spot on each side of second tergite. For additional details, see Rayment, Journ. Roy. Soc. W. Austr., xvii., p. 160, and Cockerell, Ann. Mag. Nat. Hist., November, 1905, p. 478, and July, 1914, p. 47.

Paracolletes boroniae Cockerell.

Birkdale, near Brisbane (Hacker). Visits flowers of *Boronia.* Female about 11 mm. long; resembles *P. viridicinctus,* but the abdomen is quite a different shade of green, a quite brilliant peacock green, with a rather satiny gloss.

Paracolletes brevicornis (Smith).

Moreton Bay, Q. Type in British Museum. Described as a *Tetralonia,* but it is very close to *P. rebellis* Ckll. Male with red hair on face; knees, tibiae and tarsi red; flagellum crenulate. See Ann. Mag. Nat. Hist., August, 1926, pp. 215, 219.

Paracolletes caeruleotinctus Cockerell.

Mackay, Q. (Turner). Type in British Museum.

Also at Kuranda and Brisbane. Male about 9 mm. long; known by the narrow, brilliantly coloured (blue green, with purple tints) and strongly punctured abdomen. A variety is described in Trans. Amer. Ent. Soc., xxxvi., p. 204. It was taken at Kuranda.

Paracolletes callander Cockerell.

Yallingup, W.A. (Turner). Type in British Museum.

Also at Perth. Female about 16 mm. long; male about 13.5 mm. Allied to *P. nigrocinctus*, but distinguished by the large size and bright colours. The sexes look very different.

Paracolletes callurus Cockerell.

Yallingup, W.A. (Turner). Type in British Museum. Female 10 mm. long. Distinguished from *P. turneri* and *P. elegans* by the black abdomen. Last two tergites densely covered with bright ferruginous hair.

Paracolletes callurus nigrior Cockerell.

King George's Sound, W.A. (Masters). Female broader; anterior part of thorax above without a white collar or band; wings less dusky; anterior tibiae deep chestnut red; end of abdomen with bright red hair. Type in Australian Museum.

Paracolletes carinatifrons Cockerell.

Sydney, N.S.W. (C. Gibbons). Type in Australian Museum. Close to *P. perpolitus*, but differs in wings. Female, length about 10.4 mm.; black, with the depressed hind margins of tergites lively rufous, and last antennal joint bright ferruginous below.

Paracolletes carinatulus Cockerell.

Mackay, Q. (Turner). Type in British Museum. Male about 8 mm. long.

Also in N.S.W. Variation, see Psyche, 1930, p. 151. Head, thorax and abdomen olive green, or thorax blue-green. Area of metathorax with a sharp transverse keel.

Paracolletes carinatus (Smith).

Described from "New Holland," but known from Queensland to Tasmania. For the characters, see the key. Specimens are in the Australian Museum.

Paracolletes castaneipes Cockerell.

Yallingup, W.A. (Turner). Type in British Museum. Male about 10 mm. long; black, with the tibiae and tarsi deep chestnut red; wings dusky; abdomen without hair-bands. Apparently related to *P. rudis*, but not its male, as the sculpture of the mesothorax is quite different.

Paracolletes chalceus Friese.

Sydney, N.S.W. Female 13-14 mm. long; black, with black-brown hair; head broader than long; area of metathorax smooth and shining; first two tergites strongly shining; tibial scopa black; wings yellowish. Said to resemble in appearance the European *Panurgus banksianus* Kirby.

Paracolletes chalcurus Cockerell.

Cunderlin, W.A. (R. Illidge). Female a little over 12 mm. long; head and thorax green, abdomen brassy yellow and crimson. Possibly the female of *P. roseoviridis*, described from a male about 8 mm. long.

Paracolletes chalybeatus (Erichson).

Described as an *Andrena*. It is at least very near to *P. providus*, and appears to me identical. Tasmania. See Mem. Queensland Museum, ix., 1929, p. 311; Rec. Austral. Museum, xvii., p. 206. This is the type of *Lamprocolletes*, distinguished from typical *Paracolletes* by the well developed stigma.

Paracolletes chrysostomus Cockerell.

Eradu, W.A. (Nicholson). Type in Australian Museum. One of the forms which could as well be placed in *Anthoglossa*. Male about 12 mm. long; scape greatly swollen and light ferruginous. For a full description, and discussion of the *Anthoglossa-Paracolletes* problem, see Records Australian Museum, xvii. (1929), p. 202.

Paracolletes cinereus (Smith).

South Australia. In my 1905 table it falls next to *P. obscurus*, being separated by the distance from first recurrent nervure to second intercubitus, little more than distance from second recurrent to end of third cubital cell; legs dark red.

Paracolletes clypeatus Cockerell.

Yallingup, W.A. (Turner). Type in British Museum. Male about 10 mm. long, female 11 mm. Both sexes with clypeus and supraclypeal area exposed, nearly bare, flattened, longitudinally striate, and with a median keel. Hind tibiae of female with a very large, entirely black, scopa.

Paracolletes colletellus Cockerell.

Adelaide River, N.T. (J. J. Walker). Type in British Museum. Male 8 mm. long; black, very pubescent, the face densely covered with light yellow hair; wings hyaline, stigma and nervures ferruginous; first recurrent nervure joining second cubital cell at its extreme base. Looks like a small *Colletes*.

Paracolletes convictus (Cockerell).

Described as *Tetralonia*. Type in British Museum. Male antennae much longer than in *P. brevicornis*; flagellum strongly crenulated, ferruginous beneath; scutellum with a median depression, but no distinct bosses (bigibbose, with a pair of bosses, in *P. brevicornis*). The only locality given is Australia.

Paracolletes crassipes Smith.

Swan River. The type of *Paracolletes*.

P. australis Friese, is a synonym. Smith described the female; the male (taken by Froggatt in New South Wales) is described in Ann. Mag. Nat. Hist., April, 1912, p. 378. It has a thick flagellum, strongly crenulated beneath; tibiae and tarsi ferruginous.

Paracolletes crassipes leptospermi Cockerell.

Mackay, Q. (Turner). Type in British Museum. Male about 12 mm. long; smaller than true *crassipes*, with light hair on posterior edge of hind tibiae (fuscous in *crassipes*). The first tergite is back, with the hind margin broadly pale reddish; the others are dark greenish, with the hind margins broadly ferruginous.

Paracolletes cristatus (Smith).

"New Holland," in the W. W. Saunders collection. Type in the Hope Museum at Oxford. Scutellum and postscutellum with long bright red hair; area of metathorax with a median transverse ridge, below which are transverse striae.

Paracolletes cupreus (Smith).

Adelaide, S.A. Type in British Museum. Head and thorax green; abdomen with strong crimson tints; hind tibiae and middle and hind tarsi red; flagellum ferruginous beneath.

Paracolletes cyaneorufus Cockerell.

Bribie Is., Q. (Hacker). Female about 7.5 mm. long; close to *P. rufoaeneus,* but considerably smaller. *Paracolletes* of this group show a certain relationship with *Euryglossidia.*

Paracolletes dentatus (Rayment).

Moora, W.A. (L. J. Newman). Female about 14 mm. long; head blue, with black clypeus; mesothorax black, blue anteriorly; scutellum blue; postscutellum with a long dentate concave process; abdomen dorsally iridescent shining green, with coppery and blue tints. Type of *Nodocolletes* Rayment.

Paracolletes dentiger Cockerell.

W.A. (Preiss). Type in Berlin Museum. Taken by Turner at Yallingup. Female about 12 mm. long; deep purplish-blue, strongly punctured, the pubescence black and white; postscutellum with a stout spine. The male is described in Ann. Mag. Nat. Hist., July, 1914, p. 41.

Paracolletes diodontus Cockerell.

Eradu, W.A. (Nicholson). Type in Australian Museum. Female about 13 mm. long; related to *P. vigilans,* but separated by the metallic head, green-banded instead of green abdomen, flagellum not fulvous beneath, and darker wings. Postscutellum with a very large median bidentate process.

Paracolletes elegans (Smith).

Adelaide, S.A. Head, thorax and abdomen dark blue; apical tuft of abdomen bright orange-fulvous; area of metathorax shining.

Paracolletes erythrurus Cockerell.

Yallingup, W.A. (Turner). Type in British Museum. Female about 12 mm. long; head and thorax black, abdomen bright but not shining ferruginous; wings unusually short, strongly dusky. Male with labrum, mandibles (except apical margin) and clypeus cream colour; face covered with bright golden-fulvous hair. Allied to *P. bimaculatus,* and superficially like *P. fimbriatinus.*

Paracolletes eucalypti Cockerell.

Mt. Yule, Healsville, V. (R. Kelly). Type in British Museum. Male about 10 mm. long.

Also at Beaconsfield, V. (F. E. Wilson). Female; see Mem. Queensland Museum, ix. (1929), p. 308. A metallic species, resembling *P. castaneipes* as to the legs, but the male has much smaller eyes and broader face. Also related to *P. subviridis,* but abdomen differently coloured.

Paracolletes eugeniarum Cockerell.

Mackay, Q. (Turner). Type in British Museum. Female about 11 mm. long; unusually narrow; black, with the hind margins of the tergites depressed, broadly whitish hyaline, the part just before the depression reddened; flagellum red beneath. Hind spur of hind tibiae with long, strong teeth, very different from the numerous slender spines of *P. platycephalus.*

Paracolletes euphenax Cockerell.

Brisbane, Q. (Hacker). Superficially resembles *P. incanescens.*

Goes south to Sandringham, V. Rayment states that this is the male of *P. advena* Sm.; he has taken the sexes mating. (Journ. Roy. Soc. W. Aust., xvil., p. 161). In my original description I referred to this as a possibility.

Paracolletes facialis Cockerell.

Coolangatta, Q. (A. J. Turner). Male nearly 9 mm. long; resembles *P. nitidulus* and *P. regalis.* The abdomen is very dark purplish. Goes south to Sandringham, V.

Paracolletes fallax Cockerell.

Bribie Is., Q. (Hacker). Female about 9 mm. long; black, punctured, looking like an *Halictus,* and with the basal nervure strongly arched. Related to *P. punctatus,* but wings strongly dusky, nervures and stigma piceous; marginal cell obliquely truncate at end.

Paracolletes ferricornis Cockerell.

Hermannsburg, Cent. Aust. (H. J. Hillier). Type in British Museum. Male a little over 11 mm. In the colour of the antennae, etc., it is curiously parallel with *P. fimbriatinus hillieri,* from the same locality. Flagellum long, entirely very bright ferruginous.

Paracolletes fervidus Smith.

"New Holland." Pubescence fulvous; flagellum fulvous beneath (according to Smith; the specimen marked type at British Museum has dark antennae); abdomen slightly metallic.

Paracolletes fervidus subdolus Cockerell.

Cheltenham, V. (French). Female a little over 12 mm. long. Perhaps a distinct species; for a discussion of the characters of this and *P. fervidus* see Ann. Mag. Nat. Hist., March, 1913, p. 279. There is much fuscous hair on thorax above in *subdolus.*

Paracolletes festivus Cockerell.

Sydney, N.S.W. (Frank). Type in Amer. Mus. Nat. History. Male, near *P. plumosus.* Amer. Mus. Novitates, 343 (1929). Flagellum ferruginous beneath; legs chestnut red; abdomen splendid purple-blue, margins of tergites reddened.

Paracolletes fimbriatinus Cockerell.

Victoria (C. French). Type male in British Museum.

The female was taken at Stanthorpe, Q.; Mem. Queensland Mus., ix. (1929), p. 306. The thorax has rich fulvous hair above; the clypeus is very coarsely rugose. (In the somewhat related *P. gallipes* the clypeus has a median keel, wanting in *P. fimbriatinus.*)

Paracolletes fimbriatinus hillieri Cockerell.

Hermannsburg, Cent. Austr. (H. J. Hillier). Type in British Museum. Male about 8 mm. long; hair of head and thorax cream colour; flagellum bright ferruginous above and beneath; abdomen more shining, the hair on apical margins of tergites wholly pale.

Paracolletes fimbriatus (Smith).

Australia, as labelled in British Museum; Smith gives no locality. Abdomen red, like that of *P. rubellus;* a dense black apical tuft; area of metathorax with a strong transverse keel.

Paracolletes flavomaculatus Cockerell.

Type in British Museum, from "Australia," but known from several localities in Queensland. Dodd and Wheeler took it at Kuranda. The female (slightly over 10 mm. long) is described in Trans. Amer. Ent. Soc., xxxvi., p. 201. The male is about 9 mm. long; scutellum with yellow hair.

Paracolletes franki Cockerell.

Adelaide, S.A. (Frank). Type in American Museum of Nat. History. Female about 12 mm. long. Amer. Mus. Novitates, 343 (1929). Black, robust; flagellum red beneath except at base; mesothorax polished; wings brownish hyaline.

Paracolletes frederici Cockerell.

W. Australia. Male abdomen red, very hairy at base, and with thin white hair-bands; no spots on sides of second tergite; legs entirely red, front femora with very long hair beneath; antennae red, flagellum blackish above; face covered with long light fulvous hair. This is *Lamprocolletes rubellus* Smith, not *Dasycolletes rubellus* Smith.

Paracolletes friesei Cockerell.

King George's Sound, W.A. Type in Queensland Museum. Female about 11 mm. long. This is *P. fervidus* Friese, and is known especially by the bright red thoracic hair. (Mem. Queensland Museum, ix., p. 306.)

Paracolletes frontalis (Smith).

"New Holland." Black, the abdomen submetallic. Male with bright ferruginous mandibles and face densely covered with silvery white hair. Tibial scopa of female white, "having a beautiful golden reflection above." There are specimens in the British Museum marked "probably *frontalis*," but they seem not to be that species.

Paracolletes fulvus (Smith).

Queensland. The female falls in a little group with *P. ruficornis* and *P. waterhousei*, the abdomen having abundant fulvous hair; but it is larger than these, with red legs, and plumose scopa on hind tibia blackish.

Paracolletes gallipes Cockerell.

Poonarunna, S.A. Female about 11 mm. long; rather slender, black and clear ferruginous red. Known by the pointed wings and unusual venation, marginal cell subtruncate at apex; second cubital cell nearly square, receiving first recurrent nervure very near base. Legs clear ferruginous.

Paracolletes hackeri Cockerell.

Brisbane, Q. (Hacker). Female 10 mm. long; head, thorax and legs black, first three tergites dark blue. South to Sydney; see Psyche, 1930, p. 150. Allied to *P. providus*.

Paracolletes halictiformis Cockerell.

Yailingup, W.A. (Turner). Type in British Museum. Female about 8 mm. long, black. Probably the female of *P. minutus* Ckll. It looks like an *Halictus*. Smaller than *P. sigillatus*, with much more closely punctured mesothorax.

Paracolletes helichrysi Cockerell.

Mt. Tambourine, Q. (Hacker). Female 7 mm. long; robust, black, the hind margins of tergites broadly fusco-testaceous; tegulae black; wings

hyaline, faintly dusky at apex. Rather like *P. halictiformis* and *P. sigillatus*, but quite distinct. (Mem. Queensland Museum, vi., 1918, p. 112.)

Paracolletes helmsi Cockerell.

Kosciusko, N.S.W., 5,000 ft. (R. Helms). Type in Australian Museum. Male about 12 mm. long, slender, head and thorax black, abdomen blue-green. Something like a large edition of *P. chalybeatus*, with much dark hair on head and thorax.

Paracolletes hobartensis Cockerell.

Hobart, Tasmania (J. J. Walker). Type in British Museum. Female 12 mm. long; black, with black and greyish-white hair; abdomen wholly without hair-bands. Tegulae black.

Paracolletes humerosus (Smith).

Melbourne, V. A large patch of short moss-like ochraceous hair on each side of mesothorax.

Paracolletes humerosus cyanurus Cockerell.

Oakley, V. (French). Female a little over 9 mm. long; patches of hair on mesothorax white, with a faint creamy tint, but hair of thoracic dorsum otherwise black; abdomen shining, distinctly purplish.

Paracolletes ibex Cockerell.

Windsor, V. (French). Male 8 mm. long; slender, black; flagellum suggesting the horns of an ibex. The legs are black.

Paracolletes incanescens Cockerell.

Stradbroke Is., Q. (Hacker). Female about 11 mm. long; black, head and thorax very hairy. Male 9 mm., face with thin, white hair, flagellum entirely black, moniliform. Related to *P. punctatus* and *P. obscurus*. The male resembles *P. thornleighensis*.

Paracolletes incomptus Cockerell.

Mundaring, W.A. (R. Illidge). Female about 9 mm. long; near to *P. plebeius*, but separated by the dark flagellum, area of metathorax shining (dull in *plebeius*); and from *P. recusus* by the brownish wings, and scutellum with no median sulcus.

Paracolletes irroratus (Smith).

Victoria. There is a large patch of short moss-like bright red or yellow hair on each side of mesothorax. *P. humerosus* Smith is the same species. See Ann. Mag. Nat. Hist., June, 1926, p. 661. The male is more slender; face densely covered with silky brownish-white hair; antennae long, entirely dark. The type of *P. irroratus* is in the Hope Museum at Oxford.

Paracolletes launcestonensis Cockerell.

Launceston, T. (Littler). Female about 8 mm. long; head, thorax and legs black, the small joints of tarsi reddish; abdomen very dark greenish, with hind margins of first two tergites appearing narrowly ferruginous; flagellum wholly dark; tegulae bright apricot colour; wings fuliginous, stigma large and black.

Paracolletes leai Cockerell.

Ulverstone, T. (Arthur M. Lea). Female about 12 mm. long; slender, black, the abdomen obscurely metallic, the fifth tergite entirely greenish; wings hyaline. Also King Island. Differs from *P. versicolor* by the ridged clypeus, and very dark smooth (not silky) abdomen.

Paracolletes latifrons Cockerell.

Coolangatta, Q. Female about 11.5 mm. long; black, robust, very broad, with rather thin dull white hair; vertex with long black hair; posterior middle of mesothorax, and disc of scutellum, with short black hair. Probably nearest to *P. advena*, which has a narrower abdomen with more distinct hair-bands.

Paracolletes maculatus Rayment.

Sandringham, V. (Rayment). Female about 10 mm. long, male 9 mm. Allied to *P. platycephalus*, *P. rufoaeneus* and *P. bimaculatus*. Rayment gives a plate of structural details (Proc. Roy. Soc. Victoria, xliii., p. 49).

Paracolletes maorium Cockerell.

Described from New Zealand, and probably not Australian, but a specimen seen labelled "New Holland."

Paracolletes marginatus Smith.

Queensland to Tasmania. It will be recognised by the characters given in the key. In Rec. Australian Museum, xvii., p. 202, its generic position is discussed, and it is concluded that it cannot be separated generically from *Anthoglossa sericea* Smith. Concerning its relation to *Trichocolletes venustus*, see Ann. Mag. Nat. Hist., March, 1913, p. 274.

Paracolletes marginatus lucidus Cockerell.

Geraldton, W.A. (Nicholson). Type in Australian Museum. Female with caudal tuft fulvous, the abdominal bands white; the clypeus highly polished, with a few scattered punctures, its apical margin reddish.

Paracolletes maximus Cockerell.

Victoria (Hill). Type in American Museum of Natural History. Male about 17 mm. long; black, robust; thorax above with bright red moss-like hair. It is one of the species which might as well be placed in *Anthoglossa*, as that genus is now understood. (Amer. Mus. Novitates, 346, p. 9.).

Paracolletes megachalceus Cockerell.

Clarence River, N.S.W. (Wilson). Female about 14 mm. long; robust; head and thorax black, densely hairy, abdomen brassy green, hind margin of second and following tergites broadly pale reddish; postscutellum with a median tubercle. Related to *P. dentiger*. There is a prominent tubercle on the supraclypeal area. The Australian Museum has it from Raymond Terrace, near Newcastle, N.S.W.

Paracolletes megadontus Cockerell.

Caloundra, Q. (Hacker). Female 10 mm. long; close to *P. dentiger*, but smaller; area of metathorax smooth and shining, without transverse striae; hind legs not metallic; abdomen shining and finely punctured. Also on Stradbroke and Bribie Islands.

Paracolletes melanurus Cockerell.

Tooloom, N.S.W. (Hacker). Female about 6.8 mm. long; rather like *P. nitidulus*, but venation quite different. Marginal cell very long, with narrow end; second cubital cell small, narrowed above, receiving first recurrent nervure a little beyond middle; first cubital cell longer than the other two together; stigma large. Face very broad.

Paracolletes melbournensis Cockerell.

Melbourne, V. Type in Berlin Museum. Female about 11 mm. long; olive-green, the clypeus and supraclypeal area strongly punctured, black,

with crimson and golden tints at sides and in vicinity of the suture between them. Known from *P. mimulus* by scopa of hind tibia with a dark fuscous band extending its whole length; vertex with dark hair.

Paracolletes melbournensis clarki Cockerell.

Perth, W.A. (J. Clark). Type in Queensland Museum. Female about 11 mm. long; clypeus highly polished; thorax above with rather pale grey hair; black on disc of mesothorax and scutellum. See also Rayment, Journ. Roy. Soc. W. Australia, xvii., p. 160.

Paracolletes metallescens Cockerell.

Yallingup, W.A. (Turner). Type in British Museum. Female about 11 mm. long, male 9 mm. Differs from *P. versicolor* by the darker abdomen, with pure white instead of yellow hair beneath. *P. providus* has the abdomen bluer and more shining. The male *P. metallescens* has the flagellum strongly crenulated beneath, recalling *P. ibex.*

Paracolletes microdontus Cockerell.

Perth, W.A. (J. Clark). Type in Queensland Museum. Female about 10 mm. long. Black, with no metallic tints; clypeus moderately convex, shining, with strong but not very dense punctures, the disc somewhat flattened; postscutellum with a small but distinct tubercle. (Mem. Queensland Museum, ix., 1929, p. 309.).

Paracolletes mimulus Cockerell.

Victoria (C. French). Type in British Museum. Female about 10 mm. long, very near to *P. melbournensis,* but smaller and less robust, with tibial scopa of hind legs white in front, yellowish behind; stigma and nervures clearer ferruginous; abdomen with golden tints.

Paracolletes minutus Cockerell.

Yallingup, W.A. (Turner). Type in British Museum. Male a little over 6 mm. long; known from *P. punctatus* by the closely punctured thorax, colour of antennae (flagellum obscure brown beneath) and fuscous nervures.

Paracolletes moniliformis Cockerell.

Yallingup, W.A. (Turner). Type in British Museum. Male 9 mm. long; closely allied to *P. ibex,* with similar flagellum, but larger, with brownish wings and dark stigma.

Paracolletes moretonianus Cockerell.

Moreton Bay. Male about 11 mm. long, with the aspect of *nomia semiaurea* Ckll. Legs red.

Paracolletes nanus (Smith).

W. Australia. Female black and shining, expanse of wings about 11 mm.; mesothorax little hairy; first recurrent nervure joining second cubital cell about its middle (not far from its base in the larger *P. argentifrons*).

Paracolletes nicholsoni Cockerell.

Kojarena, Eradu and Geraldton (Nicholson). Type in Australian Museum. Female nearly 7 mm. long; black, shining, with thin erect white hair. Known from *P. nanus* by the dark antennae, and apical margins of tergites not testaceous.

Paracolletes nigritulus Cockerell.

Yallingup, W.A. (Turner). Type in British Museum. Female about 7 mm. long; known by the small size, dusky wings and especially the truncate marginal cell. The clypeus is quite convex and prominent. There is black hair on vertex.

Paracolletes nigrocinctus Cockerell.

Yallingup, W.A. (Turner). Type in British Museum. Male 11-12 mm. long.

Also at Kojarena, W.A.

The abdomen is dull red, tergites 1 to 5 having narrow subapical black bands, the margin beyond subhyaline, and on tergites 2 to 5 having a thin fringe of short silvery-white hairs.

Paracolletes nigroclypeatus Cockerell.

Victoria (C. French). Type in British Museum. Female 12 mm. long; close to *P. carinatus*, but larger, with the clypeus black, and fringe on fourth sternite white. Flagellum bright ferruginous beneath.

Paracolletes nigroclypeatus hardyi Cockerell.

Perth, W.A. (Hardy). Type in Queensland Museum. Female with abdomen black, with a steel blue band on each tergite before the marginal depression. It presents the unusual condition of having the head and thorax more metallic than the abdomen.

Paracolletes nigrofulvus Cockerell.

Shoalhaven, N.S.W. (Froggatt). Male, length about 11.5 mm.; black, with the hind margins of tergites, and the hind tarsi, obscurely ferruginous; flagellum strongly crenulated beneath; wings dusky.

Paracolletes nitidulus Cockerell.

Yallingup, W.A. (Turner). Type in British Museum. Female about 9.5 to 10 mm. long, male about 8.5 mm. An ordinary looking species, but entirely unique by the large black spot at end of marginal nervure of hind wing of male. In the female this is represented by a much smaller, elongated spot. Wings brownish, with large stigma.

Paracolletes nitidus Smith.

N.W. Coast of Australia. Female abdomen with a distinct bluish lustre; violet tints on mesothorax; basal nervure falling a long way short of nervulus; first recurrent nervure joining second cubital cell about or slightly before its middle.

Paracolletes nomadiformis Cockerell.

Kuranda, Q. (Dodd). Male about 6.5 mm. long; abdomen clavate, with a narrowed base, giving it the appearance of a *Nomada*. Tubercles covered with fulvous hair, and also scutellum and postscutellum, forming a large orange-fulvous patch, as in *P. flavomaculatus*.

Paracolletes nomiaeformis Cockerell.

Charleville, Q. (A. J. Turner). Male about 8 mm. long; very near *P. sigillatus*, but smaller, face much narrower, and mesothorax much more punctured. It looks like a *Nomia*. (Mem. Queensland Museum, x., p. 48.).

Paracolletes obscuripennis Cockerell.

Tasmania. Type in British Museum. Male about 9 mm. long; face densely covered with light yellow hair, at sides of upper part of front it is black; wings rather light fuliginous; stigma large.

Paracolletes obscurus (Smith).

Tasmania. Distance from first recurrent nervure to second intercubitus more than twice distance from second recurrent to end of third cubital cell. For a discussion of characters, see Mem. Queensland Museum, ix. (1929), p. 310. Variation, Mem. Queensland Museum, vii., p. 92.

Paracolletes opaculus Cockerell.

Geraldton, W.A. (Nicholson). Type in Australian Museum. Female about 9 mm. long. Known from *P. tuberculatus* by the rough opaque clypeus. Also related to *P. obscuripennis.*

Paracolletes pachyodontus Cockerell.

Yallingup, W.A. (Turner). Type in British Museum. Male 8 to 9 mm. long; black, with red mandibles, and the abdomen with approximately lateral thirds of first three tergites, as well as apical bands on the first four, deep chestnut red. Somewhat related to *P. rhodopus.*

Paracolletes pavonellus Cockerell.

King George's Sound, W.A. (Masters). Type in Australian Museum. Female about 9.3 mm. long. Known from *P. viridicinctus* by the peacock green abdomen with dull sericeous surface, the apical depressions of tergites black. The abdomen resembles that of the much larger *P. boroniae.*

Paracolletes perfasciatus Cockerell.

Western Australia. Type in British Museum. Female nearly 12 mm. long; black, the abdomen narrow, depressed, very shiny, with broad entire sordid white hair-bands. Stigma and nervures black.

Paracolletes perminutus Cockerell.

Fremantle, W.A. (Frank). Type in Amer. Mus. Nat. History. Female about 7 mm. long. This is *Lamprocolletes minutus* Friese. The first tergite is smooth and highly polished, this and the very pale dull yellowish stigma, with dark border, separating it from *P. minutus* Ckll. (Amer. Mus. Novitates, 343, 1929, p. 2.).

Paracolletes perpolitus Cockerell.

Yallingup, W.A. (Turner). Type in British Museum. Male about 9.5 mm. long; very close to *P. incanescens,* which has the same type of clypeus (with bare flattened polished disc), but flagellum red at end, abdomen more finely punctured, and third cubital cell different.

Paracolletes phanerodontus Cockerell.

King George's Sound, W.A. (Masters). Type in Australian Museum. Female 14.3 mm. long; abdomen steel blue. Related to *P. subvigilans,* but abdomen differently coloured and wings much clearer. The smooth polished abdomen separates it from *P. dentiger.*

Paracolletes pictus Rayment.

Charleville, Q. (G. F. Hill). Female about 11 mm. long; allied to *P. elegans.* (Proc. Roy. Soc. Victoria, xliii., 1930, p. 47.). I am indebted to Mr. Rayment for a specimen of this beautiful metallic species.

Paracolletes platycephalus Cockerell.

Windsor, V. (C. French). Type in British Museum. Female about 10 mm. long; black, with the abdomen bright ferruginous red; second tergite with a black spot on each side. The dark legs and venation separate it from *P. fimbriatus* and *P. fimbriatinus.* The hind spur of hind tibia is very finely pectinate, with many very slender long spines. The male has hair of head and thorax above ochreous, without fuscous; apex of abdomen with pale golden hair.

Paracolletes plebeius Cockerell.

Bright, V. (H. W. Davey). Female about 10 mm. long; very near *P. providus,* but the head is smaller, the flagellum dusky chestnut red be-

neath, and the dark purplish colour of the abdomen is quite different. The tibial scopa, black above, white beneath, separates it from *P. frontalis.*

Paracolletes plumosellus Cockerell.

"New Holland." Type in British Museum. Male about 7.5 mm. long; head and thorax bluish green; abdomen with a strong purple lustre. Near to *P. plumosus.* Rayment records it from Perth, W.A.

Paracolletes plumosus (Smith).

From W. Australia to Victoria, and north to Queensland. Head and thorax green, abdomen purple; basal nervure meets nervulus; stigma narrow and lanceolate. The male is described, and distinguished from *P. plumosellus,* in Trans. Amer. Ent. Soc., xxxvi., p. 200. See also Rayment, Journ. Roy. Soc. W. Australia, xvi., p 50. Variation, Mem. Queensland Museum, x., p. 48.

Paracolletes providellus Cockerell.

Type in British Museum, labelled "Australia." Male about 7.5 mm. long; head and thorax shining black; abdomen shining dark bluish green, with the hind margins of the tergites broadly reddish.

Paracolletes providellus bacchalis Cockerell.

Bacchus Marsh, V. (F. L. Billinghurst). Male a little over 7 mm. long; abdomen with only the faintest greenish tinge; hind tibiae, and basal half of their basitarsi, bright chestnut red; tegulae piceous.

Paracolletes providellus caerulescens Cockerell.

Como, N.S.W. (Froggatt). Type in Amer. Mus. Nat. History. Amer. Mus. Novitates, 343 (1929). Legs all rather dark red, including femora; abdomen shining steel blue, with hind margins of tergites conspicuously dusky reddish. If *P. bacchalis* is considered a distinct species, this is a variety of *bacchalis.*

Paracolletes providus (Smith).

Tasmania to Queensland. Doubtfully distinct from *P. chalybeatus,* and I believe it to be a synonym. Western Australia, recorded by Rayment in Journ. Roy. Soc. W. Australia, xvii., p. 161. The abdomen is broader than in *P. versicolor.* Comparison with *P. hackeri,* Mem. Queensland Museum, x., p. 49.

Paracolletes punctatus (Smith).

Adelaide, S.A. Female with abdomen brown-black; stigma and nervures ferruginous. The basal nervure meets nervulus.

Paracolletes punctiventris Cockerell.

Sydney, N.S.W. Type in Amer. Mus. Nat. History. Male about 8.5 mm. long; near *P. incanescens,* but fifth sternite with a stiff fringe of long pale hair. Amer. Mus. Novitates, 343 (1929). Area of metathorax not transversely striate, as it is in *P. speculiferus* and *P. perpolitus.*

Paracolletes pusillus Cockerell.

Geraldton, W.A. (Nicholson). Type in Australian Museum. Male with the aspect of *P. nicholsoni,* but basal nervure conspicuously less arched, and second cubital cell receiving recurrent nervure almost at its inner corner. Known from *P. scitulus* by the entirely black middle and hind legs, and from *P. minutus* by the dark mandibles.

Paracolletes rebellis Cockerell.

Melbourne, V. (C. French). Type in British Museum.

North to Jindebyne, N.S.W., at 3,000 ft. Legs darker than in *P. brevicornis*. See Ann. Mag. Nat. Hist., August, 1926, p. 218. It resembles *P. crassipes*, but the large triangular area of metathorax is strongly longitudinally sulcate in the middle and finely transversely striate.

Paracolletes recusus Cockerell.

Mt. Tambourine, Q. (Hacker). Female about 10 mm. long; similar to *P. plebeius*, with median sulcus on scutellum and hyaline wings, but antennae black, surface of clypeus polished, and area of metathorax shining. Apical margins of tergites dark greenish.

Paracolletes regalis Cockerell.

Kuranda, Q. (Dodd). Male about 10 mm. long; head and thorax black, abdomen shining deep rich purple, without hair-bands; antennae black; a strong brown cloud in the marginal cell and beyond (in the related *P. recusus* there is no such cloud).

Paracolletes rhodopus Cockerell.

Yallingup, W.A. (Turner). Type in British Museum. Female a little over 13 mm. long; rather robust, black, with the hind tibiae bright ferruginous, with hair of the same colour on outer side; hair of head and thorax abundant; black in the same places as in *P. subvigilans*, otherwise pale ochreous-tinted.

Paracolletes robustus Cockerell.

King George's Sound, W.A. (Masters). Female 12.3 mm. long; resembling *P. tenuicinctus*, but separated by the very broad apical plate of abdomen, which has no median raised line. Wings brownish. Postscutellum with a rather low conical process.

Paracolletes roseoviridis Cockerell.

Western Australia. Type in British Museum. Male about 8 mm. long; allied to *P. carinatulus*, but more robust, yellowish green instead of blue green, the abdomen with a rosy suffusion.

Paracolletes rubellus (Smith).

Lower Plenty, S. Australia. Described under *Dasycolletes*. Female abdomen red; hind spur of hind tibiae pectinate with numerous fine long teeth; first recurrent nervure meeting second intercubitus; second recurrent meeting outer intercubitus.

Paracolletes rudis Cockerell.

Swan River, W.A. Type in British Museum. Female about 10 mm. long; black, with the general appearance of *P. worsfoldi*, but lacking the abdominal bands; easily known from *P. obscurus* by the dull mesothorax; the scutellum is dull and roughened, while in *P. worsfoldi* it is shining.

Paracolletes rudissimus Cockerell.

Wyalcatchem, W.A. (Nicholson). Type in Australian Museum. Male about 7.3 mm. long; black, including mandibles, antennae, tegulae and legs; hind margins of tergites rather narrowly shining brown; postscutellum with a distinct but low median tubercle. Looks like a *Nomia*, but is related to *P. rudis*, and may possibly be its male.

Paracolletes rufibasis Cockerell.

Eradu, W.A. (Nicholson). Type in Australian Museum. Male about 12 mm. long; black, with clypeus honey colour (black along lateral sutures); scape clear red; abdomen marked with red. It has a relatively short first

cubital cell, and could be placed in *Anthoglossa*. It also appears related to *Andrenopsis flavorufus*.

Paracolletes ruficornis (Smith).

W. Australia. Area of metathorax large, indistinctly transversely sericeo-striate; flagellum red; face covered with fulvous hair. I have thought that this might be a female, *Goniocolletes*.

Paracolletes rufiventris Friese.

Adelaide. Female 13-14 mm. long; black, with thick fulvous hair; abdomen red, tergites 1 to 3 with a dark mark, tergites 5 and 6 black brown, with dark hair. The wings are dusky.

Paracolletes rufoaeneus Friese.

Adelaide, S.A. (Frank). Very near *P. bimaculatus*. Second cubital cell receiving recurrent nervure not far from its end. Additional details are given in Amer. Mus. Novitates, 343 (1929).

Paracolletes rufus Rayment.

Purnong, S.A. (Fulton). Male about 11 mm. long; head and thorax black, abdomen clear red; face densely covered with long golden hair; wings hyaline. Rayment figures the details of structure, showing the remarkable antennae (Proc. Roy. Soc. Victoria, xliii., p. 53).

Paracolletes scitulus Cockerell.

Brisbane, Q. (Hacker). Male about 8 mm. long; resembles *P. speculiferus*, but easily separated by the clypeus, which is convex and finely punctured; antennae long, not moniliform, flagellum dark brown beneath. There is a superficial resemblance to *P. incanescens*.

Paracolletes semilautus Cockerell.

Type in British Museum, from "Australia." Male about 8 mm. long, black; known by the very broad face, with black hair at sides. Stigma and nervures amber colour. A table to separate this and numerous other species is given in Ann. Mag. Nat. Hist., January, 1906, p. 28.

Paracolletes semilucens Cockerell.

Perth, W.A. (J. Clark). Type in Queensland Museum. Female about 8.5 mm. long; black, small and rather slender, with rather the aspect of a male. Compared with *P. sigillatus*, it is very distinct by the lack of broad hyaline margins to the tergites, the dark hair at apex of abdomen, and the red tegulae.

Paracolletes semipurpureus (Cockerell).

Mackay, Q. (Turner). Type in British Museum. Female about 9.5 mm. long. Described as a race of *P. cupreus, Lamprocolletes cupreus* var. *minor* Friese is the same. Variation, see Psyche, 1930, p. 150. The abdomen is much less shining than in the variety *frenchi*.

Paracolletes semipurpureus frenchi Cockerell.

Rutherglen, V. (French). Vertex, thorax above, and tubercles with light orange-fulvous hair; abdomen strongly crimson; anterior and middle basitarsi almost entirely black.

Paracolletes semipurpureus ornatissimus (Cockerell).

Oxley, near Brisbane, Q. (Hacker). Female about 8.5 mm. long; very brilliantly coloured, the abdomen shining but not polished, with peacock green, lilac-purple and crimson tints. The male is also known. Described as a distinct species.

Paracolletes semiviridis Cockerell.

Charleville, Q. (A. J. Turner). Type in Queensland Museum. Male about 8.3 mm. long; head and thorax black, with much outstanding white hair, pale ochreous on thorax above; abdomen dull olive green, hind margins of the tergites very pale testaceous. (Mem. Queensland Museum, x., p. 48.).

Paracolletes sexmaculatus Cockerell.

Yallingup, W.A. (Turner). Type in British Museum. Female 13-14 mm. long; robust, with head, thorax and legs black; abdomen bluish green, with six patches of pure white hair. Male 11-12 mm., much more slender, and the abdomen only very feebly metallic, and not spotted.

Paracolletes sigillatus Cockerell.

S. Australia (from Froggatt's collection). Female 10 mm. long; black, with hind margins of tergites broadly testaceous; postscutellum angularly produced behind, with a small shining tubercle suggesting the seal on the flap of an envelope.

Paracolletes simillimus Cockerell.

Yallingup, W.A. (Turner). Type in British Museum. Male about 10.5 mm. long, resembling *P. metallescens,* but sculpture of abdomen entirely different.

Paracolletes speculiferus Cockerell.

National Park, Q. (Hacker). Male about 9 mm. long; known from *P. perpolitus* by the entirely dark antennae and entirely black front tibiae.

Paracolletes subdentatus (Rayment).

Quairading, W.A. Female about 12 mm. long; head dark blue, with black clypeus; mesothorax black, bluish posteriorly; scutellum bluish; pleura blue, with fuscous hair; postscutellum with a bidentate process; abdomen dorsally green. The area of metathorax has concentric striations. Flagellum fulvous beneath.

Paracolletes subfuscus Cockerell.

Adelaide, S.A. Type in British Museum. Male about 13 mm. long, looking like a large *Colletes;* area of metathorax shining; abdomen hairy.

Paracolletes subvigilans Cockerell.

Yallingup, W.A. (Turner). Type in British Museum. Female 13.5-14 mm. long; the abdomen dark green, the discs of the tergites sometimes almost black, but the broad hind margins always green; postscutellum with an obtuse tubercle.

Paracolletes subviridis Cockerell.

Bridport, T. (Littler). Female 9.5 mm. long; rather slender, apparently black, but on close inspection it is seen that the front, mesothorax (except a large central area) and abdomen are faintly greenish; wings hyaline, not at all reddish. Differs from *P. obscurus* by the black mandibles, tibial scopa beneath white (not yellow), and dull thorax. It is much narrower than *P. advena.*

Paracolletes tenuicinctus Cockerell.

Yallingup, W.A. (Turner). Type in British Museum. Female 12.5-13 mm. long. This proves to be the female of *P. nigrocinctus.* Turner found the sexes together abundantly on *Leptospermum.*

Paracolletes thornleighensis Cockerell.

Thornleigh, N.S.W. (Froggatt). Type in British Museum. Male a little

over 7 mm. long. *Lamprocolletes nigriventris* Friese, also from Thornleigh, is a synonym. The female is described in Ann. Mag. Nat. Hist., July, 1914, p. 42.

Paracolletes tropicalis Cockerell.

Melville Island (G. F. Hill). Female about 6 mm. long; black, with the mandibles and labrum clear red, tegulae ferruginous, hind margins of tergites broadly dark reddish brown. Known by the small size, short dark flagellum, red mandibles and largely red legs. Type in American Museum of Natural History. (Amer. Mus. Novitates, 346, 1929, p. 1.).

Paracolletes truncatulus Cockerell.

Blackwood, N.S.W. (Froggatt). Female about 9 mm. long; head and thorax black, abdomen clear red, with a pyriform black spot on each side of second tergite. Related to *P. rubellus,* but nervures not testaceous and apex of abdomen with neither hair nor tegument dark.

Paracolletes tuberculatus Cockerell.

Cheltenham, V. (French). Female about 11 mm. long, male 10 mm.; postscutellum with an obtuse median tubercle or very prominent angle. Except for the character of the postscutellum, allied to the group of *P. versicolor.*

Paracolletes tuberculatus insularis Cockerell.

Stradbroke Is., Q. (Hacker).

Also on Bribie Island. A little smaller and less robust; mesothorax more shining and less densely punctured; area of metathorax with the transverse striae feeble, scarcely evident; thorax above with some dark hair; hind tibial scopa with black hair behind to apex. This is based on the female.

Paracolletes turneri Cockerell.

Mackay, Q. (Turner). Type in British Museum. Female about 11 mm. long; brilliant blue and green, with the caudal tuft bright orange fulvous. Allied to *P. elegans.*

Paracolletes velutinus Cockerell.

Eradu, W.A. (Nicholson). Type in Australian Museum. Male about 11 mm. long; black, slender, wings unusually short; flagellum clear ferruginous beneath.

Paracolletes ventralis Friese.

Sydney, N.S.W. (Frank). ♀ about 12.5 mm. long, black, without metallic colours. Very briefly described by Friese, but a full description is given in Amer. Mus. Novitates, 343 (1929).

Paracolletes versicolor (Smith).

Adelaide, S.A., to Mt. Wellington, T.; and *P. spatulatus* Cockerell, taken by Froggatt at Blackheath, N.S.W., is the same species. *P. spatulatus* was described from a male, slightly over 8 mm. long; it is broad, with rather the shape of a female.

Paracolletes vigilans (Smith).

Swan River, W.A. Abdomen strongly green; area of metathorax smooth and shining; postscutellum with a large bidentate process. It is larger than *P. metallicus* (being over 13 mm. long) and has darker wings. As to the process on postscutellum (overlooked by Smith), see Trans. Amer. Ent. Soc., xxxvi., p. 199.

Paracolletes viridicinctus Cockerell.

Tasmania. Type in British Museum. Female a little over 8 mm. long; head and thorax black; abdomen black with the depressed hind margins of the tergites brassy green. Antennae black.

Paracolletes vitrifrons (Smith).

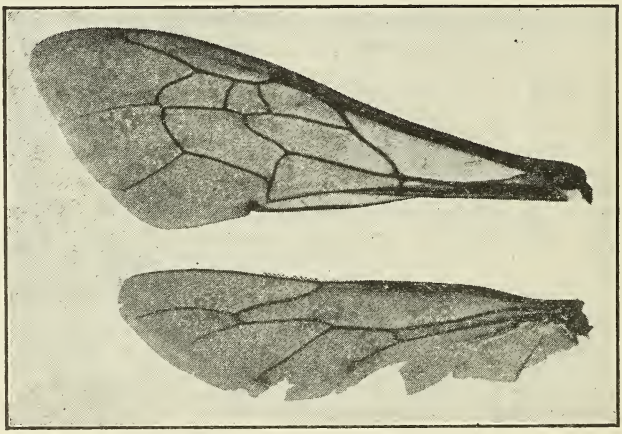
Swan River, W.A. Male with only two cubital cells; stigma large; clypeus covered with silvery hair; supraclypeal area nude, shining brassy.

Paracolletes waterhousei Cockerell.

Victoria. Differs from *P. ruficornis* Sm. by the area of metathorax smaller, shining, with a beaded margin, and flagellum not red. It is smaller than *P. fulvus*. There is a strong resemblance to the New Zealand *P. fulvescens* (Smith); see Ann. Mag. Nat. Hist., August, 1926, p. 218.

Paracolletes worsfoldi Cockerell.

W. Australia (C. M. Worsfold). Type in British Museum. Female about 10.5 mm. long. Also at King George's Sound. Best regarded as a subspecies of *P. advena;* see Mem. Queensland Museum, ix. (1929), p. 308. The shining scutellum distinguishes it from *P. rudis*.



Wings of *Tricholletes venustus* Smith (Sydney, N.S.W.).
Photographed by J. G. Pratt, U.S. National Museum.

THE DEVELOPMENT OF THE AVIAN EMBRYO.

(Read before members of the Avicultural Section on 14th August, 1933.)

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While aviculturists acknowledged their indebtedness to Darwin and Mendel of last century they had come to realise, however, that in recent years modern biologists had so advanced their work that further fundamental principles were now accepted.

This applied particularly to the science of cell-life, and much of this work had been done on the avian embryo.

To a body of men so well versed in the study of the macroscopic in bird-life, whose excursions afield and whose avicultural observations had perfected their knowledge in such matters as bird distribution, variations, feeding and nesting habits, it followed, a priori, that constructive use should be made of the knowledge so gained, and there resulted therefrom the breeding of new colour varieties, the evolution of new types, and hybridisation.

But both macroscopic and microscopic studies must go hand in hand if they were to more thoroughly understand and appreciate the underlying principles of such constructive work. Moreover, such microscopic studies should go back to the commencement of cell-life and excursions down the microscope into the realms of avian embryology provided much of interest.

The mechanism of fertilisation of the ovum could be demonstrated microscopically, and the professional biologist in recent years had advanced our knowledge of the sex-determining sex-chromosome distributing mechanism. It was known that each cell had its characteristic species number and type of chromosomes. The chromosomes were alike in the cells of the two sexes, with the exception of one pair known as the sex-chromosomes, and these differed in the sexes. In each body cell or unripe egg of the female there would be an identical pair of these sex chromosomes, usually designated as the X. chromosomes (XX), whereas in each body cell and unripe sperm of the male there would be an X. chromosome and a somewhat dissimilar mate—the Y. chromosome (XY).

Certain erroneous theories of sex determination were now discarded, and the modern conception of sex determination through the medium of the sex chromosomes was generally accepted.

It was now recognised that the sex of any individual was determined at the moment of fertilisation by this sex-chromosome interchange in which to the chromosomes already existent in the unfertilised egg there were superadded those of the fertilising spermatozoan. It was the male and not the female in mammals that was heterogametic, meaning, thereby, that from the sex determination point of view the ova were of the same type, but the sperms were of two kinds—male determiners and female determiners.

In birds, however, this order was reversed, the female being heterogametic and the male monogametic.

The transmission of hereditary factors or genes on the chromosomes could also be demonstrated.

Examples of sex-linked inheritance were known in which physical characteristics were transmitted on the sex chromosomes of the cells.

Drosophila, the fruitfly, was a lateral gynandromorph in which the red eye was on the female side. The cells on this female side carried two X.

chromosomes (XX.), whereas the cells of the male white-eyed side had only one X. chromosome. Colour blindness in homo sapiens was a further example of sex-linked inheritance; the normal, the carrier and the colour-blind determining factors being transmitted on the chromosomes.

An interesting field for observation would seem to be opened up in hybridisation where there must be an interchange of chromosomes between cells of two individuals of different chromosomal number and type.

Proven examples of hybrid fertility should be recorded, as in the case of the bird exhibited by Mrs. D. Alexander, Plenty Road, Preston, Victoria, who claimed it to be the off-spring of a canary and canary mule.

As development proceeded, certain gland secretions or "hormones" played an important part in determining the birds' later attributes. Sex reversal was known to occur in the bird world. Whereas it was well known in other classes—the Gipsy moth, the oyster and the sword-tailed minnow being classical examples—it did occasionally occur in the bird. It could be demonstrated both by controlled experiment as in removal of the functioning ovary in the hen or in disease of that organ. In either case, the smaller non-functioning ovary could then become active and conformed microscopically to the male type of sex gland. Coincident with this change in the gland, the external characteristics of sex were also reversed —the bird now behaving and appearing as a male.

Biologists had come to the conclusion that the differentiation into a female is a function which every embryo can perform, unless a male sex-chromosome is present to differentiate it into the male type.

Goldschidt assumed "that during embryonic life the female-determining reactions are effectively in excess in the case of the female fowl, and the sex gland was then differentiated under the influence of these reactions. So long as this ovary remained healthy, then its action could preclude the operation of the male-differentiating reactions. In later life, if the ovary were removed by the knife or disease, it would take place under the influence of the male-differentiating reactions, which had overtaken and replaced the female-determining reactions.

This would appear to be a reasonable explanation of sex reversal.

Examples of alleged sex reversal, observed personally by trained aviculturalists in this section, should be recorded in the scientific literature of this Society, and, if possible, submitted to laboratory investigation.

Mr. Ernest Jones, past Secretary of the Avicultural Section, has supplied me with notes on a case of probable sex reversal in a hen King Quail. Having reared families during the first two seasons, she then gradually assumed the plumage of a male bird. This plumage she retained throughout the next year and showed no desire to breed.

At the next time of moulting she reverted to female plumage, such plumage being several shades darker than the normal hen bird. She never laid again, however.

She subsequently became very sluggish in her movements, became very plump and overfat, waddling along as her abdomen touched the ground. A week later she died.

Facilities were not available for further investigation, but it is probable that such sex reversal was associated with a left ovarian tumour which subsequently caused her death.

Sex Ratio.

Little seemed to be known of the control of the sex-ratio in bird life, and therein lay the opportunity for further research. In the case of man,

it was established that far more males were conceived and that both before and after birth the male died more easily than did the female, leaving an excess of adult females. Almost always the male births were in excess, however, on an average, the ratio being 106 : 100.

Certain statistics are available, however, in the case of the Pigeon and "Hen Fowl." We are indebted to Professor W. J. Dakin, of Sydney University, for the translation of Goldschmidt's work on this subject. Discussing the selective elimination of the sexes, he states "it is a frequent occurrence that in the hybridisation of relatively widely separated forms only males are produced or strikingly many males. In many cases this may be due to inter-sexual transformation as in a series of Lepidopteron crosses and perhaps certain pigeon crosses (Whitman-Riddle). But in other cases it may be bound up with a general constitutional weakness of the hybrids, one sex of which is more affected than the other, just as one sometimes finds, that one sex is more sensitive than another in the young stages. In this category perhaps come Guyer's pheasant and guinea-fowl, i.e., common fowl hybrids, but the accuracy of his statements, namely, that there is a marked excess of males in such hybrids, is strongly contradicted by Poll, who found quite a normal distribution of the sexes."

Elimination of a sex by a sex-linked inheritance factor known as the "lethal factor" might also occur.

Where birds were bred in sufficient numbers and careful note was made over a period of years of lineage, Mendelian ratios, sex and plumage of the off-spring, such a breeder should be in a position to supply accurate statistics on the subject of sex-ratio, and such statistics should be contributed to the literature of scientific aviculture.

Sufficient had been said to show that there was a call for co-operation between the aviculturist and the professional zoologist. From this section, as from the other ancillary sciences functioning within the ambit of the parent zoological Society, much valuable data could be made available, and our problems begun in the humble nest-box were more clearly discernible when viewed in the light and focus of the oil-immersion lens of a trained laboratory worker.

The progressive stages of chromosome interchange and early avian development were demonstrated by lantern slides.

THE DOOM OF THE BIRD OF PROVIDENCE.

Pterodroma melanopus (Gmelin).

By Gilbert Whitley, F.R.Z.S., R.A.O.U.

(Plate i.)

Many different kinds of birds have become extinct within historical time. When they flourished, few persons imagined that their existence was in danger, or troubled to conserve them, and their passing was either scarcely noticed, or regarded as a temporary inconvenience.

A record, unique in the annals of ornithology, has come to light in the form of a contemporary account of the extermination of the petrels of Mount Pitt, at Norfolk Island, in the early days of settlement in New South Wales. This account is contained in a manuscript diary, kept by Lieutenant Ralph Clark, of the Royal Marines, which is preserved in the Mitchell Library, Sydney. Clark arrived at Sydney with the First Fleet in 1788 in the "Friendship" Transport, and went to Norfolk Island, under Major Ross, in March, 1790, when he was appointed Quartermaster General and keeper of the Public Stores. In this capacity, he kept a conscientious tally of all the petrels or "mount Pit Birds" (called the Bird of Providence by Hunter) which were killed by the marines, sailors, and convicts from day to day, so we obtain what is practically an exact record of the slaughter of this species in the earliest days of Australian settlement.

Lieutenant Ralph Clark was styled "The Pepys of early settlement and of the First Fleet" by a writer using the pseudonym "Quercus" who reviewed this same diary in the "Sydney Morning Herald," September 26, 1891. Clark Island, a well known spot in Sydney Harbour, was named after him.

Fortunately, Mr. Tom Iredale has epitomised the history of the Bird of Providence (*Pterodroma melanopus*) in earlier papers in this journal (1), to which the present data are complementary.

Over 170,000 *Birds Slaughtered!*

The following is a typical entry in Clark's manuscript journal:— "Saturday, 10th April, 1790. Birds kild by M. 159 S. 147 C. 319 625."

This indicates that the marines killed 159 birds, the sailors 147 and the convicts 319, the total being 625 birds brought in to the Quartermaster the night before. Many further figures are given, and totals checked from time to time, but to avoid the interpolation of wearisome ciphers, I append the data in a single footnote (2).

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(1) Iredale, Australian Zoologist, v., 4, 1929, pp. 358-361, pls. xxxix.-xl.; *et ibid.*, vi., 2, 1930, pp. 112-116, pl. xiii.

(2) April 10th: M. 159, S. 147, C. 319; 11th: M. 145, S. 178, C. 291; 15th: M. 183, S. 165, C. 418; 18th: 766, plus 68; 21st: 431, 511, 634; 22nd: 296, 184, 301; 23rd: 234; 24th: 409, 374, 814; 25th: M. 218, S. 179, "by the convicts don't know"; 26th and 27th: 2,653; 28th: 211, 191; 29th: 313, 480, 505; 30th: 196, 483, 795.

May 1st: 743, 901, 1,239; 2nd: 941, 749, 1,397; 3rd: 302; 4th: 845, 793; 5th: 905, 965, 705; 6th: 507, 801, 761; 7th: 501, 991, 1,092; 8th: 796, 1,013, 1,890; 9th: 4,783; 10th: 410, 903, 2,797; 11th: 304, 687, 301; 12th: 398, 594, 1,130; 13th: 403, 731, 391; 14th: 703, 409, 931; 15th: 608, 703, 485; 16th: 4,731; 17th: 4,031; 18th: 309, 437, 614; 19th: 3,081; 20th: 939; 21st: 381, 631, 839;

These figures may be taken as being the minimum.

From them, we see that, in April, 13,251 birds were killed; in May, 82,321; June, 70,699; and part of July, 5,091. This results in a grand total of 171,362 birds, or, in round figures for the three months, April 10 to July 10, 1790, over 170,000 Birds of Providence slaughtered.

Further Extracts from Clark's Diary.

April 18th, 1790.—"The patroles in going the Rounds last night took Ino Loural a convict prisoner he being out of his hut after Tattoe beating contrary to orders and having a Sack with Birds in it on the patrole challenging him he attempted to make his escape by flight but the Corpl of the Patroles was to nimble for him and before he would stop for him he was wounded in the head but not of any consequence.

"The Haversack contained 68 of the mount Pit Birds."

It will be noticed that punctuation is not one of Lieutenant Clark's strong points. His diary is very closely written and difficult to read on this account, and because he frequently employed contractions, notably "the" for "they."

May 1st, 1790.—"A General Order given out respecting the Birds."

May 2nd.—"The Birds of mount Pit last night were so thick that the came down a little after sunset like a shower of hail. My servant was there and kil'd himself 193 Birds it is a great Blessing that we have these Birds in such abundance. Birds M. 941 S. 749 C. 1,397."

May 9th.—"Sent the Boat out a fishing who caught 182 large Snappers supplyd every [body] on the Island with a great allowance of Fish. The people brought in Birds last night to the amount of 4,783, long may this Blessing continue."

May 19.—"Birds brought in last night 3081" [Major Ross prohibited the cutting down of trees on Mount Pitt, as this might cause the birds to leave.]

May 21.—"A complaint was made to Major Ross to day that some of the convicts had [been] to Mount Pit only for the sake of the Birds Eggs. The catch the Birds and them that have no eggs the let go again and them that are with Egg the cut the Egg out of them and then let the Poor Bird fly again which is one of the crueles things which I think I ever hord. I hope that some of them will be caught at this cruel work for the sake of making an example of them. Birds kil'd last night by M.381 S.631 convicts 839."

May 22.—"One order came out to day respecting the people going to mount Pit and taking with them Dogs, Tools and Implements and

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22nd: 2,052; 23rd: 5,631; 24th: 4,354; 25th: 1,839; 26th: 3,113; 27th: 1,811; 28th: 1,393; 29th: 153; 30th: 4,727; 31st: 913, 1,101, 2,743.

June 1st: 951; 2nd: 3,930; 3rd: 1,390; 4th: 4,341; 5th: 6,125; 6th: 5,190; 7th: 5,653; 8th: 1,213; 9th: 3,515; 10th: 1,591; 11th: 1,831; 12th: 1,907; 13th: 5,709; 14th: 4,103; 15th: 2,114; 16th: 1,320; 17th: 307; 18th: 410; 19th: 319; 20th: 734, 1,137, 2,341; 21st: 3,464; 22nd: 703; 23rd: 1,149; 24th: 805; 25th: 410; 26th: 1,793; 27th: 5,035; 28th: 451; 29th: 343; 30th: 415.

July 1st: 241; 2nd: 213; 3rd: 439; 4th: 591; 5th: 608; 6th: 313; 7th: 443; 8th: 410; 9th to 11th (no record, Clark being away); 12th: 310; 13th: 409; 14th: 319; 15th: 441; 16th: 354; 17th onwards: no record.

destroying the Birds there cruely and wantonly for which *See the Orderly Book.* The Convicts were mustered to day and the order which came out today read to them..Birds 2052."

July 19th, 1790.

"Majr. Ross called the Council together and we came to the following Resolution, Viz.

The Lieutenant Governor and Council having Judged it absolutely necessary that as long as the Birds at Mount Pit are to be had in such abundance and as the Season of the Year is approaching for the Boat to be Employed in fishing that there should not be any more Salt Beef or Pork Issued from the store until these most Valuable Resources fail us." . .

"Since I have been out to at Charlotte Field the Serjeants of the guard have neglected taking an account of the number of Birds which the people have brought in so that I have no account off them and as the people dont come to the guard house as before shall not be able to get an account."

Thus the tally ceases, but the data given are extraordinarily comprehensive and constitute, I think, unique observations on the extinction of a species. In April to July, 1790, we have seen that at least one hundred and seventy thousand Birds of Providence were killed, so it is small wonder that the species became scarce for a while and eventually became extinct on Norfolk Island.

On *Saturday, October 6, 1790,* Clark went to Phillip Island with his servant and caught Tropic Birds, and on later dates secured still more specimens to replenish the Larder of the Marines. On *December 6,* Clark sent "one of the Boat's crew on Nepean Island to get Gannets for the sake of the Feathers to make me a Bed". Fifty gannets were obtained for him, and eighteen more the day after, so it is hoped that our Lieutenant slept well. His diary is then taken up for weeks with the affairs of the settlement (both in "Town" and at Charlotte Field), accounts of the weather, and references to the punishment of the convicts, both male and female, by flogging.

Wednesday, 23 March, 1791, "two of the convicts went to Mount Pit to see if the Birds were come in, the were taking Prisoners by the Patrole and when I came out Mr. Doidge reported them to me when I order them to their work and took the Birds from them (the got 23) and gave the Birds to the Patrole and acquainted Major Ross with it that the Birds were returned to the Mount again who sent me out word to desire Mr. Doidge would lett some men go there every night to get Birds for them selves, and that he would stop Salt Provisions in lieu of the Birds."

In the next few days the "Birds are as numerous as ever," and on Tuesday, *April 12, 1791,* Clark visited Mount Pitt and himself killed 55, though, he says, he could have killed four times that number had he wished.

Early Bird-marking Experiments.

Saturday, May 21, 1791.—"Sleep at Charlotte Field last night and the night before and went both evening to mount Pit to see if the Birds have any particular hole which I am convinced the have from the Birds which I marked on Thursday Eveg coming back to the same hole last night with the mark on there leggs which I put on them the night before."

This is an important note, as these appear to be the first bird-marking experiments in the Pacific Ocean of which we have any record.

Then there is this last ornithological observation from Norfolk Island, when Clark remarks the damage done to birds by storms:—

November 9, 1791.—"After cold weather and heavy winds a great number of different Sea Birds have been blown on shore some of them dead or great number with hardly any life in them."

It is interesting to note that sea-birds are usually washed ashore dead on Sydney beaches about the end of October almost every year.

Clark left Norfolk Island on the "Queen" about the end of November, 1791, having been on the island continuously since March 13, 1790. He proceded to England in the "Gorgon" in 1792, and his diary terminates abruptly:

Sunday, June 17, 1792.—"I wish God that the wind would come full then we might goe into Plymouth but there is no hopes of that."

The Clark Correspondence.

The Mitchell Library also has a typewritten copy of Clark's Journal (No. C. 219), in which there are, in addition, copies of some of his correspondence. One communication (Letter Book MS., p. 26) from Clark to James Beveridge, London, is dated Norfolk Island, August 24, 1790, and has the following postscript: "I have taken the liberty to send you your favour of Mr. Murray, a Mount Pit Bird (not on account of the beauty of its plumage) of which it has none, but on account of its being one of the birds that has preserved the lives of five hundred and odd persons, for these several months past."

In a letter to G. Kempster, Stonehouse [near Plymouth], dated Norfolk Island, August 26th, 1790, Clark says: "The Mount Pit Birds have been the greatest friends that ever any of us knew, for I may with truth say that they have saved all our lives, the greatest part of us would have been in our graves long ago if it had not been for these birds, since April last, there has been no less, one night with another, than between four and five thousand killed. I shall return my thanks for them the longest day I have to live, they are all nearly gone, they just lasted until the arrival of the ships, but there is another bird come in now, also a sea fowl which burrows in the grounds, also like the Mount Pit Bird (which they call mutton birds) from their tasting like to mutton, they are remarkably fat and in great abundance."

Writing to Capt. Campbell, Marines, Port Jackson, on February 11, 1791, Clark repeats some of the earlier information, but adds:—

"You will hardly believe me when I inform you that from the latter end of April until the middle of July, no smaller number on a very moderate computation than five thousand, was killed a night. I have often known seven and eight thousand, particularly on the Sunday evenings, brought into camp, by the Sailors, Marines, and Convicts (male and female) which number was caught in five hours, there never was a bird caught until one hour after sunset, and everybody was obliged to leave the Mount before ten o'clock, they never came in from the sea (or wherever they came from, for that I do not know) until about sunset, when they generally hovered about the Mount for an hour before they came down, which was as thick as a shower of hail, this account will make the old story of Moses being in the Wilderness be a little more believed, respecting the shower of quails (3), everybody here owes their existence to the Mount Pit Birds, before

(3) Exodus, xvi., 13; Numbers xi., 31 & 32; and Psalm cv., 40.

they entirely left us, another bird (4) came in and supplied their place, but was not attached to Mount Pit only but was found in the holes of the ground in the day time, all over the Island. They resemble the Mount Pit Bird in plumage, make, etc. all but the feet, which are white, which the Mount Pit birds are not, they cut, when boiled, like mutton for which we named them the flying sheep, they were also in great abundance for six weeks, when their young took flight and they all left us."

William Bradley's Observations.

In the hope that the interest of the subject will form the excuse for some unavoidable repetition, I will append quotations from other contemporary accounts, commencing with the unpublished journal of William Bradley, another First Fleet naturalist whose MSS. are also in the Mitchell Library. William Bradley, of the "Sirius," prepared some of the first maps of Port Jackson, and Bradley's Head, not far from Clark Island, is named after him. In his "A Voyage to New South Wales" (Mitch. Lib. MS., p. 199), Bradley wrote from Norfolk Island, in April, 1790:—

"Parties were allowed to go for Birds, for the Seamen, Marines & Convicts twice a week each & limited not to bring more than a proportion of 3 for each Man. These Birds are very numerous and burrow in the ground about the Hills particularly about Mount Pitt which is the highest land in the Island; It was the practice before we came to dig them out of their holes in the daytime, but the people now take them as they settle in the evening & early part of the night & were they not restricted they could bring away almost any number. These Birds are nearly the same as the English Puffin or Manks Puffin as described in Brooks's Natural History found on the Isle of Man & Scilly Isles: & is of the size of a tame pigeon; The colour on the upper parts is brown or black & on the under brown & white; legs black. The bill is narrow & black, about an inch & half in length, the upper chap is crooked at the point like that of a Cormorant & at the base there is a bald skin in which the nostrils are placed. The wings are long & the tail is a palm in length. It feeds at Sea & although such incredible numbers settle on the Hills to get into their Holes at the appearance of night, a great number has been taken in the daytime by being dug out with grubbing hoes or brought out by tarrier dogs, they lay but one Egg which is larger than that of the common Hens, they are said to be in & about this Island from March to August when the young are ready to fly they all go off together; about which time another sort is said to come, but not in such numbers; these Birds are a great resourse to us, they enable us to go on with the Cultivation of the land for the Crops which we must soon depend on if we are not releived & which, I fear, will not keep us without feeling the pangs of extreme hunger."

Again in *February, 1791.*—The birds which so providentially afforded us subsistence from March until August, when relief arrived from Port Jack-

(4) Apropos of this second bird, Mr. Tom Iredale remarks: "The coloration of the feet suggests the Fleshy-footed Shearwater, *Hemipuffinus carneipes* (Gould), which does not now live on Norfolk Island, though abundant on Lord Howe Island. Another Shearwater, *Thyellodroma pacifica* (Gmelin), now breeds on Norfolk Island, but in this species the legs are plumbeous in coloration. No species takes such a small length of time for incubation and growth of young, so that 'six weeks' is probably simply an error of time."

son, cannot again be expected for some years, from the vast number of Eggs & young Birds that were destroyed & the ground in which they burrowed being torn up; But for a small number of Inhabitants the Birds may always [be] a resourse in case of accident happening to a ship with supplies or other failure. (MS., pp. 221-222).

Other Contemporary Accounts.

In his excellent article, already quoted, Mr. Iredale wrote: "Probably there is more romance connected with the Petrel, entitled by Captain John Hunter, 'the Bird of Providence,' about one hundred and forty years ago, than with any other bird on the Australian List." The romance is even heightened by this additional information which has so unexpectedly come to hand since, and search through other documents of our early days may reward the ornithologist with more tit-bits. For the present, I may quote an apposite contemporary account of the Bird of Providence from Mr. Iredale's account.

"Thus wrote Hunter: 'In the month of April (1790) we found that Mount Pitt (Norfolk Island), which is the highest ground on the island, was, during the night, crowded with birds. This hill is as full of holes as any rabbit-warren; in these holes at this season these birds burrow and make their nests, and, as they are an aquatic bird, they are, during the day-time, frequently at sea in search of food; as soon as it is dark, they hover in vast flocks over the ground where their nests are. Our people (I mean seamen, marines, and convicts), who are sent out in parties to provide birds for the general benefit, arrive upon the ground soon after dusk, where they light small fires, which attract the attention of the birds, and they drop down out of the air as fast as the people can take them up and kill them; when they are upon the ground, the length of their wings prevents their becoming able to rise, and, until they can ascend an eminence, they are unable to recover the use of their wings; for this purpose, nature has provided them with a strong, sharp, and hooked bill, and in their heel a sharp spur, with the assistance of which and the strength of their bill, they have been seen to climb the stalk of a tree sufficiently high to throw themselves upon the wing. This bird, when deprived of its feathers, is about the size of a pigeon, but when clothed, is considerably larger, for their feathers are exceedingly thick; they are web-footed, and of a rusty-black colour; they make their holes upon the hills for breeding their young in; they lay but one egg, and that is full as large as a duck's egg. They were, at the end of May, as plentiful as if none had been caught, although for two months before there had not been less taken than from two to three thousand birds every night: most of the females taken in May were with egg, which really fills the whole cavity of the body, and is so heavy that I think it must fatigue the bird much in flying. This "Bird of Providence," which I may with great propriety call it, appeared to me to resemble that sea bird in England, called the Puffin; they had a strong fishy taste, but our keen appetites relished them very well; the eggs were excellent. For a further description, and an engraving of this bird, see the Norfolk Island Petrel, in Phillip's Voyage, 4th Edition.'

"If we now refer to Collins, we read the tragic ending to the wholesale murder of these defenceless birds. 'The great havoc and destruction which the reduced ration had occasioned among the birds frequenting Mount Pitt had so thinned their numbers, that they were no longer to be depended upon as a resource. The convicts, senseless and improvident, not only

destroyed the bird, its young, and its egg, but the hole in which it burrowed; a circumstance which ought most cautiously to have been guarded against: as nothing appeared more likely to make them forsake the island.' This appeared under date August, 1792.

"The prognostication that they would forsake the island proved correct, but we have no data as to when this event occurred. Apparently few birds were preserved as specimens. . . .

"The Norfolk Island Petrel bred in numbers, and was exterminated in that locality through stress of food demand at a very early date, perhaps before the year 1800. . . .

"Many years later a similar bird was shot in Bass Strait, and remained unrecognised for over seventy years, when the original species was again found living, not on Norfolk Island, but on Lord Howe Island. It still breeds there and apparently wanders through the Tasman Sea as the example captured by Gould indicated.

"The bird is known to the Lord Howe Islanders as the 'Big Hill Mutton Bird.'"

An Anonymous Account.

A letter written by one of the non-commissioned officers of the "Sirius" after the wreck of that vessel at Norfolk Island is reproduced from the Banks Papers in the Historical Records of New South Wales, i., 2 (1783-1792), 1892, pp. 397-402. It is dated August, 1790, and the part dealing with the Bird of Providence is as follows:—

"No doubt you will wonder when I tell you that the same Tasks were performed on these very reduced Rations as when on full allowance; but this was owing to a Divine and providential resource from and about Mount Pitt, which place supplied the whole Settlement with Birds from the latter end of March till the middle of August.

"The Bird is a specie of the Petrel, which comes to this Island about the beginning of March, when they burrow under Ground for laying. They were at first taken out of their Holes in the Day, but soon after we found Night to be the Time for slaughter, as our whole Horizon (in the Woods) was then covered with them, and there was no walking without kicking them before you.

"The Mould being soft and loose on the Mount, they found no difficulty in scratching their Way. Their holes are about 3 feet long, and on a gradual descent. About the middle of April there were vast numbers of Eggs taken, both from the Holes and Birds, which, if possible, were now thicker than ever. It would be impossible for me to give an account of either the Quantity of Birds or Eggs. I can only say that while the Birds laid them (which was from the middle of May to the beginning of June) there was no scarcity in any part of the Town, and were bartered at a very cheap rate. On the 19th of April the Birds became so very plentiful (and our Store so lean) the Governor issued out a conditional Order that if every person would give up half a pound of his salt Meat a Week they might kill and bring home as many Birds from the Mount as they pleased (as long as it did not interfere with their Work), being before this restricted by allowing only so many Persons to go out at a time, and that quantity issued out by the Store Keeper to every individual. This being agreed to, instantly took place, and the slaughter and nightly havoc is beyond Description. It is worthy of Remark that these Birds were coming in when our sad and melancholy Catastrophe happened, and were very scarce at the arrival of the relief. Nothing could have been better timed, and,

though rather paradoxical, everything happened as favourably as could be: the Birds as above; the Ship being cast away in the only spot where there would be the least Chance of saving either our People or the Provisions, all our Men keeping health to the last, and our Crops in a most flourishing State at the relief's arrival. As I have enclosed a drawing of the Bird, I shall give no further description. We had, besides our Friends, the Pittites (the Vulgar Appelation), another very capital resource if the weather would have permitted fishing, which in this Season of the Year is so very unsettled that on an average we have had but 3 fine days out of 15 fit for fishing. Therefore, our reliance on this very precarious resource was of little note when compared to the Birds, which were to be had in any number for going for. They are very fine eating, exceeding fat and firm, and, I think (though no Connoisseur), as good as any I ever eat."

The editor of the Historical Records states that "The sketches and plans mentioned in the letter are not among the Banks Papers."

Rome commemorates the sacred geese whose cackling saved the Capitol from the surprise attack of the Gauls, and Norfolk Island may well remember the Birds of Providence which were sacrificed to save the lives of its first white inhabitants.

EXPLANATION OF PLATE I.

The Bird of Providence, *Pterodroma melanopus* (Gmelin).

The larger figure is from a hitherto unpublished painting, the original of which is rather more than one foot high. Artist unknown.

The upper figure is from a smaller drawing, likewise unsigned, but painted by another artist. The originals of both are included in the King Estate papers in the Mitchell Library, where they were photographed by Mr. Anthony Musgrave.

NOTES ON SARCOPHAGID FLIES (DIPTERA).

By G. H. Hardy.
Walter and Eliza Hall Fellow in Economic Biology,
Queensland University, Brisbane.

On the bristles of the posterior clasper.—When examining the various features common to forms in certain groups of the genus *Sarcophaga,* I have been impressed with the consistency in which the outstanding bristles on the posterior clasper occur. These are not only consistent in number, but also in position, and in no case of the Australian fauna and their immediate allies from other parts of the world have I found the bristles entirely absent, but occurring in groups of one, two or three bristles.

The *antilope*-group has but one bristle, and it is the only case yet found where a slight variation occurs, and when the posterior clasper is short and broad the bristle may be small and overlooked. It is situated on the apical half and sometimes well towards the apex of the clasper. (See Hardy, 1923, p. 278, fig. 3.)

In the *crinata*-group one bristle is strongly developed and situated towards the base.

Specimens of the *fergusoni*-group are too few for adequate study, but apparently only one bristle occurs, situated towards the apex and is not very well defined.

Other species that have a single bristle, situated basally, are: *littoralis* J. & T., *froggatti* Taylor and *spinifera* Hardy (1923, p. 277, fig. 2).

On *epsilon* J. & T., and possibly the same applies to *depressa* Desv., it is situated apically, whilst on the *impatiens*-group, *hardyi* J. & T., and *alcicornis* Hardy (1932, p. 276, fig. 1), the bristle is situated about the middle of the anterior edge.

Under the subgeneric name *Parasarcophaga* J. & T., it is proposed to combine the *albiceps*-group, the *misera*-group and the *peregrina*-group, all of which have two bristles, situated very close together and placed subapically (Hardy, 1932, p. 279, fig. 4). The same character on *S. aurifrons* Macq. brings that species into this subgeneric conception.

Two species have three bristles on the posterior clasper, and these bristles are widely separated. The two forms seem to have no other important character in common, and hence cannot be related. *S. kappa* J. & T. is indigenous to Australia, whilst *S. securifera* is an introduced form that seems to have some remote relationship with the subgenus *Parasarcophaga.*

Helicobia australis J. & T. has two bristles, situated towards the apex, but, unlike *Parasarcophaga,* these are situated wide apart.

The only Australian species not accounted for in this paper is *Sarcophaga omikron* J. & T., and there seems to be no specimen sufficiently well mounted to permit a study of the claspers. They were omitted from the drawings given by Johnston and Hardy on this account and, although widely distributed, further specimens do not seem to have been discovered since then.

As these bristles will play a leading part in the future studies on the Sarcophagid flies, especially for group formation, they have been made a leading feature in the following key:—

Key to the Australian Sarcophagid flies, chiefly based on the posterior clasper.

1. With one bristle on the posterior clasper .. .. 2.
   With more than one bristle on the posterior clasper .. 4.

2. Bristles on the posterior clasper placed more or less basally .. .. 9.
Bristle placed at or beyond half the length of the posterior clasper .. .. 3.
3. Anterior clasper furcate .. .. *antilope*-group.
Anterior clasper simple .. .. 12.
4. With three bristles spaced wide apart on the posterior clasper .. .. 5.
With only two bristles situated on the apical half of the posterior clasper .. .. 6.
5. Anterior and posterior clasper equal in length .. .. .. *kappa* J. & T.
Anterior clasper about twice the length of the posterior clasper .. .. *securifera* Vill.
6. The two bristles spaced widely apart .. .. *Helicobia australis* J. & T.
The two bristles placed very close together .. .. (*Parasarcophaga*) 7.
7. Anterior appendage with a cup-shaped part arising from a long slender stalk .. .. *albiceps*-group.
Anterior appendage not incorporating a slender stalk .. 8.
8. Anterior appendage thickly studded with minute spines .. .. *peregrina*-group.
Spines on the anterior appendage normal in number and hardly perceptible .. .. *misera*-group.
9. Apex of the aedeagus provided with a row of strong angulated spines .. .. *spinifera* Hardy.
Aedeagus without such spines .. .. 10.
10. Forceps with a minute indentation at apex; anterior clasper with a small subapical flange; sheath of aedeagus without a lateral process and simple at apex .. .. *crinata*-group.
Forceps and anterior clasper otherwise formed; with lateral process and with sheath deeply cleft .. .. .. 11.
11. Apex of forceps strongly bent towards each other .. *froggatti* Taylor.
Apex of forceps parallel .. .. *littoralis* J. & T.
12. Bristle placed subapically .. .. 13.
Bristle placed in the median position .. .. 15.
13. Anterior and posterior claspers about equal in length .. 14.
Anterior clasper nearly twice the length of the posterior clasper .. .. *depressa* Desv.
14. Anterior clasper with a large lateral flange .. .. *epsilon* J. & T.
Anterior clasper without such a flange .. .. *fergusoni*-group.
15. Anterior appendage with a hook-shaped process on the upper edge. Forceps strong and, seen laterally, arched .. .. *impatiens*-group.
Anterior appendage without such a process .. .. 16.
16. Appendages of the aedeagus flattened out, somewhat foliaceous, set well apart and exposing well developed filaments .. *hardyi* J. & T.
Appendages of the aedeagus much more complicated, curved inwards, the filaments, if present, not discernible; at apex with a pair of three-pronged, elk-horn formed processes .. .. .. *alcicornis* Hardy.

Subgenus PARASARCOPHAGA J. & T.

Johnston & Tiegs, Proc. Roy. Soc. Queensland, xxxiii., 1921, 86.

The general features found in the *misera*-group, *albiceps*-group and *peregrina*-group all indicate that there may be a close alliance between

these three, so that a major division of the Sarcophagas could be created, using them as a basis. If such an action proves justified they may ultimately be raised to generic status and equivalent to other genera that have been erected recently and separated from genus *Sarcophaga, sensu stricto.*

The subgenus was originally proposed for *Sarcophaga omega* J. & T., but it was based on a faulty conception of the head characters, whilst under the present consideration it may be recognised by the presence of two closely adjacent subapical bristles on the posterior clasper.

Besides the species already grouped under the three group-names mentioned above, *S. aurifrons* Macquart, would come within it. *S. aurifrons* Doleschall, as identified by Senior-White, may also belong here; the name was changed to *doleschalli* by Johnston and Tiegs on the grounds of priority, but these authors did not recognise specimens under that name. Doubtless there are many other species that may belong here, but as the necessary characters for recognition are omitted from drawings, or are incorporated in an unsatisfactory manner, I am unable to include them with conviction, nevertheless *S. walayari* S.-W., and *S. caudagalli* Bott. may be mentioned in this connection.

In a consignment of flies received from Mr. N. Baranoff, I have recently received two specimens, labelled respectively as being *Villeneuvella,* namely, *S. aratrix* Pandel and *S. dicifera* Pandel. Both these may come into the subgenus *Parasarcophaga.*

Sarcophaga albiceps-group.

I have discovered an error of interpretation in correspondence with Mr. R. Senior-White regarding the *albiceps*-group. Moreover, Mr. C. Ho, of the Fan Memorial Institute of Biology, has got in touch with me as he was about to publish in this same group. From both these I have been notified of this error occurring in my previous paper. There were two consignments of Sarcophaga received from Mr. Senior-White, neither of which bore names other than in covering letters, and one of these I understood to be *S. albiceps,* whereas both of them were *S. knabi.*

Mr. Ho has sent to me specimens of what he regards as being identical with *S. albiceps* from India, these certainly being in agreement with the illustration by Mr. Senior-White, but do not agree with that given by Bottcher, based on European specimens. From Dr. Herve-Bazin I have received an European specimen, and find this does agree with Bottcher's figure and not with that of Senior-White. I can only conclude that there is some confusion between European and Asiatic specimens, and to point out that the explanation to my figures should be amended by substituting *S. knabi* where *S. albiceps* occurs. The text also needs amendment, for all comparisons were between *knabi* and *omega,* but the general argument to the effect of the validity of the various species concerned still remains without alteration.

Sarcophaga crinata-group, *new group.*

In a previous paper (Hardy, 1927), I suggested that *S. carnaria* might be allied to *S. synia* and *S. crinata,* to which must now be added *S. kankauensis.* A study of the characters shows, however, that, although *S. carnaria* has superficial resemblances to the others, it does not have the same group values. That species is therefore excluded, leaving three or perhaps four described species to form the *crinata*-group:—

crinata Parker, 1917. Philippine Islands.

crinata Senior-White, 1924. India. May be another species.
synia Johnston & Hardy, 1923. Australia.
kankauensis Baranoff, 1931. Formosa.

I have been unable to detect in literature other species that may belong here, nevertheless there are certain features in some illustrations to suggest such alliances. Also both Parker and Senior-White do not seem to have drawn their figures in sufficient detail for me to be sure that certain characters found on both of the last two listed species do not also occur upon theirs. There is some doubt, therefore, as to whether all the characters listed below cover these species in their entirety, nevertheless such characters seem to be important enough for attention to be specially drawn to them.

Characters.—The forceps have a minute indentation at the apex, this being best seen from the lateral aspect (not shown by Parker and Senior-White). The anterior clasper has a small flange at its apex and is consistent in shape (except in Senior-White's figure where also a basal flange seems to occur). The bristle on the posterior clasper is placed basally (not illustrated on any figure published). The aedeagus is provided with a long simple anterior appendage and the main sheath is simple and strongly curved. The lateral process is never present, but a lobe may occur (occurs in Senior-White's figure and on *S. synia*).

SARCOPHAGA SYNIA Johnston & Hardy.

This species is rare in collections, all specimens being from Queensland. The holotype and another are from Brisbane, and Mr. F. A. Perkins took several in September, 1927, at Dunk Island.

SARCOPHAGA IMPATIENS-group, *new group.*

In this group I include *S. impatiens* Walker and *S. tryoni* Johnston and Tiegs. When last breeding these flies, some few years ago, I secured carrion blown almost exclusively by these two species and bred out a long series of each. Usually I have no difficulty in separating the puparia when more than one Sarcophagid fly is present in the pabulum, but in the present case I was unable to find characters to divide them. Since this I have been impressed by the manner in which the two forms are continuously grouping themselves together whenever new developments are made in taxonomic work. I believe an alliance will ultimately be found, but I have been unable to associate either with exotic forms known to me.

In distribution, *Sarcophaga impatiens* appears to be a common species breeding throughout the year in Sydney, whereas *S. tryoni* mainly replaced it in Brisbane. I do not know of the latter occurring outside Queensland, where it is found in abundance at least as far north as Townsville.

References.

HARDY, Aust. Zool., vii., 1932, pp. 275-281, 4 figs. (Certain characters of the bristles on the posterior clasper are illustrated here).

BARANOFF, "Konowia," x., 1931, pp. 110-115, figs. (Two exotic forms allied to Australian species are described in this paper).

ENDERLEIN, Arch. klas phylog. Ent. Wien., i., 1928, pp. 1-56, 7 figs. (Erects a number of new genera out of Sarcophaga, including *Villeneuvella,* but apparently these are mostly equivalent in value to my groups. I have not seen this work).

Other references are recorded in my earlier papers.

FIELD NOTES ON THE YELLOW-BELLIED FLYING PHALANGER.

PETAURUS AUSTRALIS Shaw.

By C. W. BRAZENOR, National Museum of Victoria.

Plate II.

Early in March of this year I was fortunate in having an opportunity to observe for several hours an adult specimen of the Yellow-bellied Flying Phalanger, *Petaurus australis* Shaw, in its native habitat. The animal was first seen, by the light of an electric torch, in the Woollybutt (*E. sieberiana*) belt (5,800 ft.), on the upper slopes of Mount Wills, Victoria. It appeared much greyer than daylight proved to be the case, and the dark dorsal stripe was very prominent, but its long and very bushy tail and large, naked ears made its identification a simple matter.

In many ways *Petaurus australis* possesses a curious combination of the characteristics of the Greater Flying Phalanger, *Petauroides volans,* and the Lesser Flying Phalanger, *Petaurus breviceps.* Beside the latter animal, which was twice seen in the same tree, its movements are sluggish, and appear somewhat laboured. It lacks this animal's apparent plumpness, but on the other hand its form is more compact and not so loosely built as the almost skeleton-like *Petauroides,* and its movements are quicker and more decisive than those of that creature.

The complete call, which I have heard on two occasions, commences on a shrill screaming note, which heard alone might be mistaken for that of *Petauroides,* though it has hardly the intensity of the larger animal's cry. It is broken suddenly, to be followed by the well known scolding *Skir-ur-ur* of *Petaurus breviceps,* which I once heard so aptly likened to the self-starter of a motor car. Either note may be uttered separately, the scold denoting aggression when the animal is teased or worried. At the instant of commencing a parachute flight, a long groaning *Oo-o-o* is uttered in apparent agony. This was the only note heard during the middle night or feeding period, the animal reserving its other calls for the morning and evening ambulations.

The Woollybutt belt of Mount Wills is sprinkled with a number of Manna Gums (*E. viminalis*), and it was upon the blossom of these that the animal was feeding. At that time the trees, some of them veritable giants, were full of blossom, which was thickest at the extreme ends of the topmost twigs. Amongst these the animal clambered, always hanging upside down like a sloth, swaying and bobbing as the twigs went under its weight, and with its long tail waving. In one particularly large tree nearly three hours was spent in this precarious position, the animal busily feeding with hardly a respite. The entire flower was eaten, no petals fell, and none was observed under the tree when daylight came. On another and smaller Manna Gum the animal spent some time on the lower trunk, being at times no more than ten or twelve feet from the ground. The bark was in places thickly studded with small pustules of dried sap, and these the Phalanger was licking, evidently being attracted by their sweetness.

Just before daylight (at this time of the year about 6 a.m.) the animal made its way to an immense Manna Gum, and, after a few shrill cries, entered a hole about 24 feet from the ground. The tree at some earlier date had been damaged by fire and was hollow at the base. Above this the heart-wood had rotted, and a narrow cavity extended up the centre from about 8 feet to almost the base of the lower branches. In this cavity was the nest, a well-made globe of gum leaves about 12 inches in diameter.

Except that it was larger and more tightly woven, it was exactly similar to the nest of *Petaurus breviceps*.

With the first few blows of the axe on the tree, the animal exhibited a trait of *Petauroides volans* by leaving the nest cavity and climbing to the top of the tree. The Lesser Flying Phalanger always remains in the hollow till the tree crashes.

Two animals were captured, an adult male, and half-grown female. Both were uninjured and are thriving in captivity. Their principal diet in the captive state consists of bread and milk, with honey or jam, and of this large quantities are consumed. Gum leaves or tips are not touched, neither will the animals eat fruit, lettuce leaves, or other green vegetables. Gum Blossom is a delicacy, and is supplied as often as it can be procured. It is already evident that *Petaurus australis* has the hardy constitution of the Lesser Flying Phalanger and does not need, in captivity, the careful nursing that must be afforded to the more delicate *Petauroides*.

The general disposition of the animals is placid, and even immediately after capture they were not greatly upset by being handled. Although the bite is deep, and, like that of *P. breviceps*, very painful, little attempt is made to use the teeth unless the animal is deliberately annoyed. Considering its unperturbed adoption of a captive life, there would seem to be no reason why this interesting species should not successfully breed in captivity.

Plate II.

Petaurus australis Shaw, ♂.

THE RATE OF GROWTH IN REPTILES.

By A. S. Le Souef, C.M.Z.S.

As it is not often that opportunity occurs to note and record the growth of reptiles, notes taken on three widely different kinds in Taronga Park should be of interest.

It is generally supposed that cold blooded animals increase in size very slowly, but it would seem that no general rule can be laid down, for lizards appear to reach maturity in two seasons. Tortoises appear to grow much more slowly, and doubtless this is retarded more or less in captivity, where conditions may not be exactly suited to all requirements of the species.

Albemarle Tortoise, *Testudo guntheri*.

This species is one of a group of Giant Tortoises, so curiously isolated on the Galapagos Islands. As it was feared that, owing to liberation of dogs and pigs on Albemarle Island, these interesting but rather helpless reptiles might become extinct, the New York Zoological Society secured about one hundred specimens and distributed them to several institutions in different parts of the world. Taronga Park received six in 1930. Since then they have lived in an open paddock, where they feed mainly on buffalo grass. It is noticeable that they cannot stand much sun, as in summer, if the sky be clear, they soon seek shade, and remain under cover until late afternoon.

The rate of growth is rather irregular, but roughly they increase their weight about two and a half times in two years.

Details are as follows:—

		Weight in lbs. as in—			
No.	July, 1928.	March, 1931.	March, 1932.	March, 1933.	March, 1934.
1.	$3\frac{1}{2}$	5	$8\frac{3}{4}$	$12\frac{1}{2}$	$19\frac{3}{4}$
2.	3	7	$11\frac{1}{4}$	$16\frac{1}{4}$	27
3.	$4\frac{1}{2}$	$7\frac{1}{8}$	10	12	23
4.	$3\frac{1}{4}$	$5\frac{3}{4}$	10	$14\frac{1}{8}$	21
5.	3	$4\frac{7}{8}$	$8\frac{1}{2}$	$12\frac{1}{2}$	21
6.	$3\frac{1}{4}$	$4\frac{5}{8}$	$7\frac{3}{4}$	12	$21\frac{3}{4}$

The period between July, 1928, and April, 1930, was spent in transport and North America, where the climate was not suitable for growth.

Boa constrictor.

Several young Boas, of the species mentioned, hatched in the Zoological Gardens, Perth, Western Australia, in March, 1931, were received in Taronga Park shortly afterwards. The youngsters were rather spiteful, hissing and striking at anything that approached them. Before they had fed the skins were cast. During the first few months of their life the only food that they showed any interest in was young mice. At a later stage they took sparrows and finches, and this enabled us to make good use of such birds as died in the aviaries. Serpents are sometimes shown as the emblem of wisdom. Although those that have been under observation here do not do anything to earn that reputation, one of these snakes showed some thought when it secured three birds that had been placed in the cage. Two of these were held in separate coils, while the third was swallowed and the other two taken seriatim.

These snakes are rather sluggish and strictly arboreal, as they spend practically all their time in the trees. As might be expected, their tails are strongly prehensile. They are handsomely marked in shades c yellow, umber brown and white, and show an unusual peculiarity in having the posterior third of the body differently patterned to the fore part.

It is interesting to note that the body markings show clearly on the cast skin.

Length:	March, 1931.	March, 1932.	March, 1933.	April, 1934.
	25 inches.	$41\frac{1}{2}$ inches.	62 inches.	65 inches.

Measurement of the live reptile and the cast skin shows that the latter stretches about 10%.

Hawksbill Turtle, *Chelone imbricata.*

Length.—January, 1932: Tip of bill to posterior end of carapace, $2\frac{1}{2}$ inches; width, 1-2/3rd inch.

Length.—April, 1933: $10\frac{1}{2}$ inches; width, 6 inches.

A Green Turtle, *Chelone mydas*, which was approximately the same size as the Hawksbill when received, has grown a little more slowly, as in April, 1933, it was $9\frac{5}{8}$ inches in length with a width of 5 inches.

It is probable that these turtles would grow very much faster in their tropical seas.

THE FRESH-WATER MUSSELS OF AUSTRALIA.

By Tom Iredale.

(By Permission of the Trustees of the Australian Museum.)

(Plates iii.-vi.)

Recent acquisitions at the Australian Museum necessitated the determination of some of these interesting shells, and so much confusion was found that a review was undertaken. To furnish a complete monograph would take many years, so a short resumé of our present knowledge is here offered to promote study. Elsewhere these shells are favourites, but nothing has been done in connection with them in this country for half a century. Hitherto river systems and geography have been neglected, and these items are most important.

In the Proceedings of the Linnean Society of London, Zoology, Vol. xvi., 1881, the conchologist of the British Museum, E. A. Smith, furnished a report "On the Freshwater Shells of Australia." On pages 307-313 an excellent account, from an extra-limital museum worker's point of view, was presented, and so well was it prepared that it has been accepted without criticism for over fifty years.

In that list all the species were listed, save one, under the genus *Unio,* and eighteen species were admitted, while eleven other names were ranked as synonyms. All the species had been figured, so no illustrations accompanied Smith's report.

Simpson, in his Catalogue of the Naiades, pt. iii., 1914, admitted *Diplodon* (*Hyridella*) *dorsuosus* Gould, 1850 = *nepeanensis* Conrad, 1852, *glenelgensis* Dennant, *vittatus* Lea, *lessoni* Kuster, *australis* auct. with many synonyms, and var. *legrandi* Petterd, *jeffreysianus* Lea, *profugus* Gould, *moretonicus* Reeve, *cultelliformis* Conrad = ? *depressa* Lam. = *paramattensis* Lea, *wilsonii* Lea = *stuarti* A. Adams & Angas, *evansi* A. Adams & Angas, (*Cucumaria*) *novae hollandiae* Gray = *cucumoides* Lea = *cumingianus* Dunker, *shuttleworthii* Lea = ? *mutabilis* Reeve = *angasi* Sowerby, and *mutabilis* Lea.

A synopsis of the Naiades had been previously published by Simpson (Proc. U.S. Nat. Mus., xxiii., 501-1044, October 8, 1900), but as the catalogue shows his later conclusions, and as in both cases he was not well conversant with Australasian forms, only the completed catalogue is here quoted.

Simpson's classification is of one family, Unionidae, split into subfamilies, of which the subfamily Hyriinae is diagnosed as having "Beak sculpture radial." This is subdivided into groups: *Rosanorhamphus,* with the "Beak sculpture generally zigzag radial; epidermis often bright," and *Lamphorhamphus,* with the "Beak sculpture radial, often curved; shell dull colored." Under the latter, Simpson classed all our mussels in the one genus, *Diplodon,* placing most under the subgenus, *Hyridella,* described as having (p. 1288) "Beaks rather low, sculpture consisting of curved, generally nodulous ridges."

Swainson had indicated that in some Australian shells the beaks were not "sulcated," but this striking feature was overlooked until Frierson again recorded the fact. Immature specimens, brought in to me by Mr. H. J. Overall from the Railway Tank at Clearfield, near Grafton, N.S.W., showed no beak sculpture, and this re-discovery led me to investigate this family. Probably this lack of beak sculpture in Australian mussels may not claim such a high value as is given elsewhere, but in connection with the absence of a hooked glochidium stage suggests the usage of a family, *Propehyri-*

dellidae, for all the Australian freshwater mussels. It may be noted that Ihering (Nautilus, xv., September, 1901, 52) advocated the distinction of the South American mussels with family rank, under the name, *Diplodontidae*; our family is nearest to this one.

By means of shell characters alone, Australian mussels are divisible into groups, and these are confirmed by study of the hinge features, while the scars of the muscles are also characteristic. It will be seen that there has been great confusion in their nomination through lack of information of the above features, and the data here produced will, it is hoped, incite interest and investigation. Many more forms and species probably exist than are here noted, while longer series will also enable separation of forms of the species here allowed.

Again, all our mussels are placed in the one family, though some have smooth umbones, and some have plicate beaks. Later study of the animals will enable separation and perhaps correlation with extra-limital genera, but in the meanwhile it would be very unwise to attach any species to extra-limital genera without complete examination of animals comparatively. However, in order that mistakes may be minimised, the species with plicate beaks will be classed together, in two subfamilies, *Propehyridellinae* and *Cucumerunionae*. Thus Family *Propehyridellidae*.

Subfamily *Velesunionae*. Beaks smooth.
Subfamily *Lortiellinae*. Beaks ridged.
Subfamily *Cucumerunionae*. Beaks plicate. Shell large.
Subfamily *Propehyridellinae*. Beaks plicate. Shell small.

There has been so much misusage of names in the past that no records of animal characters can be assigned at present, and no further investigation in this direction can be undertaken until the shell names have been correctly allotted. Further, the river systems, so much utilised elsewhere in the discrimination of species, are not yet well known, as very similar species are found in apparently distinct systems. The species have been distinguished, taking geographical data into consideration, with the material at hand, and this review must be understood as a basic attempt only. Many of the older species were described from "Australia," and careful criticism of series with the figures has resulted in the assignment of the names as hereafter given. Many figures are known, but they are scattered throughout many books, none of them commonly available to the student to-day, so photographs are here offered of the species recognised.

This essay is offered as an introduction only, and it is hoped that search will be made in many rivers, as many inquiries are received regarding the possibility of their commercial value as pearl shell. Specimens may be sent to the Australian Museum for identification.

Note.—After this paper had been prepared I received a very unexpected account of the "Australian Unionidae," by B. C. Cotton and C. J. Gabriel (Proc. Roy. Soc. Vict., vol. 44 (n.s.), pp. 155-160, pl. xvi., published April 20, 1932). Covering exactly the same ground as my essay, these writers did not have access to the literature available to me, and their collections were of much less extent, save as regards South Australia and Victoria. They have introduced two new generic names, *Propehyridella* (p. 158), with type, *U. nepeanensis* Conrad, arranging thereunder *cultelliformis* Conrad (= *depressus* Lamarck), *narracanensis* nov. (Narracan River, Gippsland, Victoria), and *nepeanensis* Conrad (p. 159) and *Protohyridella* (p. 159), with type, *U. glenelgensis* Dennant. In my MS. I had proposed a new generic name for the *depressa* group, but had regarded *glenelgensis* as worthy only

of subgeneric rank. Otherwise there is little conflict with my conclusions in their paper, and I am simply making the necessary alterations with a few comments when needful.

A large quantity of useful material accompanied by exact notes has been forwarded to the Museum by Mr. H. Bernhard, of Rockhampton, Queensland, and this has confirmed my previous conclusions as to the stability and variability of the species and genera.

Genus Velesunio nov.

Type *Unio balonnensis* Conrad.

This name is introduced for large series of Australian mussels which have been variously named.

The characteristics of the group as regards shell features are well marked and easily recognisable.

Shell thin, with beaks submedian, smooth, neither radial nor zigzag nodulation being present; swollen but little winged, growth stages being sometimes well marked, but otherwise the only sculpture is delicate, concentric striation. Teeth normal, two pseudocardinals and one lateral in right valve, one pseudocardinal and two laterals in left valve; the teeth elongate and slender. Muscle scars lightly impressed, the anterior adductor large, the anterior retractor-pedis small and fused with the adductor, the protractor-pedis rounded, medium and not separated from the adductor, though line of demarcation usually present; posterior scars so lightly marked that they cannot be utilised easily; dorsal scars four in a line under the beaks sometimes coalescing. Nacre of varied coloration.

Previous descriptions of animals may apply to this genus, but re-investigation is necessary in connection with the species as distinguished in this account.

Velesunio balonnensis.

(Plate iii., figs. 1-3; pl. iv., figs. 1-3.)

1850. *balonnensis, Unio,* Conrad, Proc. Acad. Nat. Sci. Philad., v. (1), 10, February. Balonne River, New South Wales.
1854. *balonnensis, Unio,* Conrad, Journ. Acad. Nat. Sci. Philad., iii., 295, pl. xxvi., fig. 3, February.
1881. *ambiguus, Unio,* Smith, Journ. Linn. Soc. (Lond.), Zool. xvi., 309.
1914. *australis, Unio,* Simpson, Cat. Naiades, iii., 1297.

For East Australian shells of this genus the specific name *ambiguus* has been commonly used, but Philippi's figure agrees better with West Australian shells, and is there allotted. Lamarck's *australis* and *depressa* have both been utilised, but are undoubtedly inapplicable, and *balonnensis* is the earliest name for a New South Wales shell. Long series showing growth and individual variation are at hand from the Moonie River, a tributary of the Barwon River, which is part of the Balonne River system. These have been compared with specimens from the Balonne River and agree minutely. Shells of medium size, oval, little winged, beaks a little anterior, much swollen posteriorly, thin, concentric growth ridges marked, posterior ridge elevated, rounded.

Specimens from the Richmond River are much more compressed, apparently larger, but differ, notably in shape, anteriorly, showing somewhat acute angulation, the dorsal ridge flattened, the posterior slope shallow, the ventral margin well rounded. For the present these are separated subspecifically only as *V. balonnensis adjunctus* subsp. nov.

From around about Rockhampton, Port Curtis, Queensland, many specimens very like the typical *balonnensis* are at hand. They are proportionally a little deeper and during growth stages more swollen, though the very aged most swollen Balonne shells may equal them. The concentric growth ridges are more pronounced, and these are named subspecifically *V. balonnensis intricatus* subsp. nov.

It must be recorded that the study of these shells must take into consideration the vicissitudes of the inland rivers under drought conditions, and, hence, distortion in growth in many specimens from such localities.

Cotton and Gabriel have admitted two species, *H. australis* (Lam) and *H. ambigua* (Philippi) from Queensland, New South Wales, Victoria, Tasmania, South Australia and West Australia, recording the former only from Victoria and Tasmania, and the latter from South Australia and West Australia alongside, a confusion not in accordance with geographical distribution as I have used it. A specimen from the National Museum, Melbourne, labelled *Hyridella australis,* from the Darling River, N.S.W., Coll. F. Cudmore, 1929, is elongate, like *danellii,* from the Dandenong; typical *danellii* are labelled *australis.*

Velesunio danellii.

(Plate iii., fig. 4; pl. iv., fig. 4.)

1871. *danellii, Unio,* Villa, Journ. de Conch., xix. (3 ser. xi.), 328, October 1, "in Australia meridionale, in rivulo prope Brunswick," i.e., tributary of the River Yarra, Victoria.

1871. *jeffreysianus, Unio,* Lea, Proc. Acad. Nat. Sci. Philad., n.s., 188, October 24. Australia = River Yarra, Victoria.

1874. *jeffreysianus, Unio,* Lea, Proc. Journ. Acad. Nat. Sci. Philad., viii., 23, pl. vii., fig. 20, April.

1881. *danellii, Unio,* Smith, Journ. Linn. Soc. (Lond.), Zool., xvi., 311.

1914. *jeffreysianus, Diplodon,* Simpson, Cat. Naiades, iii., 1299.

The common Yarra shell was undoubtedly named *danellii,* as the measurements testify, 92 x 57 x 34 mm., and Crosse, the editor of the French journal, noted at the time he was the possessor of specimens of the same species from the river Yarra, sent to him by Dr. J. Cox, unaware of the exact location of Brunswick, in Southern Australia.

The measurements of *jeffreysianus,* 2.8 x 1.7 x 1 inch, indicate the same species, whose differential feature was the lateral tooth, single in both valves. Smith suggested this single tooth was merely an aberation, and that a specimen in the British Museum from Melbourne also showed this peculiarity.

Velesunio shuttleworthi.

(Plate iii., fig. 5; pl. iv., fig. 5.)

1855. *shuttleworthi, Unio,* Kuster, Conch. Cab. (Mart. & Chemn.), continued, ix. (2), lief. 147, pl. xliv., fig. 2 (name on cover), ex-Charpentier MS. Australia = Tasmania: here determined.

1856. *shuttleworthi, Unio,* Kuster, Conch. Cab. (Mart. & Chemn.), continued, ix. (2), (lief. 150), p. 152.

1859. *vittatus, Unio,* Lea, Proc. Acad. Nat. Sci. Philad., iii., 153. Australia = Tasmania: here selected.

1860. *vittatus, Unio,* Lea, Journ. Acad. Nat. Sci. Philad., iv., 249, pl. xxxviii., fig. 128, March.

1865. *moretonicus, Unio,* Reeve, Conch. Icon., xvi., pl. xxiv., sp. & fig. 118. April. Tasmania and Moreton Bay.

1881. *shuttleworthi, Unio,* Smith, Journ. Linn. Soc. (Lond.), Zool., xvi., 311.

1889. *legrandi, Unio,* Petterd. Papers Proc. Roy. Soc. Tasm., 1888, 81. (Not Proc. Roy. Soc. Tasm., 1887, 22, where it does not occur.) Tasmania.

1914. *vittatus, Diplodon,* Simpson, Cat. Naiades, iii., 1296.

1914. *australis* var. *legrandi, Diplodon,* Simpson, Cat. Naiades, iii., 1298.

1914. *moretonicus, Diplodon,* Simpson, Cat. Naiades, iii., 1300.

1921. *australis, Diplodon,* May, Check List Moll., Tasm., 21.

1923. *australis, Diplodon,* May, Illustr. Index Tasm. Shells, pl. ix., fig. 11.

The Tasmanian mussel or rather mussels have always caused trouble, as when Reeve named his *Unio moretonicus* in 1865 he gave as localities, "Tasmania and Moreton Bay." The name selected would imply that the type locality should be Moreton Bay, but unfortunately no musseel agreeing with the figure is known from that locality. As a matter of fact the figure does not portray the Tasmanian shell too well, so that Simpson has even written, "It is quite probable that he had before him a *Unio obesus blandingianus* from Florida, as his figure and brief, incomplete description absolutely agree with that."

Tenison Woods agreed that the localities Moreton Bay and Tasmania for the one species were inacceptable, and then Petterd (Papers and Proc. Roy Soc. Tasm., 1888, 81, 188) cut the Gordian Knot by naming the Tasmanian shell *Unio legrandi.* A curious complication in this reference must be noted here. In the Australian Museum is a specimen labelled "type" *"Unio legrandi* Petterd, Proc. Roy. Soc. Tasm., 1887, 22." Nothing like this occurs at the place cited, and it seemed inexplicable until it was found in the Zoological Record carefully recorded for the year 1887. Search through sets of reprints soon located it, and it appears that the paper was set up as the first paper of 1887, and then withheld for a year and included in the 1888 volume, the pagination altered, but little else changed. Simpson cites the earlier reference, as well as the correct one.

The reason may have been R. M. Johnston's antagonism, as following Petterd's published account appears a long diatribe by the first-named concerning all Petterd's work, and a special paper endeavouring to show the immense variation in the mussels (Papers Proc. Roy. Soc. Tasm., 1888, pp. 95-96, 2 pls.). Very recently May has included two species, noting that the second might be only a variant, much smaller and narrower, but unfortunately his nomination is altogether at fault. The larger one he calls *australis* (including var. *legrandi*) and the smaller *mortonicus* (through mental confusion with A. Morton, a famous Tasmanian naturalist). The smaller one is quite unlike Reeve's figure of *moretonicus* and resembles shells from Mount Kosciusko, New South Wales, and these suggest relationship with the Neozelanic mussel known as *"zelebori."*

While as written above the figure of *moretonicus* is doubtfully prepared from a Tasmanian shell, the earlier *shuttleworthi* of Kuster is very like, agreeing in detail, a notable feature being the spaced growth periods.

The Tasmanian species is a little winged, the posterior end somewhat abruptly truncate, the posterior ridge elevated, the anterior end narrowed and rounded. It is never so swollen as Northern N.S.W. shells, and is always a different shape. The shell varies in thickness, and is sometimes rather solid for this genus, and then the teeth are correspondingly stouter.

Velesunio evansi.

(Plate iii., figs. 6, 7; pl. iv., figs. 6, 7.)

1864. *evansi, Unio* (*Alasmodon*), A. Adams & Angas, Proc. Zool. Soc. (Lond.), 1864, 39. June 24. Lagoon of the Lower Murray River, Australia.

1867. *evansi, Unio,* Sowerby, Conch. Icon. (Reeve), xvi., pl. lvi., sp. & fig. 285. June. Same locality and collection; type figured.

1881. *evansi, Unio,* Smith, Journ. Linn. Soc. (Lond.), Zool. xvi., 312.

1914. *evansi, Diplodon,* Simpson, Cat. Naiades, iii., 1303.

No series of this form is available at present though Angas remarked upon their uses by the natives many years before the species was given a name (Savage Life and Scenes in Australia and New Zealand, i., p. 55, 1847).

Apparently it is a compressed shell, as Sowerby's note says, "A rounded square, rather flattened," and "thin, depressed," though the figure suggested a somewhat obese shell. Two specimens agree fairly with the illustration and description, but one is juvenile and the other a little aberrant, and might even belong to a different species. The juvenile is a little more winged than the Tasmanian species, and even at this stage "more square."

Specimens from the National Museum, Melbourne, collected by Blandowski at Reedy Lake, junction of Murray and Darling Rivers, N.S.W., and named as *H. ambiguus* agree absolutely with the above cited figure.

Genus Westralunio nov.

Type *W. ambiguus carteri* nov.

All the South-west Australian specimens are small and of the *"ambiguus"* shape, but with strong teeth. Comparison with the figure of *ambiguus* indicated more exactly the West Australian shells than East Australian as commonly accepted. Consequently, Philippi's name is here restricted to the South-west Australian group, but as differences are noted in the series studied the generic characters are here prepared from specimens collected by Mr. Tom Carter, which are here distinguished for the sake of accuracy as *W. a. carteri.* Shells scarcely winged, oblong, posterior end obliquely truncate, anterior rounded, ventral edge little rounded; beaks smooth. Teeth smooth; pseudocardinal in right valve elongate, stout, coarsely grooved, fitting into a similar socket in the left valve, the internal tooth stout and grooved, the external one small, flattened and disappearing; the long blade-like lateral in the left valve is slightly grooved and fits into a deep groove in the right; the external tooth tending to disappearance, and the internal one large and prominent. The muscle scars are well impressed, sometimes deeply so, the anterior retractor pedis and the protractor pedis both being small and confluent with the adductor; posterior scars light but little impressed; dorsal scars two or three deep pits.

Westralunio ambiguus.

(Plate iii., fig. 8; pl. iv., fig. 8.)

1847. *ambiguus, Unio,* Philippi, Abbild. Conch., iii., Unio, pl. iii., fig. 2, p. 7 (47), ex-Parreyss MS. (November). Nova Hollandia = West Australia.

1861. *philippianus, Unio,* Kuster, Conch. Cab. (Mart. & Chemn.), continued, ix. (2), 235. New name for *ambiguus* Philippi.

Comparison of a series of mussels from South-west Australia shows that *ambiguus* was almost certainly a West Australian shell. Specimens have been examined from the Victoria Reservoir, in the Darling Ranges, 12 miles east of Perth, from the Canning River, near Perth, from the Collie River, Vasse River, Warren River, Frankland River, and King George's Sound. The three last-named series approximate most closely to Philippi's figure and description, and King George's Sound is here selected as the restricted type locality. The specimens from the Victoria Reservoir are larger and more elongate and are here named *W. a. carteri* subsp. nov., and the generic characters have been written up from this subspecies. The typical form is small, rather solid, rather plump, anterior end broadly rounded, posterior rather sharply truncate, posterior ridge rounded. Teeth stout, muscle scars deeply impressed. Smith, in the Zoology of the Erebus and Terror, published a figure on plate iv., to which he ascribed the name of *U. moretonicus* Reeve, giving the locality as "Australia" (Membridge River), presented by Sir J. Richardson. I have not exactly determined the locality "Membridge River," but it is apparently somewhere in the Northern Territory, perhaps near Victoria River. Specimens agreeing very closely with Smith's figure were collected by Dr. H. Basedow in the area between Port Darwin and Katherine River, Northern Territory, and their shape recalls that of these southern West Australian shells, but the hinge does not show the coarse teeth, and they seem to represent the true *angasi* in a degenerate ally.

Genus ALATHYRIA nov.

Type *A. jacksoni* nov.

Simpson placed the members of this group, which he called *Diplodon shuttleworthii* Lea, under the section *Cucumaria,* with the type of which genus they have little in common. He allowed *profugus* Gould to remain in his complex section *Hyridella,* whereas it appears to belong here. The generic characters are well marked conchologically. Shells large, swollen ovals, more or less winged posteriorly, this feature more noticeable in the juvenile, thick, beaks antemedian, not wrinkled; teeth strong, well developed; muscle scars well marked but a little variable in the species. The anterior retractor-pedis is small and sometimes well indicated, while the protractor-pedis is sometimes small and separated, but later become connected and larger.

Simpson wrote: "Beak sculpture consisting of strong, irregularly radiate, curved, nodulous bars," as the group character, and then in the specific description, "beaks low, subcompressed, sculptured, with radial bars, which curve towards each other." As locality he gave "Australia," a somewhat meaningless term.

Frierson (Nautilus, xxii., 1908, 118) has reiterated that *"Diplodon shuttleworthi* Lea, has a deeply and coarsely sulcated disc"; also regarding "Australia" as unworthy of subdivision further.

These statements are very puzzling, as large numbers of the so-called *shuttleworthi* are available from 20 mills. upwards, and, though none has a completely uneroded beak, there is no sign of sulcation present. After this was written, to my astonishment, I found that Simpson's *shuttleworthi* was undoubtedly a very slight variant of *novae hollandiae,* the measurements agreeing exactly, while study of the detailed description leaves no doubt whatever. It is then even more curious to reconcile Frierson's statements, as no Australian conchologist would confuse the two species, and Frierson asserts his shells were both labelled *angasi,* a remarkable error.

This group is called *Hyridella angasi* (Reeve), by Cotton and Gabriel, a Victorian locality, Cramenton, being added.

Note.—Internally the anterior portion of the shell is thickened and flattened ventrally, while the posterior portion is thin and swollen, suggesting a brood pouch.

Alathyria profuga.

(Plate iii., fig. 9; pl. iv., fig. 9.)

1851. *profugus, Unio,* Gould, Proc. Bost. Soc. Nat. Hist., iii., 295 (dated November, 1850), Hunter's River, New South Wales.
1852. *profugus, Unio,* Gould, United States Expl. Exped., xii., 429 (fig. 543, 1862).
1881. *profugus, Unio,* Smith, Journ. Linn. Soc. (Lond.), Zool., xvi., 310.
1914. *profugus, Diplodon,* Simpson, Cat. Naiades, iii., 1299.

This fine species has been called *shuttleworthi* or *angasi,* but the correct name seems to be one here selected. Three forms, which are here given specific rank, can be separated, the coastal form from New South Wales being typical.

Shell elongate-oval, anterior end rounded and narrowed, posterior end a little broader but little winged, posterior ridge flattened and negligible; shell thick, beaks apparently smooth; sculpture concentric growth lines well marked and forming shallow ridges. From the thickened flattened teeth and very deeply impressed muscle scars the typical form does not appear to grow to such a large size as it congeners, the left laterals coalescing and save for a slight duplication posteriorly appearing to be single and the pseudocardinals likewise.

Alathyria pertexta sp. nov.

(Plate iii., fig. 10; pl. iv., fig. 10.)

1856. *shuttleworthi, Unio,* Lea, Proc. Acad. Nat. Sci. Philad., viii., 94. Australia. Not *Unio shuttleworthi* Kuster, 1855, ante.
1857. *shuttleworthi, Unio,* Lea, Journ. Acad. Nat. Sci. Philad., iii. (2), 304, pl. xxviii., fig. 19.
1866. *shuttleworthi, Unio,* Sowerby, Conch. Icon., xvi., pl. xxxvii., fig. 167. March.
1881. *angasi, Unio,* Smith, Journ. Linn. Soc. (Lond.), Zool., xvi., 307. Specimens from Brisbane River and perhaps those from River Isaacs.

This very fine shell from mid and south Queensland rivers differs from the coastal New South Wales *profuga* in being more elongate and perhaps growing to a larger size. Sowerby's figure quoted above represents this elongated shell, as also Lea's, and South Queensland specimens were commonly available at that time.

Shell elongate oval, anteriorly rounded, posteriorly winged and elongate, dorsal margin a little excavate anterior of the umbo, ventral margin rather straight; posterior ridge elevated, posterior area flattened and sometimes scantily radially wrinkled; sculpture of remainder of shell concentric striae only becoming wrinkled towards the margins and less rugose than in preceding species.

Alathyria jacksoni sp. nov.

(Plate iii., fig. 11; pl. iv., fig. 11.)

Many years ago Hedley made a note in his copy of Smith's account of Unios that shells from the interior of New South Wales were more winged

than coastal ones. A very fine collection made by Mr. Sidney W. Jackson from the Barwon River showed all sizes, and the "winging" of the juvenile is very striking, the shape of the shell separating this species at sight from its congeners, *profuga* and *pertexta*.

Shell large, elongate oval, fairly strongly winged and posteriorly somewhat acuminate; anteriorly rounded and the ventral margin nearly straight; posterior ridge elevated and rounded; posterior slope flattened and thinned out. Beaks apparently smooth, remainder of shell rather finely regularly concentrically striate, growth periods not strongly differentiated. Juvenile shells much more strongly winged, almost wedge-shaped and comparatively thin. Teeth variable in strength, according to weather growth conditions; sometimes the pseudocardinals short and stumpy, at others large and prominent; often the left laterals fuse most of their length; muscle scars deeply impressed; the protractor-pedis small and sometimes free.

Genus Centralhyria nov.

Type *Unio stuarti* A. Adams & Angas.

This genus is provided to include all the mussels from Central Australia, ranging into the Fitzroy River in the north-west until Fitzroy River in Queensland, which have generally been classed as one species. Probably many forms will later be recognised as the size variation is great.

The superficial aspect recalls that of *Anodonta,* and the teeth are slender, delicate and sometimes obsolete through growth; the shell itself being thin until it reaches very large size. Shell elongate, thin, of medium convexity, rounded anteriorly, somewhat acuminate posteriorly, the posterior ridge rounded; the ventral edge subparallel to the dorsal, rounded. Beaks smooth, the sculpture being concentric growth lines between which fine concentric striae run wrinkly.

The teeth are normal, but through degeneration sometimes appear obsolete; at others only a weak pseudocardinal persists in the right valve; the laterals in the left valve very slender, laminar and close together. The muscle scars are very lightly impressed, the anterior adductor showing a rounded protractor-pedis which elongates with age, while the anterior retractor-pedis is indistinguishable in some forms; in others it can be detected as a small semi-fused scar.

Centralhyria stuarti.

(Plate iii., fig. 12; pl. iv., fig. 12.)

1864. *stuarti, Unio* (*Alasmodon*), A. Adams & Angas, Proc. Zool. Soc. (Lond.), 1863, 417, April 20, 1864. Lagoon, near Mt. Margaret, Central Australia.
1866. *stuarti, Unio,* Sowerby, Conch. Icon., Reeve, xvi., pl. liv., fig. 279. November. Immature. Port Jackson. Mus. Cum. in Brit.
1867. *stuarti, Unio,* Sowerby, Conch. Icon., Reeve, pl. lv., fig. 279a. June. Fully grown, ex Mus. Angas.
1870. *stuarti, Anodon,* Sowerby, Conch. Icon., Reeve, xvii., pl. xxxiv., fig. 136 a.b. June. Hab. ? Juv. in B.M.
1881. *stuarti, Unio,* Smith, Journ. Linn. Soc. (Lond.), Zool., xvi., 311.
1914. *wilsonii, Diplodon,* Simpson, Cat. Naiades, iii., 1302.

The type locality lies about 136° E. Lat. and 28° 30' S. Long., west of Lake Eyre, but Tate later records specimens from Newcastle Waters, apparently taken on Stuart's second expedition.

The second figure given by Sowerby, either of the type or a paratype,

agrees with specimens from Algebuckinna, a locality close to the type locality. These were recorded by Hedley (Trans. Roy. Soc. South Aust., xxix., 1905, 161) under the name *Diplodon wilsonii.* While that species resembles the present one it cannot be regarded as conspecific, the teeth in this case becoming obsolete with age, while in *wilsonii,* as here understood, they become stouter and the shell thicker.

The Algebuckinna shells are elongate, anteriorly rounded, posteriorly rather angulate, ventral margin rather straight, subparallel to the dorsal margin; the posterior ridge is low and flattened, the growth ridges irregularly pronounced, beaks apparently smooth and the whole shell thin. The teeth are very delicate, thin and laminar, almost disappearing with age; muscle scars very lightly impressed.

Centralhyria wilsonii.

(Plate iii., figs. 13, 14; pl. iv., figs. 13, 14.)

1859. *wilsonii, Unio,* Lea, Proc. Acad. Nat. Sci. Philad., 153. May. Eastern branch of Isaac's Plains, New South Wales.
1860. *wilsonii, Unio,* Lea, Journal Acad. Nat. Sci. Philad., iv., 256, pl. 40, fig. 137. March.
1868. *wilsonii, Unio,* Sowerby, Conch. Icon. (Reeve), xvi., pl. 88, lxxxviii., fig. 472. September. (Copied from Lea.).
1881. *wilsonii, Unio,* Smith, Journ. Linn. Soc. (Lond.), xvi., 311.
1914. *wilsonii, Diplodon,* Simpson, Cat. Naiades, iii., 1302.

The type locality cited appears to be in what is now called Queensland, inland a little, midway between St. Lawrence and Bowen, Isaac's River running into the Mackenzie River, which is itself captured by the Fitzroy. The shell figured by Lea was a small fairly symmetrical oval measuring 1.9 x 1 x .6 inch, and the teeth are thus described "cardinal teeth small, lamellar, oblique, double in the right and single in the left vale (sic) lateral teeth long, acicular and nearly straight."

Specimens from "Gladstone," Mary River, Emmett Downs, Hughenden and Longreach differ a little among themselves, but all show a larger growth, more swollen and deeper posteriorly, and in the largest specimens strong acicular teeth persist. Consequently, until much more study has been undertaken, the species should be kept separate, and it is very possible that the series here lumped under *wilsonii* will be divided. Shells from the May River, North-west Australia, though of the same thin texture and having similar delicate teeth, again differ in shape, being much deeper posteriorly, the ventral margin distinctly sloping posteriorly, while the dorsal margin is there heightened. This subspecies may be called *C. wilsonii caurina* nov.

Centralhyria angasi.

(Plate v., fig. 4; pl. vi., fig. 1.)

1867. *angasi, Unio,* Sowerby, Conch. Icon. (Reeve), xvi., pl. lv., fig. 282, ex Lea MS. June. Strangway River, North Australia.
1864. *"angasana, Alasmodon,* Lea," A. Adams & Angas, Proc. Zool. Soc. (Lond.), 1863, 417, April 20, 1864, *nom. nud.* Central Australia.
[1870. *angasii, Anodon,* Sowerby, Conch. Icon. (Reeve), xvii., pl. xxxii., fig. 127, June, ex "Lea, Obs." South Australia.]
1881. *angasi, Unio,* Smith, Journ. Linn. Soc. (Lond.), xvi., 307. Includes common Eastern species *profugus,* etc.

Smith utilised this name for "the largest of the Australian species,"

concluding that it "was described by Reeve from what I take to be the rather young state of this form." It is worthy of note that when A. Adams and Angas described *Unio stuarti,* they observed "is the only Naiad, besides *Alasmodon angasana* of Lea, yet discovered in the regions traversed by the explorers."

Lea protested later that he did not remember this nomination. Although Sowerby's figure suggests the large Eastern shell, the description "thin . . . bluish within with thin laminar teeth" and the locality do not agree, and the described shell is easily recognised when Northern Territory shells are examined. The figure suggests that the umbones are wrinkled, but the description reads "umbones smooth," which is correct. Shell a little elongate, oval, anteriorly rounded, posteriorly acuminately truncate, dorsal margin sloping and ventral margin nearly straight, posterior ridge flattened, but the posterior slope rather marked. Beaks apparently smooth, whole shell being fairly smooth, though growth lines are apparent, while a fine, but very subdued striation occurs. Teeth long and acicular, the pseudocardinals especially so, the pair in the right valve being long and subequal, the corresponding tooth in the left valve agreeing, but in one case a perfect accessory tooth has developed, while in an old shell the single tooth is in danger of extinction. The subgeneric name *Aparcthyria* is proposed for this species.

The shell figured in the Zoology of the "Erebus and Terror," pl. iv., fig. 2, from the Membridge River, Australia, under the name *Unio moretonicus* Reeve & Smith, is here determined as a Northern Territory species, and its rounded form appears to be due to poor conditions of living, and specimens differ from typical *angasi* in being shorter, more rounded, more solid, the hinge line more curved, the pseudocardinals shorter, and may be subspecifically separated as *C. angasi subjecta* nov.

Centralhyria bednalli.

1882. *bednalli, Unio,* Tate, Trans. Proc. Roy. Soc. South Austr., v., 56. December. River Adelaide, at the ford, Northern Territory.

This species has not been figured, though Frierson (Nautilus, xxi., 118, February, 1908) reported that from examination of a fine series from Bednall it was not synonymous with *australis,* but was much nearer to *wilsonii* Lea (= *stuartii* Adams & Angas), but he does not give the locality whence the specimens were obtained.

Tate had written "differs from *U. stuartii* in being more tumid, less inequilateral, and in its truncated, not acuminate, posterior margin. Epidermis always blackish brown. Measurements, 79 x 40 x 30 mm.; anterior 23; posterior 56. Measurements of a large *stuartii* from Newcastle waters, 107 x 52 x 30; anterior 28; posterior 79."

It seems more probable, however, that Tate's shell is a form of the true *"angasi,"* but in the same essay he recorded *angasi* and a form near *angasi,* so the case must be left for later solution.

Genus Hyridella.

1840. *Hyridella,* Swainson, Treat. Malac., pp. 285, 380. May. Haplotype, *Unio australis,* "Lamarck."

On page 285, Swainson wrote: "The peculiarities of Lamarck's *Unio australis* (*Hyridella* Sw.), and its affinity to *Iridea,* lead us to arrange it as the anodontine type of the *Hyrianae,* although it may possibly be an

aberrant example of *Iridea*; the bosses, however, are not striated, and the whole shell has very much the aspect of an *Anodon*."

The fuller diagnosis on page 380 reads: "Transversely oval; bosses not sulcated; posterior margin elevated and winged; one cardinal and one lateral tooth in each valve."

The comparison with *Anodon* might suggest that Swainson had before him a specimen of the *"balonnensis"* series, but it is an early date for that kind of shell; it might even have been the Tasmanian species. The reference to the teeth is, however, fatal to its acceptance, as also the phrase, "posterior margin elevated and winged," which is scarcely applicable to any of this group. Swainson was notoriously careless, and it is even possible that he did not have before him an Australian shell, so that the name cannot be utilised at present for any of our groups.

As long ago as 1908, Frierson, a specialist in American freshwater mussels, contributed some "Notes on Some Australian Unionidae" (Nautilus, xxi., pp. 118-9, February, 1908), and observed *"angasii* Sow.," "shows a beak having not a trace of radial sculpture, but only a fine concentric sulcation. Hence the shell . . . strictly speaking, is not even a *Diplodon*."

A little later Ortmann, another famous student of American freshwater mussels, in the same Journal (xxv., p. 100, January, 1912), discussed the Anatomy of the Najad *Hyridella australis* (Lamarck) (= *Diplodon australis*), concluding, *"Hyridella* must be generically allowed, but it is close to *Diplodon*." The specimens examined were from Gippsland, Victoria, and were apparently of the *Velesunio* series, but the only specimens in this museum from Gippsland do not belong to this group.

Genus Hyridunio nov.

Type *H. australis drapeta* nov.

As *Hyridella* cannot be used with exactitude for any Australian group, although Lamarck's *Unio australis* was named in connection with it, the above name is introduced for the shell agreeing best with Hanley's figure and Lamarck's description. In order that there can be no mistake in the genus proposed, I am giving as type a Queensland form which notably differs from the New South Wales series in being more elongated; and the generic characters are drawn up from it.

Shell stout, compressed elongate, scarcely winged, posterior ridge rounded, sculpture concentric lines with growth stages not strongly marked, but striae notably crinkled. Beaks placed anteriorly, eroded, but apparently wrinkled, ridges being decipherable upon the eroded surface.

Teeth stout, the right pseudo-cardinals being both strong, the inner one developed into a rugose conical tooth, the outer one less stout, the right lateral being strong and blade-like; the left pseudocardinal is correspondingly a strong rugose conical tooth, and the left laterals are fused umboned, but separate posteriorly. Anterior muscle scars deeply impressed, the posterior as usual lightly marked; the anterior adductor rather small, the anterior retractor-pedis small, separated and deep forming a pit; the protractor-pedis small, roundish and connected; dorsal scars pits in a line under the beaks sometimes confluent.

While the general diagnosis reads somewhat like that of *Rugoshyria*, the whole facies of the shell is dissimilar, the solidity and shape of the present group contrasting vividly with the thinness and elongation of that genus. The hinge line of *Hyridunio* is also much more curved, and consequently the pseudo-cardinals more perpendicular.

Hyridunio australis.

(Plate v., figs. 1, 2; pl. vi., figs. 2, 3.)

1819. *australis, Unio,* Lamarck, Hist. Anim. s. Vert., vi. (1), 80. July. New Holland.

This species has given trouble ever since its description, which reads: "U(nio) testâ transversim ovatâ, medio subsinuata; extremitatibus lateralibus rotundatis; dente cardinali parvo, compresso, subacuto. Habite à la Nouvelle Hollande. Mus. no. Largeur. 55 millimetres." Smith commented: "Lamarck's diagnosis is so brief, that it is utterly impossible to know what species he had before him. I therefore adopt Phillipi's idea of it. He was the first to describe and figure a shell which he believed to be the *U. australis.*"

Hanley, however (Recent Shells, 1843, 192, pl. 25, fig. 21), had copied Lamarck's description and figured a shell agreeing with it, and it is well known that Lamarck's shells were studied by Hanley, and probably Lamarck's type is thus figured. This was published before Phillipi's account appeared, so that Phillipi's idea had been anticipated by a more exact application, while it may be noted that Swainson had used Lamarck's name still earlier for a shell which again appears to differ.

A species answering better to Lamarck's description and Hanley's figure occurs near Sydney in the coastal rivers of New South Wales, and is here so identified. Shell elongate oval, thick, both ends rounded, compressed, the posterior ridge rounded and flattened, medially with a rounded depression; beaks eroded but showing traces of radial ridging, a very fine wrinkled concentric striation succeeding, growth stages ill-defined.

A specimen from Jamberoo, near Kiama, N.S.W., is a little more winged and therefore comparatively deeper, while from Lilydale, Victoria, a fully adult specimen is a little smaller, less winged, the pseudocardinals less erect and more rugose, the anterior muscle scars smaller, the anterior retractor-pedis pit notably so. This apparently represents a southern subspecies which may be named *Hyridunio australis orion* subsp. nov.

From the Brisbane River a more elongated shell of the same species offers a deeper and larger anterior retractor-pedis pit and a smaller protractor-pedis scar; the teeth are stouter and the laterals longer. It is here named *H. australis drapeta* subsp. nov.

Hyridunio renutus sp. nov.

(Plate v., fig. 3; pl. vi., fig. 4.)

From the Latrobe River, Gippsland, Victoria, is a specimen quite different from the normal species in being notably winged, consequently of a very different shape. It is even more compressed, and the anterior muscle scars are very deeply impressed, and the pseudocardinals thickened and less conical, the outer one in the right valve being almost obsolete, while the left pseudocardinal is almost subdivided into two; the laterals in the left valve are reduced to two small laminar teeth distant from the umbo.

The shell is anteriorly rounded, posteriorly winged and broadened, the ventral margin almost straight, the dorsal margin elevated; the medial sinuation is weak but present and the posterior ridge broad and flattened.

Specimens from the National Museum, Melbourne, under the name *Propehyridella cultelliformis* (Conrad) from Tarra Creek, Tarraville, near Port Albert, Victoria, belong to *Hydrunio* and suggest that the above-named specimen may be abnormal as these are a little winged. The above name

will be available, however, as they have nothing whatever to do with *cultelliformis*.

MYCETOPUS RUGATUS.

1868. *rugatus, Mycetopus,* Sowerby, Conch. Icon. Reeve, xvi., pl. iii., fig. & sp. 7. March. Victoria River, Australia.
1875. *rugatus, Mycetopus,* Smith, Zool. Erebus and Terror Moll., p. 3, pl. 4, fig. 1. Mus. Brit. specimen.
1881. *rugatus, Mycetopus,* Smith, Journ. Linn. Soc. (Lond.), Zool., xvi., 313. (Collector, Capt. Wickham).
1914. *rugata, Solenaia,* Simpson, Cat. Naiades, i., 462.

Smith, in 1881, commented: "It is very remarkable that Australia and South America should possess species so much alike as *M. siliquosus* and the above."

Simpson (Cat. Naiades, i., 1914, 462), calls this species *Solenaia rugata* (Sowerby), judging from figure above, with the comment: "Said to come from Victoria River, Australia. I am a little in doubt about the locality."

Although no further specimens have been secured the locality appears acceptable, and Smith figured the hinge in connection with the Mollusca of the "Erebus and Terror," commenting: "Possibly when the animal inhabiting this shell is examined it will prove to be an *Anodonta.* The shell scarcely gapes at the anterior extremity."

The shell does not look much like a *Solenaia,* and seems to be an elongate relation of the *angasi* or *stuarti* series, but obviously distinct from either. To relieve it of its present very anomalous position the new generic name *Lortiella* is introduced.

The curious inclusion of this species in the zoology of the "Erebus and Terror" puzzled, but a little investigation solved a previously unattacked problem. Four quarto plates, supposed to have been prepared for the zoology of the "Erebus and Terror" in the forties of the last century, were issued some thirty years later, in 1874, with a scant letterpress by Smith, ignorant of their exact preparation. In the few notes he admits that three are of New Zealand shells, though the fourth is of Australian with one Cape of Good Hope shell. On this plate iv. this species is figured from the Victoria River, North Australia, and this plate iv. shows two octavo plates prepared on the same stone and obviously nothing to do with the other three plates, nor with the zoology of the "Erebus and Terror." Eighteen species are figured from various localities, such as Victoria River, Dupuch's Island and Blackwood Bay, mostly presented to the British Museum by Sir J. Richardson. Richardson received fishes, shells, etc., from these localities, collected by Lieutenant Emery, of the Beagle. The captain of the Beagle was Captain Wickham, and later Captain Stokes, who published an account, entitled, "Discoveries in Australia." Therein he mentions the "muscles" met with on the Victoria River, and later (ii., p. 176) dealing with the zoology of Dupuch's Island, wrote: "The specimen of the species of Helix I have above mentioned was found by Mr. Dring, one of our most successful collectors in that department. In the appendix are figured some of the new shells discovered during the voyage." There is no description nor plates in the appendix, and it is now certain that the plate iv. of the zoology of the "Erebus and Terror" is composed of two plates prepared from the new shells discovered on the voyage of the Beagle. All the species are undoubtedly North Australian, and the "Cape of Good Hope" determination of Smith is incorrect.

In 1881, Smith gave Captain Wickham as collector of some of the specimens of the present species in the British Museum.

Lortiella froggatti sp. nov.

(Plate v., fig. 5; pl. vi., fig. 5.)

When the well-known entomologist, Mr. W. W. Froggatt, collected for Mr. W. Macleay, in North-west Australia, he secured a series of land shells, novelties being described by Cox, Smith and Ancey. In the Macleay Museum, a series of mussels collected at the same time were recently noted, and these proved of absorbing interest in view of the preceding account of *Mycetopus rugatus*. Obviously a smaller relative of the older puzzling species, they prove the suggestion as to their alliance to be correct. The shell is small, thin elongate, narrowed anteriorly, winged posteriorly, with as nearly straight ventral margin; the anterior end is produced and rounded, the posterior somewhat acuminately lengthened, the ridge being rounded, the posterior area flattened. The whole surface is strongly sculptured with growth lines, obscure radial rays being faintly observed, traces of zigzag surface threads also occurring. The teeth are thin and delicate, the laterals being elongate, the pseudocardinals being small and tending to disappear, the right pair being distinguishable in the juvenile, but one only stronger in the adult. The Lennard River is the type locality.

Genus Rugoshyria nov.

Type *Unio paramattensis* Lea = *Unio depressa* Lamarck.

A genus of small mussels, elongate in shape, shells of comparative thinness, teeth strong and a deep pit under the extremity of the pseudocardinals. Beaks with radial ridges, otherwise the only sculpture is concentric growth lines and striation. The laterals are slender, the external one in the left valve being smaller at the ends and fused umboned; the pseudocardinals are short and stout, the single one in the left valve being roughened and erectly conical almost separating into two; in the right the outer of the corresponding pair is small and flattened, the inner one erect, conical, and grooved. The anterior muscle scar is deeply impressed, and the protractor-pedis is small and coalescent with the adductor. The deep pit which attracted attention almost one hundred years ago appears to be the seat of the anterior retractor-pedis, and is seen in the Australian species having plicate beaks, and is not confined to the Australian species, being noted in *U. guppyi* Smith, from the Solomon Islands.

Rugoshyria depressa.

(Plate v., figs. 6, 7; pl. vi., figs. 6, 10.)

1819. *depressa, Unio,* Lamarck, Hist. Anim. s. Vert., vi. (1), 79. July. Rivers of New Holland. (In Mus. & Lam. coll.).

1859. *mutabilis, Unio,* Lea, Proc. Acad. Nat. Sci. Philad., iii., 152. May. Brisbane Water, Austr.; New Zealand and Murray River.

1860. *mutabilis, Unio,* Lea, Journ. Acad. Nat. Sci. Philad., iv., 248. March, pl. xxviii., fig. 127. ? Reeve, C. I., xvi., pl. xxiv., sp. fig. 112, April, 1865.

1862. *paramattensis, Unio,* Lea, Proc. Acad. Nat. Sci. Philad., iv., 176. April-May. Parramatta River, New South Wales.

1866. *paramattensis, Unio,* Lea, Journ. Acad. Nat. Sci. Philad., 2nd ser., vi., 60, pl. xx., fig. 59. July. (Separate May).

1881. *depressus, Unio,* Smith, Journ. Linn. Soc. (Lond.), Zool., xvi., 308 (includes *cultelliformis* Conrad).
1914. *cultelliformis, Diplodon,* Simpson, Cat. Naiades, iii., 1300.
1914. *mutabilis, Diplodon,* Simpson, Cat. Naiades, iii., 1308. Murray River shells.

Lamarck's description reads: "U(nio) testa ovata-oblonga, depressa, tenui, intus caerulescente; laterum extremitalibus rotundatis. Habite dans les rivières de la Nouvelle Hollande. Mus. no. Mon. cabinet. Epiderme brun. Largeur 52 millimetres."

Simpson got rid of Lamarck's species name by the plea that Donovan previously had named a freshwater mussel *Mya depressa,* a false procedure. He then utilised Conrad's *cultelliformis* for Lea's *paramattensis,* but the former was described from the Bogan River, a member of a different river system to that carrying *paramattensis.* Simpson then preserved Lea's *mutabilis* as a distinct species, placing it in the section *Cucumaria.*

The shell here recognised as Lamarck's species from Delessert's illustration (Recueil Coquilles Lam., pl. 12, fig. 5, 1841) varies a little in shape. Specimens from the Parramatta River are here taken as typical *depressa,* and are a little elongate, thin, posterior ridge rounded, slightly winged; concentric striation is pronounced, but growth stages are not strongly differentiated. Umbones generally eroded, but juvenile specimens show marked radial ridges, missing on the posterior region.

A large series collected by Helms on the Grosse's Plain Creek, Moonbar Run, Mt. Kosciusko, between 3,000-3,500 feet altitude, show subspecific features, being shorter and deeper and the teeth stronger. They may be called *R. depressa monticola* subsp. nov.

May has figured (Illustr. Index Tasm. Shells, 1923, pl. ix., fig. 12) a form of this species, under the name *D. mortonicus* Reeve, commenting, "possibly only a variant, much smaller and narrower." The figure is very like the Kosciusko form, and as it has nothing to do with *mortonicus* (recte *moretonicus*) it may be named *R. depressa sodalis* subsp. nov.

Apparently, following Simpson, Cotton and Gabriel have used the name *Propehyridella cultelliformis* for this species, giving various localities in New South Wales and Victoria, but their first record, "Richmond River, N.S.W. (153 mm. x 71 mm.)" is incorrect; it would be a fine shell, but the only species with these measurements is *C. novaehollandiae* Gray. Specimens received from the National Museum, Melbourne, collected in the Mitchell River, Bairnsdale, Gippsland, Victoria, are larger and more elongate than Kosciusko shells, and may be called *R. depressa vicinalis* subsp. nov.

The range of the species northward is at present unknown, as a specimen from Kenilworth, Mary River, Queensland, is undoubtedly specifically separable, being larger, more obese, posterior ridge elevated and pronounced and the anterior end angulately produced. It is here named *R. interserta* sp. nov.

A very interesting shell from the Bloomfield River, North Queensland, is, however, very like the typical form, but is more compressed, the beaks more anteriorly placed, the ridge more flattened and the anterior end more rounded. It is here named *R. aquilonalis* sp. nov., as specimens from the Solomon Islands determined as *U. guppyi* Smith, are of the same facies, and the North Queensland shell may be more closely related to those than to the southern shells. Simpson (Cat. Naiades, iii., 1914, 1156) placed the species *guppyi* in the genus *Cristadens* on account of the surface sculpture. The North Queensland shells show traces of similar sculpture, but its value is problematical.

Rugoshyria cultelliformis.

(Plate v., fig. 10; pl. vi., fig. 7.)

1850. *cultelliformis, Unio,* Conrad, Proc. Acad. Nat. Sci. Philad., v. (1), 10, February. Bogan River, New South Wales.

[1854. *depressus, Unio,* Conrad, Journ. Acad. Nat. Sci. Philad., 295, pl. xxxvi., fig. 2. February.]

Conrad described a *Unio* from the Bogan River, but four years later synonymised it with Lamarck's *U. depressus,* writing, "The shell I have described appears to be the adult, or a large variety of Lamarck's species," giving a copy of Delessert's illustration of the Lamarckian shell. As on the same plate he gave a figure (6) of the shell later named by Lea *U. paramattensis* his species must have differed, though recently they have been regarded as the same. Conrad's comment on the figured shell (6) reads: "This figure represents a shell sent from Australia in company with *U. napeanensis, Balonnensis,* etc., labelled Bogan River. It cannot be distinguished from a common variety of *U. complanatus,* yet if it inhabits an Australian river it must be a different species." Notwithstanding Pilsbry's strictures (Nautilus, xliv., 1931, 108) I agree with Conrad, and do not record the Australian species, under the genus *Elliptio* or *Unio,* especially as Simpson regarded Pilsbry's location in *Arconaia* incorrect.

There appears to be a series of shells resembling *depressa* in the rivers of central and northern Australia, and with this series Conrad's *cultelliformis* would be associated. These are larger, more elongate, more produced posteriorly, and the name *cultelliformis* may be used until they are better known.

Genus Propehyridella.

1932. *Propehyridella,* Cotton & Gabriel, Proc. Roy. Soc. Vict., xliv., n.s., 158. April 20. Orthotype *Unio nepeanensis* Conrad.

The shell is a rather solid, short, plump oval, truncated posteriorly, rounded anteriorly, hingeline sloping, agreeing with dorsal margin, ventral margin nearly straight, little rounded; growth ridges marked but surface of shell smoothened; the beaks strongly sculptured with radial bars sloping inwards from both sides; the posterior two much thicker than the anterior four or five. The teeth are strong, the left laterals long; in one specimen one of these being suppressed, while the pseudocardinals are stout and conical; in the right valve the outer of the two small and thin, the inner large and rugose.

Propehyridella nepeanensis.

(Plate v., figs. 11, 12, 13; pl. vi., figs. 11, 12, 13.)

1831. *depressa, Unio,* Lesson, Voy. Coquille Zool., ii., 427, pl. 15, fig. 5g. Nepean River N.S.W. Not *Unio depressa* Lamarck, 1819 (ante).

1850. *napeanensis* (sic) *Unio,* Conrad, Proc. Acad. Nat. Sci. Philad., v. (1), 10. February. Nepean River, New South Wales.

1851. *dorsuosus, Unio,* Gould, Proc. Bost. Soc. Nat. Hist., iii., 296 (dated November, 1850). Eastern Asia. ?

1852. *dorsuosus, Unio,* Gould, United States Expl. Exped., xii., 430 (fig. 540, a.b., 1862).

1854. *napeanensis, Unio,* Conrad, Journ. Acad. Nat. Sci. Philad., iii., 296, pl. xxvi., fig. 4. February.

1856. *lessoni, Unio,* Kuster, Conch. Cab. (Mart. & Chemin.) continued, ix. (2), 135, pl. xxxvii., fig. 4. New name for *Unio depressa* Lesson, not Lamarck.

1865. *napeanensis, Unio,* Reeve, Conch. Icon., xvi., pl. xxiii., sp. & fig. 110. April.

1881. *nepeanensis, Unio,* Smith, Journ. Linn. Soc. (Lond.), Zool., xvi., 312.

1914. *dorsuosus, Diplodon,* Simpson, Cat. Naiades, iii., 1289.

1914. *lessoni, Diplodon,* Simpson, Cat. Naiades, iii., 1296 (may be *nepeanensis*).

1932. *narracanensis, Propehyridella,* Cotton & Gabriel, Proc. Roy. Soc. Vict., xliv., n.s., 159. April 20. Narracan River, Gippsland, Victoria.

At present no near relation of this species is known. The Richmond River shells are larger and longer than the local topotypes and apparently represent a distinct subspecies which may be called *P. nepeanensis opportuna*. nov. Specimens from the National Museum, Melbourne, collected in the backwater of Mitchell River, Bairnsdale, Victoria, by W. Kershaw, and recorded by Cotton and Gabriel as *P. nepeanensis* are large and narrower with more heavily sculptured umbones. These may be regarded as a distinct subspecies whose name will be *P. n. narracanensis* Cotton & Gabriel, as shown by specimens from the National Museum, Melbourne. The species named by Cotton and Gabriel is undoubtedly the very juvenile form of the specimens regarded by them as *nepeanensis*.

Genus Protohyridella.

1932. *Protohyridella* Cotton & Gabriel, Proc. Roy. Soc. Vict., xliv., n.s., 159. April 20. Orthotype *Unio glenelgensis* Dennant.

This group was distinguished on account of "the peculiar sculpture occupying the greater portion of the shell," and as I had already separated it by means of the strong teeth the group must be recognised. The comment, "The corrugated sculpture, typical of freshwater mussels inhabiting quick-flowing rivers seems scarcely warranted in present-day slow-flowing Australian rivers," needs study.

Protohyridella glenelgensis.

(Plate v., fig. 14; pl. vi., fig. 14.)

1898. *glenelgensis, Unio,* Dennant, Proc. Roy. Soc. Vict., x. (n.s.), 112, pl. iv. May. Dartmoor, Glenelg River, Victoria.

1914. *glenelgensis, Diplodon,* Simpson, Cat. Naiades, iv., 1290.

Shell very small, stout, oval, markedly winged, with the anterior end angulate, ventral margin rounded.

Sculpture of beaks mainly zigzag radials succeeded by concentric wavy nodules overrunning the close concentric striation, growth stages being well marked.

Teeth very strong, the pseudocardinals stout and grooved, almost denticulate, the laterals strong and roughened, the left pseudocardinal being almost duplicate.

The anterior muscle scars deeply impressed, the posterior as usual very lightly; under the edge of the pseudocardinals a very deep pit, the seat of the anterior retractor-pedis appears, while the protractor-pedis is small, rounded and confluent; only one dorsal scar under the beak. The sum of the characters and especially the strong rugose teeth demand separation.

Genus Cucumerunio nov.

Type *Unio novaehollandiae* Gray.

1853. *Cucumaria* Conrad, Proc. Acad. Nat. Sci. Philad., vi., 269. Haplotype *Unio cucumoides* Lea. Not *Cucumaria* Blainville, Dict. Sci. Nat. (Levr.), ix., 173, 1830, or Lesson, Cent. Zool., 153, ante March, 1831.

The sole member of this genus is easily recognised by its large size, thick shell, elongate shape, wrinkled external sculpture; beaks with radial, anteriorly zigzag, ridges; the posterior radials continue as growth increases the shell, but the anterior zigzag ridges disappear. The adult shell is thus strongly radially ridged posteriorly behind the ridge, but smooth anteriorly, a few longitudinal striae being developed erratically in the median area; otherwise finely concentrically striate, growth periods fairly well marked; beaks at about one-sixth anteriorly; height less than half length.

Teeth stout, the left pseudocardinals (for there are two), although the outer one is very small, subconical, rugose, the left laterals fused for more than half their length umbonad, the right lateral single, stout, blade-like, a little rugose posteriorly; the right pseudocardinals (for here the two correspond), the outer small, the inner one rugose and conical.

Posterior muscle scars, as usual, lightly marked, but anterior deeply set.

Cucumerunio novaehollandiae.

(Plate v., fig. 15; pl. vi., fig. 15.)

1834. *novaehollandiae, Unio,* Gray, Proc. Zool. Soc. (Lond.), 1834, 57. Nov. River Macquarie, New South Wales. (Probably collected by Allan Cunningham.) Gray Coll.

[1840. *elongata, Naia,* Swainson, Treat. Mal., 285. May. New Holland.]

1840. *cucumoides, Unio,* Lea, Proc. Amer. Phil. Soc., i., 285. October. Hunter's River, New South Wales.

1842. *cucumoides, Unio,* Lea, Trans. Amer. Phil. Soc., viii., 192, pl. vii., fig. 2.

1843. *novaehollandiae, Unio,* Hanley, Gen. Recent Shells, 182.

1852. *cumingianus, Unio,* Dunker, Zeitsch. für Mal., ix., 53. May 12. New Holland.

1856. *cucumoides, Unio,* Hanley, Recent Shells, 382, pl. 24, fig. 4.

1861. *cucumoides, Unio,* Kuster, Conch. Cab. (Mart. & Chem.) continued, ix. (2), 219, pl. lxxiv., fig. 1.

1865. *cucumoides, Unio,* Reeve, Conch. Icon., xvi., pl. xx., fig. 89.

1870. *cumingii, Unio,* Lea, Synopsis Naiades, 4th ed., 31, as of "Dunker Zeitschr. für Mal., 1846, 109. Richmond River." lapsus only, name does not occur.

1881. *novaehollandiae, Unio,* Smith, Journ. Proc. Linn. Soc. (Lond.), Zool., xvi., 312 = *cucumoides* Lea. Gray's types, now in British Museum, examined.

1914. *novaehollandiae, Diplodon,* Simpson, Cat. Naiades, iii., 1304.

1914. *shuttleworthii, Diplodon,* Simpson, Cat. Naiades, iii., 1306.

This remarkable mussel has a somewhat restricted range, being confined to the coastal rivers of northern New South Wales and southern Queensland. There is variation in shape and strength of sculpture, but so far no geographical quantity has been noted. An overlooked reference seems to be that of Swainson, when he recorded *Naia elongata* from New Holland . . . "having the form of one type and the teeth of the other. This interesting species, once the property of Admiral Bligh, was purchased by

us at his sale." The single species, of which the characters have been given under the generic heading, really varies so slightly from series available at present that it becomes amazing to find Simpson including it twice in his catalogue, yet the description of *"shuttleworthii"* given by him refers to this species.

In Smith's 1881 list appear the following:—

Unio rugulosus Charpentier, Kuster's Con. Cab., 1855, pt. 147, pl. xliv., fig. 5, do., 1856, pt. 150, p. 154. Described from New Holland.

Simpson (Cat. Naiades, i., 1914, 277) states that the locality is wrong and that the species is "evidently Mexican or Central American."

Unio multidentatus Parreyss, Philippi Abbild., vol. iii., p. 46, pl. iii., fig. 4. Kuster's Con. Cab., pl. xxxvi., fig. 5. var. = *Unio fulmineus* Parreyss, Philippi, l.c., figs. 5-6. Kuster, p. 286, pl. xcvi., figs. 2-3. Australia.

Simpson (Cat. Naiades, iii., 1914, 1106/7) places both these names in the synonymy of *Parreysia corrugata* Müller, of India.

Unio gratiosus Parreyss, Philippi Abbild., vol. i., pl. 1, fig. 5. Kuster's Con. Cab., p. 239, pl. lxxx., fig. 3. Australia.

Simpson (Cat. Naiades, ii., 1914, 993) states "Philippi's locality is evidently erroneous," and calls the species *"Nodularia gratiosa,* South-east Asia."

Unio semiplicatus Kuster, Con. Cab., p. 279, pl. xciv., fig. 4. Australia.

Simpson (Cat. Naiades, i., 1914, 251) cites this as a synonym of *Medonidus acutissimus* Lea, from Alabama River system, U.S.A.

According to these conclusions, the mussels may be listed thus:—

Family Propehyridellidae.

Subfamily Velesunionae.

Velesunio balonnensis Conrad. Inland New South Wales.
Velesunio balonnensis adjunctus Iredale. Coastal New South Wales.
Velesunio balonnensis intricatus Iredale. South Queensland.
Velesunio danellii Villa = *jeffreysianus* Lea. Victoria.
Velesunio shuttleworthi Kuster = *vittatus* Lea = *moretonicus* Reeve = *legrandi* Petterd. Tasmania.
Velesunio evansi A. Adams and Angas. South Australia.
Westralunio ambiguus Philippi = *philippianus* Kuster. South-west Australia.
Westralunio ambiguus carteri Iredale. West Australia (Perth).
Alathyria profuga Gould. Coastal New South Wales.
Alathyria pertexta Iredale = *shuttleworthi* Lea. South Queensland.
Alathyria jacksoni Iredale. Inland New South Wales.
Centralhyria stuarti A. Adams and Angas. South and Central Australia.
Centralhyria wilsonii Lea. Mid Queensland.
Centralhyria wilsonii caurina Iredale. North-west Australia.
Centralhyria angasi Sowerby. Northern Territory.
Centralhyria angasi subjecta Iredale. Northern Territory.
Centralhyria bednalli Tate. Northern Territory.
Hyridunio australis Lamarck. Coastal New South Wales.
Hyridunio australis orion Iredale. Victoria.
Hyridunio australis drapeta Iredale. South Queensland.
Hyridunio renutus Iredale. Gippsland, Victoria.

Subfamily LORTIELLINAE.

Lortiella rugata Sowerby. Northern Territory.
Lortiella froggatti Iredale. North-west Australia.

Subfamily PROPEHYRIDELLINAE.

Rugoshyria depressa Lamarck = *mutabilis* Lea = *paramattensis* Lea. New South Wales.
Rugoshyria depressa monticola Iredale. Mt. Kosciusko, N.S.W.
Rugoshyria depressa sodalis Iredale. Tasmania.
Rugoshyria depressa vicinalis Iredale. Gippsland, Victoria.
Rugoshyria interserta Iredale. Mid Queensland.
Rugoshyria aquilonalis Iredale. North Queensland.
Rugoshyria cultelliformis Conrad. Inland North New South Wales.
Propehyridella nepeanensis Conrad = *dorsuosus* Gould = *lessoni* Kuster. Mid New South Wales.
Propehyridella nepeanensis opportuna Iredale. North New South Wales.
Propehyridella nepeanensis narracanensis Cotton and Gabriel. Victoria.
Protohyridella glenelgensis Dennant. Victoria.

Subfamily CUCUMERUNIONAE.

Cucumerunio novaehollandiae Gray = *cucumoides* Lea = *cumingianus* Dunker. North N.S.W., and South Queensland.

Thanks are here tendered to Mr. G. C. Clutton, of the Australian Museum, for the excellent photographs here offered. It must be explained that owing to irregular growth variation no range of dimensions has been given in the text, but a normal medium sized specimen has been selected for figuring, and the measurements of this "norm" are cited in the explanation of the plates here following.

EXPLANATION OF PLATE III.

Fig. 1. *Velesunio balonnensis* Conrad, 68 mm. x 48 mm.
„ 2. *Velesunio balonnensis intricatus* Iredale, 73 mm. x 45 mm. Type.
„ 3. *Velesunio balonnensis adjunctus* Iredale, 74 mm. x 45 mm. Type.
„ 4. *Velesunio danellii* Villa, 86 mm. x 51 mm.
„ 5. *Velesunio shuttleworthi* Kuster, 65 mm. x 45 mm.
„ 6. *Velesunio evansi* A. Adams and Angas, 58 mm. x 43 mm.
„ 7. *Velesunio evansi* A. Adams and Angas, 70 mm. x 42 mm.
„ 8. *Westralunio ambiguus* Philippi, 51 mm. x 35 mm.
„ 9. *Alathyria profuga* Gould, 98 mm. x 58 mm.
„ 10. *Alathyria pertexta* Iredale, 115 mm. x 63 mm. Type.
„ 11. *Alathyria jacksoni* Iredale 105 mm. x 62 mm. Type.
„ 12. *Centralhyria stuarti* A. Adams and Angas, 85 mm. x 43 mm.
„ 13. *Centralhyria wilsonii* Lea, 130 mm. x 62 mm.
„ 14. *Centralhyria wilsonii caurina* Iredale, 74 mm. x 39 mm. Type.

EXPLANATION OF PLATE IV.

Fig. 1. *Velesunio balonnensis* Conrad, 68 mm. x 48 mm.
„ 2. *Velesunio balonnensis intricatus* Iredale, 73 mm. x 45 mm. Type.
„ 3. *Velesunio balonnensis adjunctus* Iredale, 74 mm. x 45 mm. Type.
„ 4. *Velesunio danellii* Villa, 86 mm. x 51 mm.
„ 5. *Velesunio shuttleworthi* Kuster, 65 mm. x 45 mm.
„ 6. *Velesunio evansi* A. Adams and Angas, 58 mm. x 43 mm.
„ 7. *Velesunio evansi* A. Adams and Angas, 70 mm. x 42 mm.

„ 8. *Westralunio ambiguus* Philippi, 51 mm. x 35 mm.
„ 9. *Alathyria profuga* Gould, 98 mm. x 58 mm.
„ 10. *Alathyria pertexta* Iredale, 115 mm. x 63 mm. Type.
„ 11. *Alathyria jacksoni* Iredale 105 mm. x 62 mm. Type.
„ 12. *Centralhyria stuarti* A. Adams and Angas, 85 mm. x 43 mm.
„ 13. *Centralhyria wilsonii* Lea, 130 mm. x 62 mm.
„ 14. *Centralhyria wilsonii caurina* Iredale, 74 mm. x 39 mm. Type.

EXPLANATION OF PLATE V.

Fig. 1. *Hyridunio australis* Lamarck, 74 mm. x 42 mm.
„ 2. *Hyridunio australis drapeta* Iredale, 83 mm. x 40 mm. Type.
„ 3. *Hyridunio renutus* Iredale, 74 mm. x 47 mm. Type.
„ 4. *Centralhyria angasi* Sowerby, 76 mm. x 45 mm.
„ 5. *Lortiella froggatti* Iredale, 57 mm. x 26 mm. Type.
„ 6. *Rugoshyria depressa* Lamarck, 56 mm. x 29 mm.
„ 7a.b. *Rugoshyria depressa monticola* Iredale, 50 mm. x 30 mm. Type.
„ 8. *Rugoshyria interserta* Iredale, 73 mm. x 34 mm. Type.
„ 9. *Rugoshyria aquilonalis* Iredale, 58 mm. x 28 mm. Type.
„ 10. *Rugoshyria cultelliformis* Conrad, 67 mm. x 31 mm.
„ 11. *Propehyridella nepeanensis* Conrad, 56 mm. x 33 mm.
„ 12. *Propehyridella nepeanensis opportuna* Iredale, 68 mm. x 40 mm. Type.
„ 13. *Propehyridella nepeanensis narracanensis* Cotton and Gabriel, 22 mm. x 14 mm.
„ 14a.b. *Protohyridella glenelgensis* Dennant, 41 mm. x 23 mm.
„ 15. *Cucumerunio novaehollandiae* Gray, 127 mm. x 50 mm.

EXPLANATION OF PLATE VI.

Fig. 1. *Centralhyria angasi* Sowerby, 76 mm. x 45 mm.
„ 2. *Hyridunio australis drapeta* Iredale, 83 mm. x 40 mm. Type.
„ 3. *Hyridunio australis* Lamarck, 74 mm. x 42 mm.
„ 4. *Hyridunio renutus* Iredale, 74 mm. x 47 mm. Type.
„ 5. *Lortiella froggatti* Iredale, 57 mm. x 26 mm. Type.
„ 6. *Rugoshyria depressa* Lamarck, 56 mm. x 29 mm.
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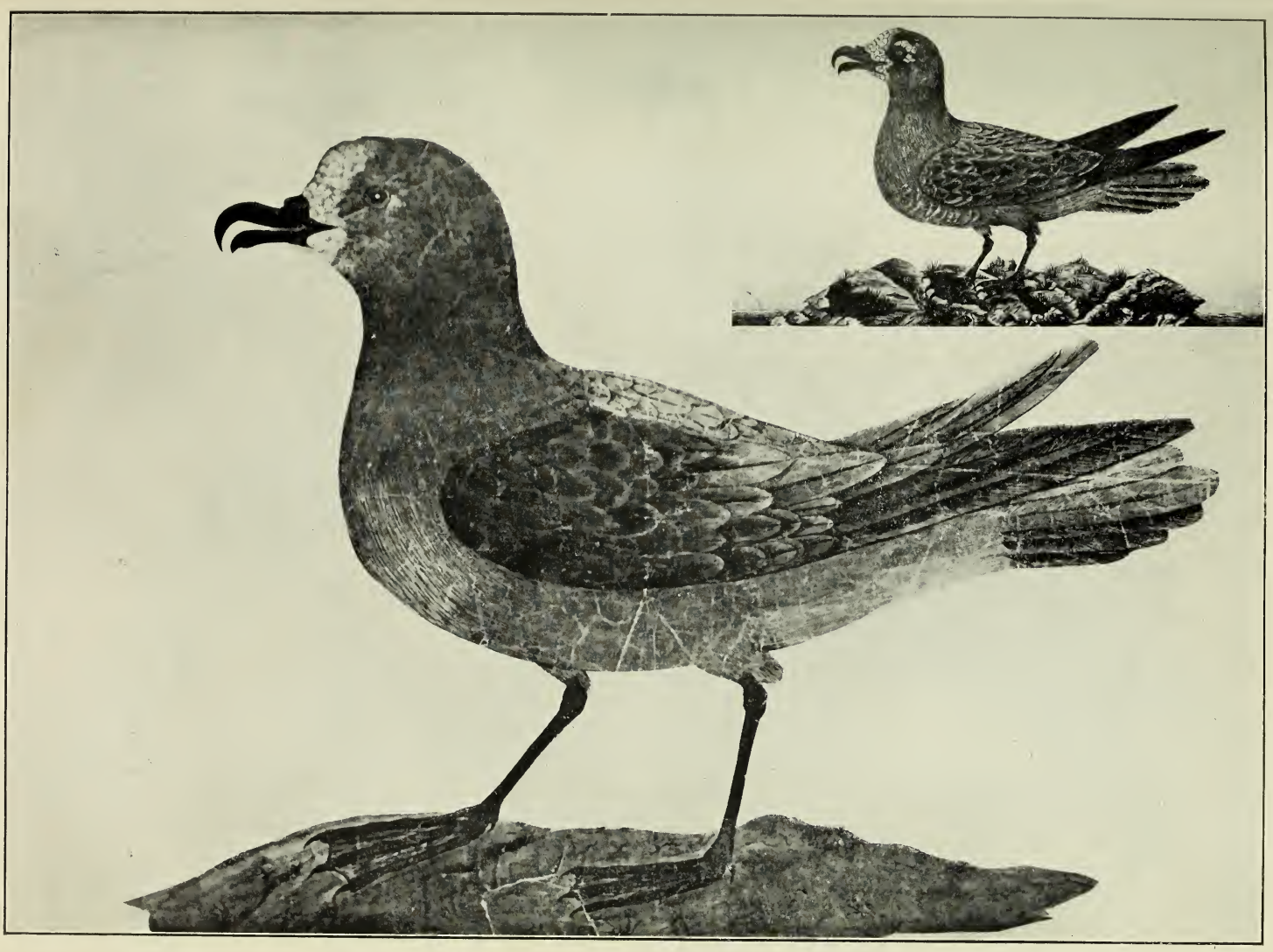
„ 12. *Propehyridella nepeanensis opportuna* Iredale, 68 mm. x 40 mm. Type.
„ 13. *Propehyridella nepeanensis narracanensis* Cotton and Gabriel, 22 mm. x 14 mm.
„ 14. *Protohyridella glenelgensis* Dennant, 41 mm. x 23 mm.
„ 15. *Cucumerunio novaehollandiae* Gray, 127 mm. x 50 mm.



The Bird of Providence, *Pterodroma melanopus* Gmelin.
Reproduced from paintings in the Mitchell Library, Sydney.
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The Yellow-bellied Flying Phalanger, *Petaurus australis* Shaw. Male.

Fresh-water Mussels of Australia.

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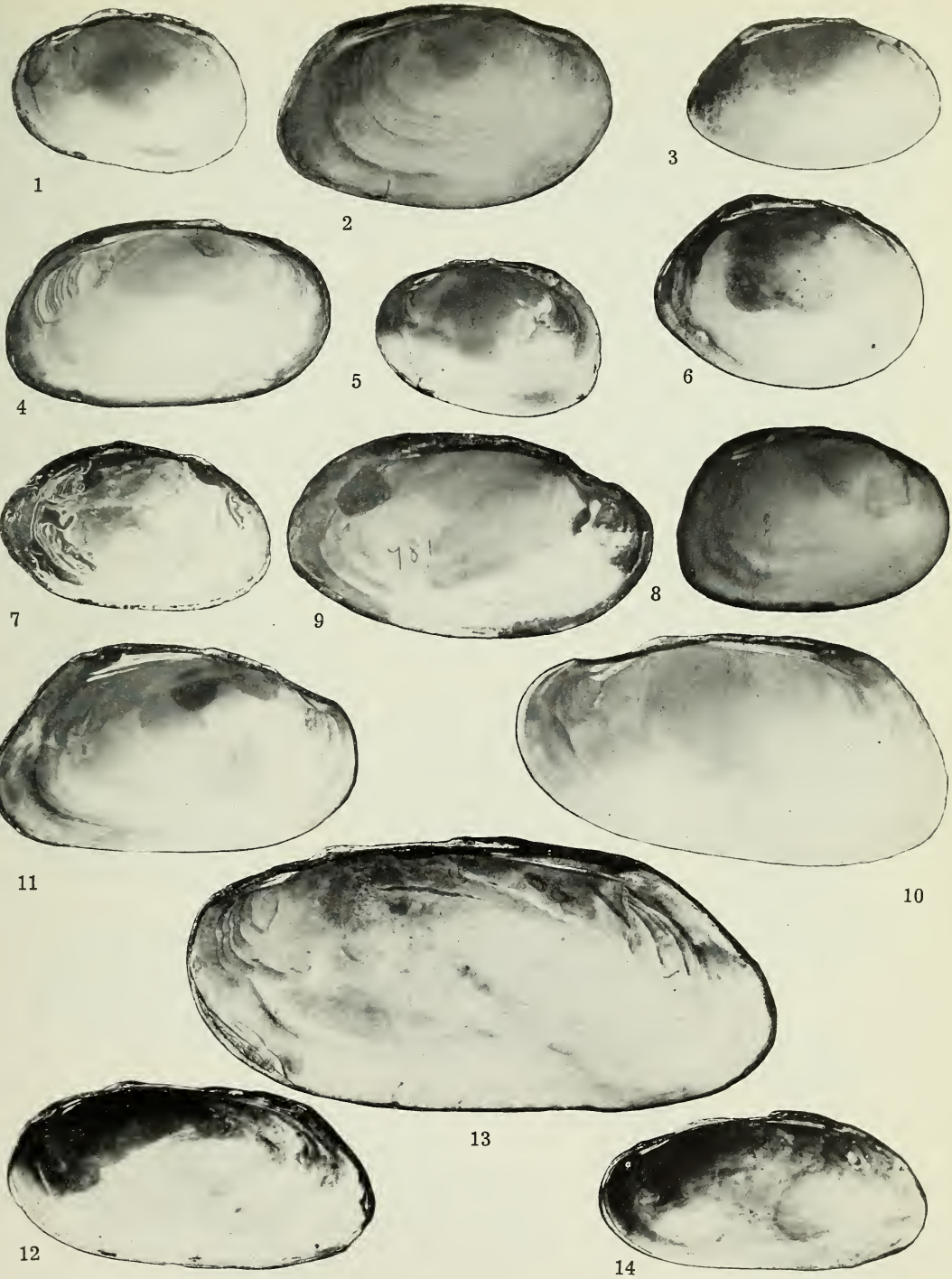

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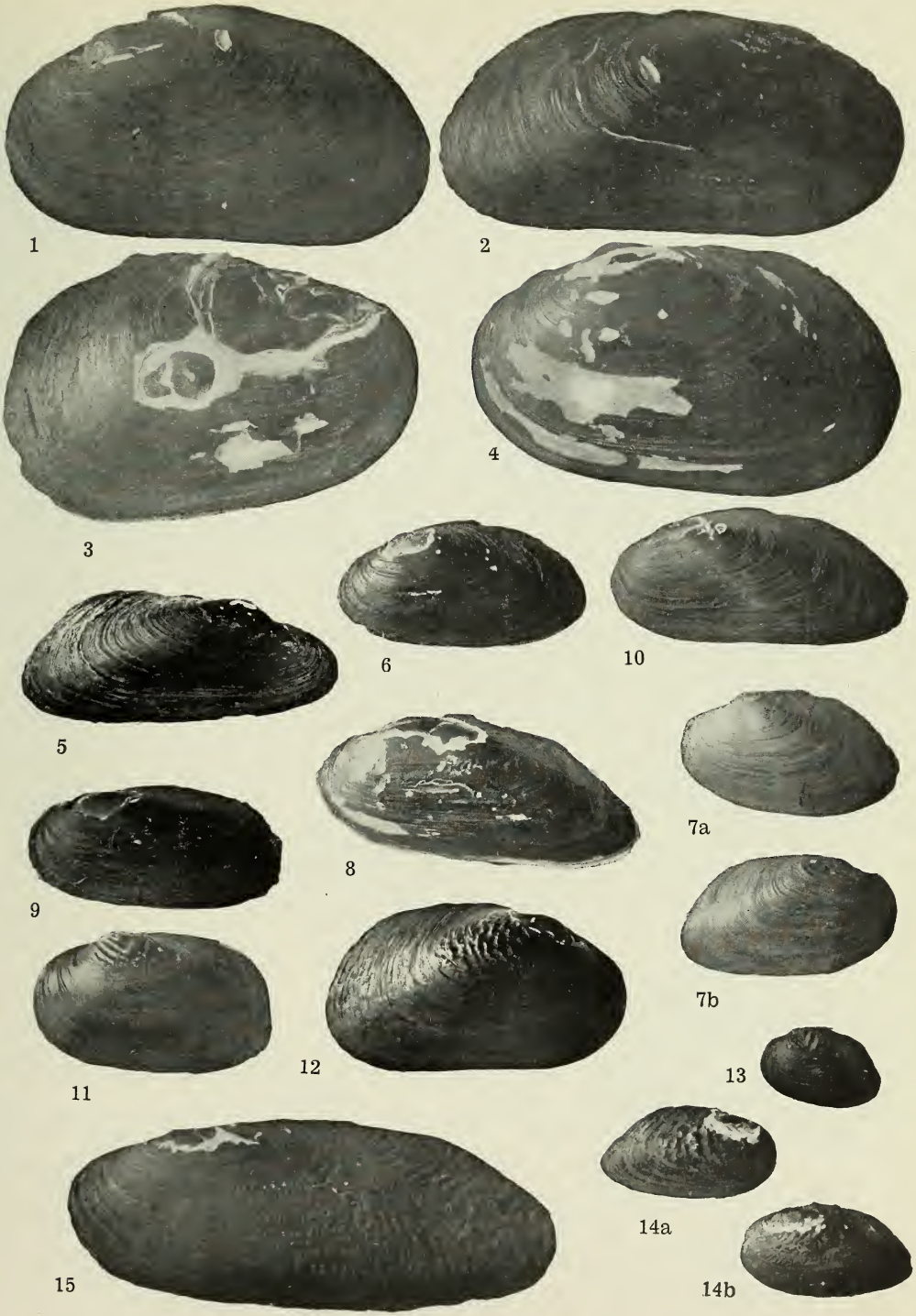

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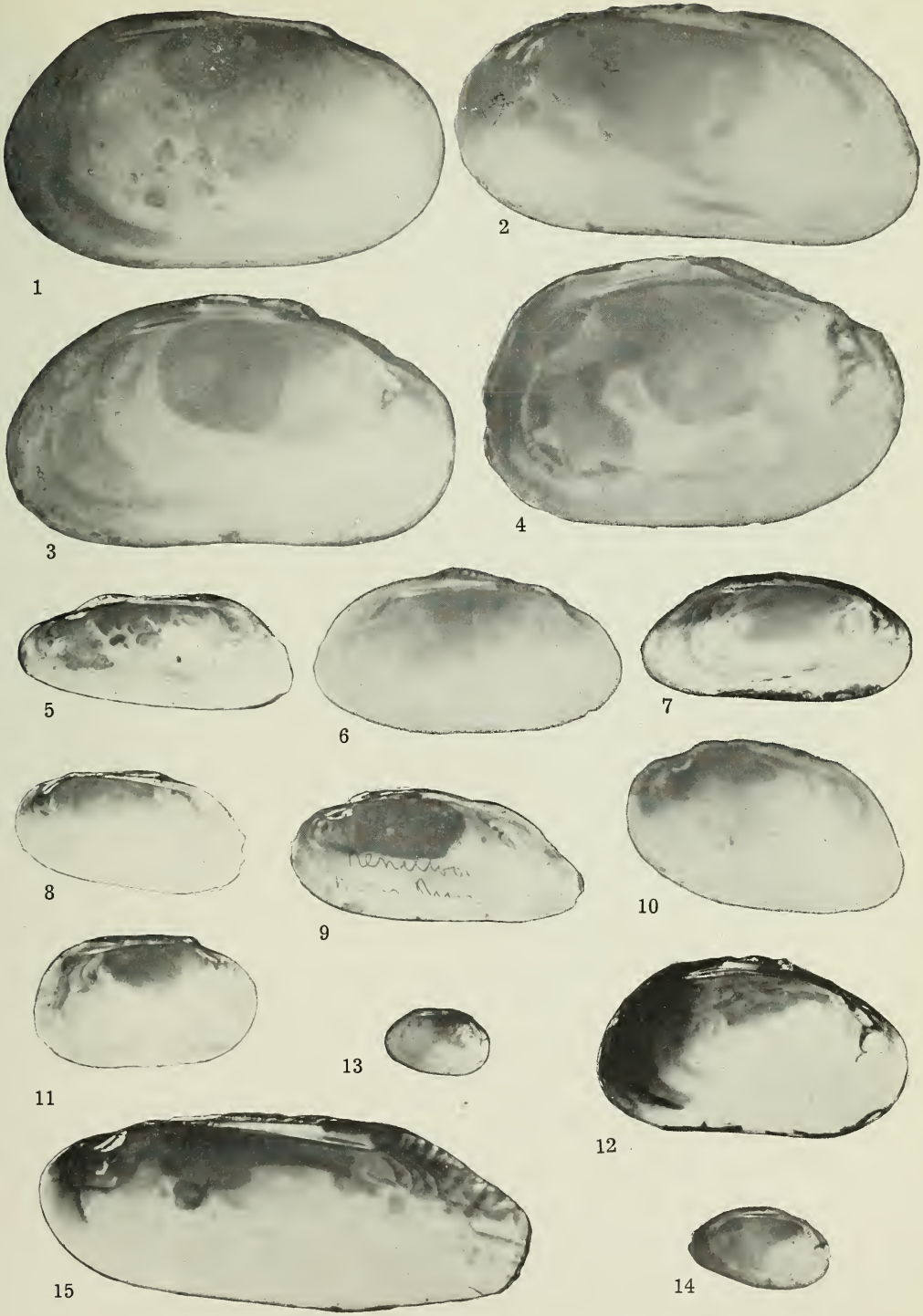

Fresh-water Mussels of Australia.

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THREE NEW SPECIES OF DRYOPIDAE.

By H. J. Carter, B.A., F.E.S., and E. H. Zeck.

Simsonia eborica n. sp.

(Plate vii., fig. 3.)

Elongate ovate, dark bronze, nitid, underside silvery save for a narrow medial red area; legs and tarsi dark (reddish beneath), post tibiae with a thin line of tomentum, antennae very slender, the basal segments yellow, otherwise dark.

Head narrower, eyes less prominent than usual.

Prothorax bilobate, the more convex anterior part separated from the basal by a deeply arched sulcus, extending from anterior angle to beyond the middle, base feebly bisinuate, widest behind middle, sides lightly rounded without sinuation, posterior angles subrectangular, disc rather coarsely and sparsely punctate, a short pre-basal sulcus on each side parallel to sides. Scutellum widely oval.

Elytra wider than prothorax at base, shoulders widely rounded, widest behind middle, striate-punctate, striae feebly impressed, strial punctures large, intervals flat and minutely punctate. Sternal area punctate in middle, prosternal process elongate, metasternum sulcate.

Dimensions: 2 mm. long.

Habitat: N.S.W., Ebor. (F. E. Wilson).

Eleven examples sent by our friend, Mr. Wilson, show the smallest species of the genus, readily distinguished from its nearest ally, *S. leai* C. & Z., by the deeply arched pronotal sulcus and its silvery underside. Holotype in Coll. Wilson.

Austrolimnius diemenensis n. sp.

(Plate vii., fig. 1.)

Ovate, nitid black above, underside reddish brown, sternal regions darker brown; antennae and legs red.

Prothorax rounded and produced at apex, anterior angles sharply defined, sides very lightly rounded, subsinuate behind, base to apex as 27:20, lateral margins entire, hind angles rectangular, foliate margins separated from disc by deep sulcus, slightly widening towards base, extreme border narrowly raised, whole surface (disc and foliation) minutely, densely punctate, medial sulcus strongly marked, widening at base.

Elytra as wide as prothorax at base, widest near middle, the three lateral ridges less raised than in *A. victoriensis* C. & Z., the innermost delimited on the inside by a marked groove and row of punctures; seriate punctures smaller than in *A. victoriensis,* intervals minutely punctate as on pronotum. Underside in general smooth, segments of abdomen concave and pubescent between the raised, glabrous margins, apical segment impunctate, prosternal process rounded, scarcely sinuate. Mid-tibiae of ♂ without marginal tooth, with minute spines near base, these becoming wider, blunt teeth on apical half—a fringe of fine hair here—a strong spine at apex, apical segment of tarsi considerably longer than in *victoriensis*.

Dimensions: 1.85 x 0.95 mm.

AUG 16 1935

Habitat: Tasmania. Upper Blessington River (Mr. Bryan Plomley, University of Sydney).

Nine examples were captured by Mr. Plomley. It is superficially very like *A. victoriensis*, but differs in the tibial structure (see figs. 6, 7, 8, 9), the more strongly marked medial sulcus of pronotum, its finer sculpture and wider form. Holotype in Coll. Carter.

Austrolimnius suffusus n. sp.

(Plate vii., fig. 2.)

Widely obovate, head and prothorax black, the latter with part of lateral margin reddish, elytra with base, wide margins, suture and discal mark black, the rest orange red. Underside and femora brown, antennae, tibiae and tarsi red.

Head, eyes large and more closely set than usual, antennae rather stout.

Prothorax rounded and produced at apex, front angles obtuse, widest behind middle, sides well rounded, base much wider than apex (8:5), lateral carinae narrow, the sublateral carina serrate and converging anteriorly from about posterior third, leaving a subhorizontal area, between carinae, of a pale colour (1), extreme border finely serrate, medial sulcus shallow, wide in middle, narrowing anteriorly and posteriorly, but widening again at base; surface very minutely and closely punctate.

Elytra rather suddenly widened at shoulders, widest behind middle, carinae narrow and little raised, seriate punctures small, those in 4th row, at sides of innermost carinae scarcely apparent; margins strongly serrate; tarsi unusually stout. Prosternal process rather large, sinuate at apical third.

Dimensions: 1.4 x 0.75 mm.

Habitat: New South Wales, Hastings River and Kindee Creek (H. Davidson and H. J. Carter), Williams River (the late Mr. J. Hopson), Sydney (L. Wassell). This is the species noted in Proc. Linn. Soc. N.S.W., 1930, p. 190, as possibly a variety of *A. luridus* C. & Z. A long series, however, taken recently in the Hastings River at Long Flat, near Wauchope, shows it to be a very distinct species, not only in colour, but in many structural details, especially the sublateral carina and the form of the pronotal sulcus. Holotype in Coll. Carter.

EXPLANATION OF PLATE VII.

1. *Austrolimnius diemenensis.*
2. *Austrolimnius suffusus.*
3. *Simsonia eborensis.*
4. Sternal process of *Austrolimnius suffusus.* x 42.
5. Sternal process of *Austrolimnius diemenensis.* x 42.
6. Fore tibia and tarsus of male *A. diemenensis.* x 93.
7. Middle tibia and tarsus of male *A. diemenensis.* x 93.
8. Hind tibia and tarsus of male *A. diemenensis.* x 93.
9. Middle tibia and tarsus of male *Austrolimnius victoriensis* C. & Z. x 93.
10. Sternal process of *Simsonia eborensis.* x 42.

Figures 6, 7, 8 and 9 drawn from micro slides.

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(1) This character also occurs to a less extent in *A. politus* King. (Vide pl. ii., fig. 15, of our Monograph).

NOTES ON THE HABITS OF AUSTRALIAN BATS.

By A. J. Marshall.

Despite the comparative abundance of both insect and fruit-eating bats in Australia, very little is known of their habits. These notes are, therefore, presented with some regret that they are not more extensive, and in the hope that they may both supplement our knowledge and provide data of general interest. It is not generally realized the high position which bats occupy in the class mammalia, for next after man and the animals nearest allied to him, come bats—divided primarily into two great sub-orders, the fruit-eating *Megachiroptera* and the smaller insectivorous *Microchiroptera*.

Fruit-bats, known to most people as "flying foxes" because of a superficial facial resemblance to the wily canine, usually assemble in vast camps in trees in secluded areas, at times in hundreds of thousands. Visiting orchards and farms nocturnally, they cause many thousands of pounds worth of damage annually, and are especially adapted for these arboreal depredations in that they possess exceedingly powerful feet and long curved thumb-claws for climbing and hanging on.

The indigenous fruits most favoured in the coast areas are lilly-pilly (*Eugenia*) and the various figs (*Ficus*). These essentially frugivorous animals have an extensive gape and teeth adapted for the nipping off and crushing of fruit, the canines being well developed for piercing and the molars flat and grooved for pulping fruit.

The *Microchiroptera* or insectivorous bats are an extensive group, and display many different kinds of specialization, and have sharp-cusped molars adapted for breaking up the hard body cases of insects. The senses of the small insectivorous bats have provided an evergreen subject for controversy, especially in view of some amazing experiments which have been conducted overseas. Bats liberated with their eyes sealed with wax, in a room crossed and recrossed with wires, flew between the strands without touching them. Others liberated in a many windowed room, obviously endeavouring to escape, did not dash themselves against the glass as birds would have done under similar circumstances. My own observations upon some bats liberated in a room showed that never once did the bats fly at the panes, but kept circling around until they became tired and settled.

It has been suggested that the explanation of this curious phenomenon is that the wing-beats of the bats set air currents in motion between them and the wires or window-panes, these being reflected instantaneously and received by the numerous highly specialised nerve-endings situated among the hair follicles, especially in the nose-leaves. The bats are thus warned of the presence of opaque objects after sight has failed to appraise them of their existence. The saying "blind as a bat," however, is misleading, as it is impossible that bats could capture their tiny swift flying prey if deprived of sight, as a sense of smell could not assist in tracing swiftly moving aerial objects leaving no definite line of odour. While the hearing of bats is extremely keen, it is probably upon eyesight that they mostly depend.

Because of such peculiarities, and the difficulty of securing specimens, bats have always had a fascination for workers in mammalogy. During the visit of the Harvard Museum Expedition in 1931-32, Dr. Glover M. Allen very kindly invited me to accompany him on a collecting trip to the North

Coast in search of local species of bats, in which he has a special interest. In acknowledging my great appreciation of the pleasant and instructive association thus provided, thanks are also expressed to Mr. E. Le G. Troughton, for looking through these notes during a week-end spent at the Society's Cabin.

Having returned in December, 1931, from Western Australia, where the mammal results had proved disappointing, Dr. Allen was naturally anxious to choose a promising field for a last attempt to secure some of the local flying mammals.

Kempsey, a large mid-North Coast town, was chosen as the base of operations, and on arrival we heard that there were several large caves in the district which might confidently be expected to contain quantities of the small insectivorous bats. Our first trip was to the Sherwood Caves, located some twelve miles west of Kempsey, which have for years been known to local people as the haunt of numerous bats, though few persons interviewed seemed to have visited them personally. Quantities of bat-guano have at various times been brought out, shipped to Sydney and sold, the prices realized being said to have repaid the trouble involved. The caves are situated about two hundred feet up a steep and heavily timbered limestone hillside; the entrance is comparatively small and would easily pass unnoticed by a vigilant observer. Nesting in the vicinity were Magpies, Nankeen Kestrels and Soldier-birds, and almost every tree was bedecked with orchids of several varieties; "tongues," "rats-tails," "pencils" and "grass" (Cymbidium) were common, as well as several species quite foreign to me. Elkhorns, staghorns and "birds-nests" grew to enormous dimensions high up in the larger tree-trunks. The lower vegetation was largely composed of stinging nettles, a bewildering variety of tangling vines and at least two species of very unpleasant stinging trees. Guarded by such a formidable entanglement, it is small wonder that the bats continue to flourish in their secluded retreat, even in these more closely settled times.

Descending about fifteen feet we reached the main chamber, a large dimly lit cavern, from which branched many ante-chambers, holes and tunnels, the floor of which were covered with several inches of guano. The atmosphere within the caverns was heavy with a particularly "batty" odour, and several dead bats were found in various stages of decay on the cavern floor, the skulls of which were taken for identification. As we entered the first cave several bats quickly detached themselves from the roof and made for the dark inner recesses, one which unwisely lingered being shot by Dr. Allen. It was later found to be the Australian form of *Miniopterus blepotis*, an interesting species whose range extends to the Malayan Archipelago.

In the darker recesses, where flashlights flickered eerily, bats in hundreds dropped swiftly from their roosting places, and fluttered about wildly, some even brushing our faces with their soft membraneous wings as they sped past. Shooting became unnecessary, as we merely stood still in a narrow part of a long cave and beat the bats to the ground with our hats as they passed. Bats in this portion of the caves—damp, musty, and pitch-dark were apparently all adults of *M. australis*, a smaller relative of *M. blepotis*, and of the Horse-shoe Bat (*Rhinolophus megaphylus*)—so named because of the distinct horse-shoe shaped nose-leaf. So different are the two species in appearance that they were readily distinguishable, even when flying from 15 to 20 feet away. The noise of

thousands of wings in a confined space, such as a cave of this nature, may be readily likened to the rush of falling water.

At the end of the farthest cavity from the entrance we encountered hundreds of slightly smaller bats gathered in clusters, in a small dark cavern whose only communication with the main cave was by way of a long narrow rising tunnel. As the bats flew out, I secured a number with my hat, and then penetrated further where the bats allowed me to pluck them by the handful from the roof and walls and thrust them biting and "ticking" indignantly into a collecting bag. Bats thus collected were all found to be immature "Horse-shoes," their age estimated by Dr. Allen to be about six weeks. The sexes were approximately equal, and it seemed apparent that the young had been segregated in one camp by their mothers, who doubtless returned at regular intervals to suckle or otherwise feed them; all the female Horse-shoe bats which were collected had distended milk glands, and none carried any baby bats clinging to their fur.

Two baby *Rhinolophus* which I kept, to the alarm of the house maid in my room at the Hotel Kempsey, though quite unfettered did not attempt to escape either day or night through the open doors or windows. Instead, they merely hung themselves up head downwards on a picture rail, curtain or window blind, and soon learnt to answer me, and became greatly agitated when I "tick-ticked" to them; one would even allow me to handle him freely without attempting to struggle and bite as did the others. Both bats hung in the room for some days and were ultimately found dead, still hanging up in the usual manner; they had evidently been more dependent on the parent for food than their appearance suggested. Their usual call was a rapid series of about six thin squeaks similar to those uttered by very young passerine birds, but series of up to ten "ticks" were repeatedly given. These immature Horse-shoe bats were easily identified from the adults by their smaller size, pale coloration, and, of course, enlarged cartilaginous wing-joints.

When a "Horse-shoe" bat wishes to "hang-up" it flies straight towards its objective, and when within a few inches of it suddenly gives a swift sideways and upward jerk, thus bringing the tail and claws in the direction the head formerly faced; the sharp little claws then catch and hold the roughened rocks to which they habitually cling. In a room I found that captive bats acted in precisely the same manner, except that the choice of landing places on the walls was limited to the beading and picture rails. They rarely attempted to land on the smooth plaster, their eye-sight in full day-light enabling them to perceive the smoothness of the walls, and to select the rails and beading upon which they alighted.

When in natural surroundings they have no difficulty in hanging from the rough limestone rocks, by even one leg, and they often revolve slowly in half circles while suspended in this manner. They are able to climb sideways quite dexterously, but always seem to prefer to climb upwards—tail end first, and the thumb claws, as well as the feet, are used extensively for climbing.

The toilet of a Horse-shoe bat is a very interesting performance. Hanging head downwards by one foot—usually the right—it scratches or combs the back of its head, back and chest with the free foot working so rapidly that it is difficult to follow the action. It frequently stretches its flexible wings to the utmost and runs its nose along the soft membranes, diligently nuzzling backwards and forwards the while. When sleeping,

the wings may be folded so that from the outside they appear as thin lines along the forearms, but usually part of the membrane is drawn across so that only the eartips and the tiny pink nose are visible. In colour, the adult Horse-shoe bats are rich chocolate brown with the fur on the back silver-tipped.

The *Miniopterus,* which on the average did not seem to avoid the partially lit caves as did the Horse-shoe bats, are easily recognised by their elongated terminal wing-joints and short ears. The tail is membraned to the extreme end. They usually hang in rows along a wall and when wishing to leave merely loose their hold and fly directly outwards, never dropping more than an inch at the most. They rise from the ground quite freely by first raising themselves on their wings and legs and giving a quick flap upwards. If, however, they are accidently knocked upside down they experience great difficulty in righting themselves. When captured they bite and claw furiously, but their gape is not extensive enough to allow them to cause injury.

The call note of *Miniopterus australis* is a series of three to ten short metallic "ticks," usually uttered when the bat is in flight. Those collected were all mature, and the majority were males, whose stomach contents seemed to be mostly small insects. Unlike *Rhinolophus,* these bats will frequently climb upward, head foremost, a thing the other species collected always avoided doing.

Considering that at least several thousands of bats frequent these caves, it seems probable that on leaving their roosts at dusk in view of the intense competition some would have to travel very many miles to secure an adequate supply of insect food. Pondering over the vast numbers of bats, one dimly realizes what an enormous amount of harmful night-flying insects a single camp of bats must consume.

Our next objective was the Willy Willy Caves, located about 20 miles from Kempsey; the up-river trip being notable for the amazing greenness of the surrounding country. Chestnut-breasted Finches were abundant, whilst among the gum-bordered Willy Willy Creek, Blue-faced and Striped Honey-eaters were plentiful, and a beautiful black male Koel Cuckoo ("Cooee-Bird") was observed diligently feeding his sombrely-clad mate on Moreton Bay figs. Climbing a steep and heavily timbered hillside we searched among stinging-nettles, lantana, vines and stinging-trees, ultimately discovering the cave entrance—a hole about 10 feet across—running apparently to the very depths of the earth. Trees were felled for use as ladders and we descended with flashlights, collecting pistols and other gear. These caves, apparently more promising than the first, failed to produce a single bat, though there were obvious traces of recent occupation by large numbers—such are the uncertainties of a bat-hunter's life!

The silence in the caves was quite oppressive, and the only living creatures seen were large pallid moths and huge spiders, but even these were scarce. The moths appear to dwell on the floor amongst the guano, whilst the spiders scuttle upside down along the roofs of the caverns, their eyes gleaming brightly when the flashlight is directed towards them. The caves in some places are like a maze, my wanderings once bringing me directly above the narrow sloping passage we had climbed down.

Why, I wonder, do the bats come and go in this manner; at times occupying certain caves, and at times deserting them? Migration, perhaps, but it is also possible that these particular caves were used by

certain species whilst hibernating. We visited the caves in December; in July, possibly, there would have been an entirely different result.

Glowing reports as to the collecting possibilities of the Morparabah caves, situated some 35 miles from Kempsey, resulted in another visit. Arriving at a small dairy farm at the foot of the range, the taxi-driver received vague directions from a dairy hand as to the whereabouts of the caves; but although the range was searched for hours, we were forced to return empty handed, with our worthy driver quite exhausted.

The following day, however, we located the caves, climbed down the 25 feet entrance-hole and observed some beautiful miniature limestone formations, but did not see more than a dozen bats, which we were unable to bag. These particular caves are situated in a dense patch of "rain-forest" which was frequented by the Lyre Bird, Wonga, and Top-knot pigeons; the latter feeding in flocks upon the fruit of a large parasitic fig which was extremely abundant in the scrub.

Along the oak-clad hillsides kangaroo grass grew extensively and grass trees assumed large proportions. Rock wallabies, and both red and grey kangaroos were seen, and unmistakable signs of bandicoots were noticed. The Forest Kingfisher (*Halcyon macleayi*) and the Square-tailed Cuckoo was also noted in the timber on the mountain side, whilst high up above soared a pair of Wedge-tailed Eagles, and Grey Goshawks and Nankeen Kestrels patrolled the country below.

Only three Fruit-bats (*Pteropus poliocephalus*) were collected; these were all females and were shot whilst feeding in a tree almost in the middle of the town of Kempsey. I noticed that when feeding near houses these voracious bats did not fight or screech excessively, and they were only located by the persistent dropping of fruit and pulped seeds, and by the heavy flapping of wings as they alighted.

Although we went to several places where fruit bats were reported to be camping in "millions," we always discovered that we were some weeks too late. Apparently the bats had practically "eaten out" this district and gone where the crops of indigenous and cultivated fruits were probably more abundant. As Fruit-bats usually feed among the leaves on the outer branches of the fig trees—possibly where fruit is most plentiful, and from where it is easier to "take off"—little difficulty was experienced in collecting them. Located by the falling pulp, when the flashlight was directed towards them, they usually looked straight down at us, their eyes gleaming yellow in the rays. Those wounded were extremely difficult to kill; in fact, one injured bat refused to fall, and was found dead on the ground among the fallen fruit pulp next morning. Fruit-bats, like possums, occasionally come to a sudden end if a favourite feeding tree is growing near electric wires, with which they often come in contact and are electrocuted.

Dr. Allen was amazed to learn that he was able to fire a gun with impunity in the centre of this large Australian town, remarking that such a happening in an American town of similar size, an ambulance, a couple of police squads, and possibly the local Fire Brigade would be on hand within a couple of minutes—imagining, perhaps, that a "gang-war" was in progress!

At regular intervals along parts of the picturesque Hawkesbury River there occur small fresh-water swamps; the haunt of many interesting creatures. As night falls, Black Ducks quietly descend upon the swamps to feed, and the quiet is then unbroken save for an occasional splash, the

peculiar notes of the "Dab-chick," and the high-pitched cries of the tiny fluttering bats overhead.

One evening at dusk I took a long shot at a pair of ducks rising hurriedly from a swamp, and whilst the peace-shattering roar of the 12-guage frightened every bird and rabbit within half a mile to cover, I found that the bats continued to wheel and circle overhead as if nothing had happened. Perhaps it is that their ears are attuned only to high-pitched sounds—the loud report of the shot-gun being quite lost upon them. Specimens were required to determine the species, and in three shots I was fortunate enough to secure representatives of two genera: *Chalinolobus gouldi* and *Nyctinomus norfolkensis*. As there are no caves in the vicinity, these bats probably dwelt in the many ancient barns and homesteads in the vicinity. These bats were rarely, if ever, noted away from the swamps, and appear to take the place of the swamp-haunting swallows at dusk.

Bats, like nearly all other living things, are infested with small parasites—these are known as Nycteribids, which are crab-like wingless flies. The Horse-shoe bats which we captured at Kempsey had parasites which seemed enormous, compared with their hosts, and, it would seem, could quite easily be discarded were it not that the Nycteribids' feet are specially adapted to moving with extraordinary speed amongst the bats' fur. These bats, upon which at least three species are parasitic, did not seem to resent their presence, nor did the Fruit-bats either, which possessed at least two species—one of which was extremely large.

OCCASIONAL NOTE.

Mr. Albert De Lestang, of Bourke Town, North Queensland, recently forwarded a skin and skull of Leichhardt's Hare-wallaby (*Lagorchestes conspicillatus leichhardti*) for identification. As this animal is rare, and we have practically no data as to its habits, Mr. De Lestang on request gave the following field notes:—

"It is always found on its own in the low tussock plains, and among the low spinifex covered ridges at the foot of the Gulf of Carpentaria coastal ranges; also in the small valleys throughout the limestone country of these parts, and occasionally in the grassy open scrubs of the highlands."

A. S. Le Souef.

NOTES ON AND DESCRIPTIONS OF NEW SPECIES OF AUSTRALIAN DIPTERA.

By John R. Malloch.

Family Syrphidae.

Graptomyza Wiedemann.

Nova Dipt. Gen., 16, 1820.

Graptomyza doddi Ferguson.

Proc. Linn. Soc. N.S.W., li., 542, 1926.

The female before me has the fourth tergite with a central black line and the third with a trace of a similar line, but the peculiar black W-shaped mark on the posterior third of the mesonotum apparently places it here rather than in *plumifer*, Ferguson. I have carefully compared the two Australian species recorded here with the Oriental species of the genus available to me in the United States National Museum and consider they are congeneric. The hind tibiae have usually a group of black setulae on the apical half of the anterior surface in all the species, and this is particularly evident in the species now recorded.

Habitat: Queensland, Kuranda (F. P. Dodd). One female.

Graptomyza flavicollis Ferguson.

Proc. Linn. Soc. N.S.W., li., 541, 1926.

This very pretty little species, originally described from a single female from Cairns district, is the only one in which the hind femur has distinct anteroventral spines on the apical half, as recorded by Ferguson. This is not sufficient to justify the removal of the species to another genus. The hind tibial setulae are very indistinct in the female now before me.

One of the most striking characters of the genus, and one met with in all its species, consists of the oval discal depression of the scutellum.

Habitat: Queensland, Eungella, near Mackay; altitude, 2,000 feet; March, 1929 (F. H. Taylor).

Family Sapromyzidae.

I present below the descriptions of two new species and record the occurrence in Queensland of the peculiar genus *Ichthyomyia* previously known exclusively from New Guinea.

Sapromyza xenia, n. sp.

♀.—Head black, the ocellar triangle and frontal orbits glossy, the interfrontalia shining, and showing yellowish below the dark surface sheen, as does also the face and to a more marked degree the lower occiput, the face grey dusted and slightly shining, faintly convex. Anterior orbital short and fine, not as long as the short ocellars or postverticals. Antennae normal, the longest hairs on the aristae barely half as long as the width of third antennal segment.

Thorax glossy black, with hardly a trace of dust, the scutellum velvety deep black, the apex shining black. Mesonotum with three pairs of strong postsutural dorsocentrals, six irregular series of fine intradorsocentral hairs, one strong pair of prescutellar acrostichals, no bristle lateral of the supra-alar, two notopleurals, and two postalars; sternopleurals two; scutellars four.

Legs testaceous yellow, fore coxae and femora black. Fore femur

without comb; all tibiae with a preapical dorsal bristle, mid tibia with one apical ventral bristle; hind femur without anteroventral bristles.

Wings greyish hyaline, veins pale. Inner cross-vein close to middle of discal cell, penultimate section of fourth vein about four-fifths as long as ultimate one.

Abdomen testaceous yellow, much shrivelled in type so that the markings, if any, are not distinguishable, the tergites with rather strong apical bristles.

Halteres pale yellow.

Length: 4 mm.

Habitat: Queensland, Millaa Millaa (F. H. Taylor).

This species will run down to caption 34 in my key to the Australian species of the genus, but the arista, though long haired, is not plumose, there is no well developed bristle laterad of the supra-alar, and the uniformly shining black mesonotum and velvety black scutellum with its shining apex distinguishes the species from any other met with so far in Australia.

SAPROMYZA PICTIGERA, n. sp.

♀.—Head testaceous, more distinctly yellow on anterior margin of frons, the latter the only part free of dense grey dust except the black spots, the posterior extremities of the undusted part dark brown. A black dot at base of each of the frontal and vertical bristles, largest at outer vertical and posterior orbital, a large dark mark behind middle of each eye, a smaller one below each eye, a dark brown mark between each antenna and eye, and the upper margin of face and to a less marked extent a small mark on centre of epistome brown. Antennae testaceous yellow, third segment with a fuscous mark at middle below; aristae fuscous, yellow at bases; palpi fuscous. Frons at vertex nearly half the head width and over 1.5 times as wide as long, the grey dusted orbits fused with the ocellar triangle at anterior ocellus, convergent anteriorly and not extending to anterior margin, the two pairs of bristles well developed, the anterior about half as long as posterior pair; postverticals about half as long as the proclinate ocellars. Eye narrowed below, slightly emarginate on posterior margin of lower half; gena about as high as width of third antennal segment, the latter over 1.5 times as long as wide, rounded at apex; aristae short haired; face slightly convex, entirely grey dusted.

Thorax brownish testaceous, the humeri and apex of scutellum yellowish, the whole covered with dense grey dust, the mesonotum with numerous dark brown marks of irregular shape and smaller dots of same colour at bases of the hairs and bristles, the pleura variegated with dark brown, the scutellum sooty blackish-brown on basal two-thirds except a narrow stripe near each lateral edge, and the apex white dusted. Dorsocentrals consisting of three postsutural pairs, the acrostichals fine and irregularly biseriate, the prescutellar pair well developed; sternopleurals 2.

Legs testaceous-yellow, coxae, femora except their apices, a ring near base and another at apex of each tibia black. Fore femur without comb, all tibiae with well developed preapical dorsal bristle; hind femur without anteroventral bristles.

Wings yellowish-hyaline, with a dark brown mark at base from basad of the humeral cross-vein on costa to over the anal lobe, a black spot filling the stigma, and the inner cross-vein slightly brown clouded, the field between the dark costal marks white and the veins there pale yellow. Inner cross vein at middle of discal cell; ultimate section of fourth vein not over 1.5 times as long as penultimate.

Halteres cream coloured.

Abdomen testaceous, densely pale grey dusted, with a dark brown spot at base of each of the apical bristles and a subquadrate mark of the same colour on the anterior half of each side of each tergite that is connected usually with one or more of the apical spots. Tergites except first and apical each with short hind marginal bristles.

Length: 3.5 mm.

Habitat: Queensland, Tambourine Mt. (C. Deane).

This very strikingly coloured species is readily distinguished from any known to me from Australia by the presence of the two conspicuous dark costal marks on the wing, the peculiar bicoloured field of the wing, and the spotted head, thorax, and abdomen.

I published a key to the species of this genus in 1928 (Proc. Linn. Soc. N.S.W., liii., pt. 4, 355), and in it the above species will run down to caption 36. The longest hairs on the aristae being distinctly longer than its basal diameter. It is placed in the first section at that point, this section containing but one species, *ocellaris* Malloch. From *ocellaris* it is readily separated by the fact that the latter has no black costal marks on the wing, but is furnished with dark reticulations on their entire surface, the frons has two brown vittae, the face has two dark spots, and the mesonotum has four brown vittae; the antennae are also entirely black and there are a number of other distinguishing characters.

Genus Melanina Malloch.

Proc. Linn. Soc. N.S.W., lii., 412, 1927.

Melanina major Malloch.

Proc. Linn. Soc. N.S.W., lii., 413, 1927.

Habitat: N.S.W., St. Albans. Two specimens (F. H. Taylor).

Genus Ichthyomyia de Meijere.

Tijdschr. v. Ent., lvii., 382. 1914.

This genus was originally described from New Guinea and has not since been recorded. In my key to the genera of Australia it will run down to caption 16. At this point it most closely agrees with the second section in which falls *Australina* Malloch, but the head is quite different in structure, the face being remarkably conically produced as shown in Fig. 1. There is no doubt as to the close affinity of the genus to *Australina,* but I consider they are entitled to acceptance as distinct. The general structures are similar and the wing markings much the same in the two genotypes.

Ichthyomyia cyprinus de Meijere.

A testaceous coloured species, with fuscous markings on head as shown in the accompanying figure, the thorax largely brownish fuscous, the dorsum grey dusted and with four dark vittae; the legs testaceous, with their femora fuscous, and the wings infuscated, hyaline along their hind margins.

Habitat: Queensland, Kuranda (F. P. Dodd). One female.

I have examined the type specimen of this species which was submitted to me by Dr. de Meijere when I was working on the Philippine species some years ago and am confident the present specimen is referable here. The life-history of the species is unknown, but *Australina geniseta* Malloch, described from Darwin, N.T., was reared from larvae that were associated with coccids on *Pandanus,* and it is not unlikely that this association will be found to be a normal one, though it is possible

the larvae are merely scavengers, feeding on the excretions of the scale insect. Very little is known of the larval habits of the members of the family, and it would be of interest to discover the habits of this and related genera as the records of the few Sapromyzidae available point to their being scavengers, the larvae feeding on or in decaying leaves or humus.

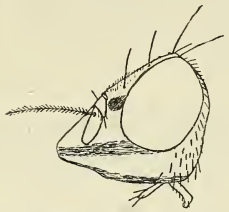

Fig. 1, Head of *Ichthyomyia cyprinus*, in profile.

Habitat: Holotype, N.S.W.; Sydney, 21.8.21 (Health Department).

Family Drosophilidae.

Leucophenga regina, n. sp.

A rather large species belonging to that section in which the halteres are entirely yellow and the wings distinctly spotted.

Head dull fawn coloured, the surface with slight whitish dusting, the ocellar spot fuscous, upper occiput shining dark brown; antennae and palpi pale brownish-yellow. Frons longer than wide, almost parallel-sided, the three orbital bristles quite strong, in a straight series and about equally spaced, the proclinate one at about one-third from anterior margin; outer pair of verticals longer than inner, the latter as long as the upper orbital and slightly longer than the ocellars, the postverticals rather short; surface with some minute spare hairs; gena linear; vibrissa single, well developed; face with a broad low central upper carina; antennae rather large, third segment rounded at apex; arista with about nine upper and four lower long hairs and some short hairs on apical half in front; palpi quite long but only slightly club-shaped; eyes bare.

Thorax fawn coloured, but slightly shining, the mesonotum without a trace of vittae, becoming testaceous yellow on sides, where it is similar in colour to the pleurae; scutellum darker brown than mesonotum, pale yellow on sides at base and around the apex. Dorsocentrals 2 pairs, prescutellar acrostichals well developed, intradorsocentral hairs strong, in about 8 rather irregular series; sternopleurals 2; the 4 scutellars subequal in length.

Legs testaceous-yellow. Mid femur with an almost complete series of anterior bristles, mid tibia with a complete series of posterodorsal setulae that are rather bristle-like.

Wings hyaline, with five dark brown spots and shading in some of the cells (Fig. 2). Halteres entirely brownish yellow.

Abdomen brownish yellow, slightly shining, the tergites with numerous brown spots and irregular discal markings, each with a series of black dots at apex, one at base of each of the apical bristles.

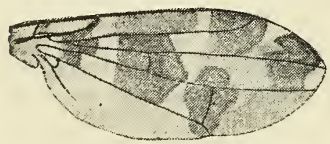

Fig. 2, Wing of *Leucophenga regina*.

Length: 3-3.5 mm.

Habitat: Queensland, Mt. Molloy (F. H. Taylor). Holotype ♂, allotype, and 8 paratypes.

This very pretty species is readily distinguished from any already described from Australia, or elsewhere, by the wing markings.

Family Tethinidae.

This group of small flies contains comparatively few genera and species, and so far but one has been described from Australia. This belongs to the genus *Tethina* in which the interfrontalia is furnished with two series of setulae or weak bristles, the apices of which are incurved or cruciate, the series converging anteriorly. There has been some confusion in the generic identities until recently, but now *Tethina* is well established and has been definitely segregated from *Pelomyia* Williston, in which latter there are no series of interfrontal bristles. I have before me two genera of the family which are distinguished as below.

Key to the Genera.

A. Face with a small glossy more or less angular elevation on each side just above and slightly mesad of the vibrissae .. .. *Tethina* Haliday.
AA. Face without glossy elevations as above .. .. *Dasyrhicnoessa* Hendel.

Tethina, Haliday.

Ann. Nat. Hist., ii., 188, 1839.

The most widely distributed genus of the family, occurring throughout the Old and New Worlds and generally associated with the shores of bodies of water, though nothing definite is known of the larval habits. Generally found on the sea-shore.

There are three Australian species before me, one previously described.

Key to the Species.

1. Hind tibia with some anterodorsal and posterodorsal bristles, some of which are distinctly longer than the diameter of the tibia; scutellum with numerous short discal hairs; intradorsocentral hairs in about eight rather irregular series, short and closely placed .. *tibiseta*, n.sp.
   Hind tibia without outstanding bristles; scutellum bare except for the four marginal bristles; intradorsocentral hairs in about four irregular series, the median two series presuturally longer than the others. 2.
2. Olive-grey dusted species, with the frontal and thoracic bristles all dark .. .. *nigriseta* Malloch.
   Whitish grey dusted species, with the cephalic and thoracic bristles yellow .. .. *pallidiseta* n.sp.

Tethina (Macrotethina) tibiseta, n. sp.

I believe that this species is entitled to subgeneric separation from *Tethina* and propose the name *Macrotethina* for the segregate. The characters are those cited in the above key to the species, and in addition the lack of a well developed pair of divergent postocellar (postvertical) bristles. The eyes are very short haired; in fact it is extremely difficult to detect the hairs, which is also the case in the species placed in the genus next dealt with.

♂, ♀.—Head yellow, the frons almost orange-yellow, the orbits slightly greyish dusted, the ocellar spot and occiput except its lower margin fuscous and with grey dust, the genae and face pale yellow, with whitish dust; antennae yellow, the third segment on a part of its outer surface, and the entire arista fuscous; palpi and proboscis yellow. Frons at vertex fully one-third of the head width, orbits poorly defined, each with two upper slightly outwardly-curved, and one reclinate lower bristle, a series of incurved inner marginal pale hairs and some rather shorter and darker outwardly curved hairs close to eye margin; all four verticals and the ocellars long, the postocellar region with a few short hairs, and the occiput with a pair of rather long incurved bristles below edge of vertex;

interfrontalia with three or four pairs of incurved setulose hairs, the central pairs strongest. Antennae normal, the second segment with a few setulae; aristae hardly longer than antennae, microscopically pubescent. Face slightly concave in profile, with the usual elevation on each side near vibrissae, gena about one-fifth as high as eye, with a series of lower marginal black upcurved bristles and a single vibrissa. Eyes with extremely short pile. Palpi slender. Prelabrum entirely pale.

Thorax fuscous, densely dark grey dusted, mesonotum not vittate, humeral angle and region at base of the posterior notopleural bristle fulvous yellow. Humerals 3, postalars 2, dorsocentrals 1 + 3, presutural well developed, prescutellar pair of acrostichals distinct, intradorsocentral hairs anteriorly in about 8 irregular series, all short and closely placed; propleural and stigmatal bristles distinct; scutellum with short discal hairs and 4 marginal bristles, the basal pair the shorter.

Legs fulvous-yellow, usually the apices of all femora and tibiae, and the fourth and fifth tarsal segments, blackened. Fore femur with a comb-like series of short black setulae on apical half of the anteroventral surface; hind tibia with one or two fine black bristles on basal half of the posteroventral surface and three or more stronger bristles on the apical two-thirds of the anterodorsal surface, apical spur on mid tibia long and straight, that on hind tibia shorter and slightly curved, the basal segment of hind tarsus with two small black bristles at base below.

Wings hyaline, veins yellow. Inner cross vein close to middle of discal cell; penultimate section of fourth vein about one-third as long as ultimate, the latter much weaker than third vein, and the section of the costa between it and third very weak, subobsolete, the ultimate section of fifth vein about three times as long as the outer cross vein. Halteres yellow.

Abdomen coloured as thorax, usually with pale apices to the tergites, which are more marked in the female than in the male.

Length: 2.5-3 mm.

Habitat: Queensland, Townsville (F. H. Taylor). Holotype ♂, allotype, and 12 paratypes.

TETHINA (TETHINA) NIGRISETA, Malloch.
Proc. Linn. Soc. N.S.W., xlix., 337, 1924.

A smaller species than *tibiseta*, with the same general coloration, but the mesonotum is not partly yellow on the sides, the bristles on the lower margin of the genae are brownish yellow, and the legs are fulvous-yellow, with the fifth tarsal segment slightly darkened. In addition to the structural distinctions mentioned in the foregoing key to the species, the following may be noted: The fore femur has no apical anteroventral comb, the apical ventral tibial spurs are much shorter, and the costal vein is distinct to the apex of the fourth vein.

In addition to the type specimen from Woolgoolga, N.S.W., I have before me two specimens from Sydney, and one from Townsville, the latter collected by F. H. Taylor.

TETHINA (TETHINA) PALLIDISETA, n. sp.

A small species much like *nigriseta* in general characters, but much paler dusted and with almost white bristles and hairs throughout.

♂, ♀.—Head yellowish white, densely white dusted, the ocellar triangle and upper part of occiput dark and with grey dust, all the bristles and hairs white or yellowish white. Frons longer than in *tibiseta* as compared with its width, the bristling much as in that species, but all the

four orbitals apparently outwardly curved, and the gena about half as high as eye.

Thorax as in *nigriseta,* but densely whitish-grey dusted, and with the hairs and bristles almost white.

Legs entirely yellow, armed as in *nigriseta.*

Wings whitish hyaline, the venation as in *nigriseta.* Halteres yellow.

Abdomen coloured as the thorax, the hairs white.

Length: 2 mm.

Habitat: New South Wales, Collaroy. Type ♂, and allotype.

The type-specimen is damaged. It was collected by the late Dr. E. W. Ferguson and belongs to the Health Department collection in Sydney.

Dasyrhicnoessa, Hendel.

This genus is very similar to *Tethina,* differing mainly in the lack of the pair of facial protuberances near the vibrissae. In the species I have seen there are no outstanding acrostichal setulae except the prescutellar pair, the postocellar pair of divergent bristles is very small, and the venation is similar to that of *Tethina,* the discal and posterior basal cells being separated by a complete cross vein. In all species there is also at least a partial series of minute spinules on the apical part of the anteroventral surface of the fore femur, though this is rather variable in strength and usually extremely difficult to make out.

There are apparently two species in the Australian material, both of them quite similar to the Formosan one which I have examined, being of a general fulvous-yellow colour, with entirely yellow legs and the abdomen partly infuscated. The bristles are largely brownish-yellow, though those on the genal margin and some of those on the orbits are darker. Both the Australian species differ from the other in having the face considerably wider, at the epistome over twice as wide as the distance from either vibrissa to the nearest point of the eye, as against less than twice as wide.

Key to the Species.

A. Mesonotum entirely dull fulvous-yellow; abdomen with blackish marks at the bases of the second and third tergites or almost all of these two tergites blackened; armature of the anteroventral surface of the fore femur consisting of a few microscopic pale spinules that are not very closely placed .. .. *fulvescens,* n. sp.

AA. Mesonotum dull brownish yellow, with greyish marks, the most obvious being a rather broad poorly margined central vitta; abdomen with the bases of the tergites blackened, their apices fulvous yellow; armature of the fore femur consisting of a comb-like series of closely placed black setulae on almost the apical half of the anteroventral surface .. .. *serratula,* n. sp.

Dasyrhicnoessa fulvescens, n. sp.

A small dull fulvous-yellow species, with a narrow black edging round the posterior side of the anterior and the inner side of the two posterior ocelli, and the second and third tergites of the abdomen largely blackened.

♀.—Head normal, the frons at vertex about two-fifths of the head width, all four verticals well developed, the postocellar divergent bristles short and fine, the incurved pair below the vertex longer and stronger, the ocellars about as long as the inner verticals, each orbit with three bristles and the usual short hairs, the interfrontalia with two series of incurved bristles, usually three in each, and some interspaced short hairs. Eyes higher than long, with extremely short hairs; gena about one-fifth

of the eye height; face depressed, fully twice as wide between the vibrissae as the distance of either from nearest point of eye. Antennae normal, the arista short, almost bare. Bristles mainly black, the hairs slightly paler.

Thorax entirely dull fulvous-yellow. Dorsocentrals 1 + 3, presutural long, the prescutellar pair of acrostichals long, intradorsocentral hairs irregularly sexseriate, the two median series hardly longer than the others; scutellum bare on the disc, the basal pair of bristles a little shorter than the apical pair.

Legs entirely fulvous-yellow. Fore femur with a series of fine and rather short posteroventral bristles, most distinct apically, and a few short rather widely spaced spinules on the apical half of the anteroventral surface; mid tibia with the apical ventral spur short; hind tibiae without dorsal bristles.

Wings whitish hyaline, veins pale. Inner cross-vein before middle of discal cell, penultimate section of fourth vein about one-third as long as ultimate and about equal to ultimate section of fifth, the latter about four times as long as the outer cross vein. Halteres yellow.

Abdomen slender, tapered to apex, with two rather long slender apical lamellae.

Length: 1.5 mm.

Habitat: Queensland, Townsville (F. H. Taylor). Type and one paratype.

DASYRHICNOESSA SERRATULA, n. sp.

♀.—A little stouter and darker than the preceding species, the mesonotum with at least a central broad dark greyish dusted vitta, and all the abdominal tergites with their bases blackened more or less broadly. The fore femur has a very evident comb-like series of short black setulae on the apical half of the anteroventral surface.

Length: 1.5 mm.

Habitat: Queensland, Townsville (F. H. Taylor).

It is possible but hardly probable that this is a variety of *fulvescens*. It is quite noticeably more robust in build and, apart from the colour characters mentioned, the armature of the fore femora would appear to justify the separation.

Family NEOTTIPHILIDAE.

Genus TAPEIGASTER Macquart.

Mem. Soc. Sci., Lille, 102, 1846.

There are five known species of this exclusively Australian genus to which species I presented a synoptic key (Proc. Linn. Soc. N.S.W., lv., 1930, 435). Before me at this time there is an additional species which is described below.

TAPEIGASTER TAYLORI, n. sp.

♂.—Head bright fulvous-yellow on frons, paler below, with faint changeable white dusting; ocellar spot black; antennae brownish-yellow. Epistome hardly projecting beyond vibrissal angles, simple.

Thorax duller than frons, the mesonotum with grey dusted rather irregular vittae that divide the surface into four darker vittae; pleura irregularly infuscated on upper margin. Bristles as in *marginifrons*, the prescutellar pair of acrostichals and two posterior pairs of dorsocentrals developed.

Legs yellow, extreme apices of all femora, a dark mark on centre of

each femur, smallest on the fore pair, and a black annulus near base and another at apex of each tibia; fifth segment of all tarsi brown. Fore and mid femora distinctly stouter than the hind pair, all with fine hairs that are longest below, and with short black bristles in a double series at apices that are weaker than usual, the hairs on the basal half of the ventral surface of mid pair dense, short, and black; mid tibia with the ventral hairing dense and rather long.

Abdomen entirely yellow. Terminalia large and complicated but without projecting dorsal processes on seventh tergite.

Wings yellowish, more intense basally on the costa. Tegulae black. Halteres yellow.

Length: 9 mm.

Habitat: N.S.W., Tallong (F. H. Taylor).

A fulvous-yellow species similar to *argyrospila* Bezzi, in general colour, the antennae brownish-yellow, and all femora with a black central mark or ring.

Named in honour of the collector.

Family Phoridae.

Genus Apocephalus Coquillett.

Proc. Washington Acad. Sci., iv., 501, 1901.

The first described species of this genus was found in North America and because of the peculiar habits of the larva was called the Ant-decapitating Fly. The larvae are found between the head and thorax of the ants upon which it is predacious, and as they feed on the host they destroy the tissue of the conjunctive, decapitating the ant. Several species have been described from various other regions, but whether the same habit obtains outside of America is unknown. No data are available on the species now described.

Apocephalus niger, n. sp.

A small dull brownish-black species, with the legs becoming paler apically, and the halteres fuscous.

♂.—Head black, frons dull, antennae and palpi brownish. Frons much wider than long, emarginate on each side in front, the vertical bristles stronger than the upper transverse series, the latter in an almost straight row, the two comprising the anterior or lower series about as far in front of the upper series as the latter are from the verticals, the bristles erect and slightly divergent. Antennae large, third segment pyriform, the apex slender, with apical arista as usual, the surface densely pilose. Palpus not as large as third antennal segment, slightly dilated and with a number of short bristles.

Mesonotum with short decumbent black hairs and a pair of prescutellar dorsocentral bristles; mesopleura bare; scutellum with a pair of strong bristles near base and slightly inside of outer edge.

Legs without any tibial setulae, the tibiae round in cross section, no dorsal ridge on hind pair; apical spur on mid and hind tibiae well developed.

Wings hyaline, veins fuscous. Costa extending to middle, the first section 1.5 as long as second, third very short, fringe not longer than diameter of costal vein.

Abdomen slender, terminalia small, bulbous.

Length: 1.25 mm.

Habitat: N.S.W., Sydney, 21.8.21. Holotype: Health Department.

AUSTRALIAN COWRIES.

By Tom Iredale.

(By Permission of the Trustees of the Australian Museum.)

(Plates viii. & ix.)

Since the earliest times Cowries have been the most popular of all shells on account of their beauty of coloration and form, the extraordinary polish calling attention to their varied patterns. However to the worker, fortunate enough to see them in the living state, the greater variety and elegance of the animals have appealed even more. Unfortunately, however, the animals are very shy and withdraw themselves into their shells, and do not easily thereafter expand themselves so that they can be examined at leisure.

Mr. Melbourne Ward, the well-known carcinologist, now living at Lindeman Island, was so attracted by these molluscs that he placed them in his aquarium, and by intensive study found that they would come out and walk about at night. He made some paintings and sent them to me, and upon my request has continued his interest and has made paintings of no less than twenty species. In each case with the painting he sent the shell itself from the animal of which the painting had been made, thus fixing absolutely the identity for all time of the species figured. For the purposes of reproduction, Miss Joyce Allan, of the Australian Museum, has copied Mr. Ward's paintings, and alongside has painted the shell from the dorsal and ventral surface, and these are now presented as a first contribution to the exact study of the animals of Cowries in Australia. Just one hundred years ago a similar series of paintings of Indo-Pacific Cowries and animals was published in the Zoology of the Voyage of the Astrolabe by Quoy and Gaimard, and these paintings have been copied in very many places ever since. Garrett, the great conchologist, who worked among the islands of the Pacific Ocean, has given descriptions of some animals, but no figures, and Mrs. Coxen published three descriptions made by her husband of common Moreton Bay animals. Angas gave a couple of notes of South Australian forms, but otherwise there seems to be very little on record. In order to assist in the further study of this delightful group, a list of Australian Cowries and their allies has been drawn up, and Quoy and Gaimard's, Garrett's and Mrs. Coxen's descriptions given. Mr. Melbourne Ward will continue his studies, and it is hoped that the present essay will induce everyone who has the good fortune to meet with these animals to take colour notes and make drawings or paintings if possible. If these be transmitted to the Australian Museum, it may be possible later to continue with a further account of the animals of Australian Cowries. In each case it will be necessary to preserve the exact shell of the animal observed, described or painted.

Conchologically, Cowries have been well monographed and illustrated in colour, Sowerby, Reeve, Weinkauff and Roberts, in Tryon's Manual, each furnishing excellent figures. More recently, Melvill, Hidalgo, Shaw and now Schilder have reviewed the group in detail, but without illustrations. Consequently, as far as the shells are concerned, a great deal has been done with them, but Mr. Ward's investigations in connection with the animals have opened up a new field, as some of the species which apparently from shell characters ran into each other are shown to cover very different animals. Schilder's series of papers since 1922 have been utilised

in the preparation of this list, which is a compilation of all the records available in conjunction with personal study in the field of Queensland and New South Wales species, the Australian Museum collection being very representative in this group.

The list herewith covers the superfamily Cypraeoidea, including the families Eratoidae, Triviidae, Pediculariidae, Amphiperatidae, Umbiliidae and Cypraeidae. All the Australian members are listed, and this will serve as a basis for further conchological research, as well as additional malacological information.

Superfamily CYPRAEOIDEA.

This agrees with the Stirps Cypraeacea of Thiele.

Family ERATOIDAE.

Although the animals of these small shells have been seen, no notes nor sketches have yet been taken.

Genus ERATOENA nov.

Type, *Ovulum corrugatum* Hinds.

The small sculptured species are very distinct from the larger smooth forms of *Lachryma,* and, as they are seen to be represented in the fossil state as *Eratopsis* from the Miocene of Austria, the tropical recent species are here separated. The nodulation makes the species easily recognisable, but when this is subobsolete the apertural characters distinguish them. There are three or more species in Australian waters, but these will be later more fully reported upon.

ERATOENA CORRUGATA Hinds.

1845. *Ovulum corrugatum* Hinds, Zool. Voy. Sulphur, Moll., p. 47, pl. xvi., figs. 5, 6. New Guinea.

Queensland.

Smith (Proc. Mal. Soc. (Lond.), Vol. ix., p. 19, March, 1910), lumped this with *E. schmeltziana* Crosse (Journ. de Conch., Vol. xv., p. 301, pl. xi., fig. 5, July 1, 1867; Fiji Islands), under *E. sulcifera* Sowerby (Conch. Illus., pt. 8, fig. 46, ex Gray M.S.; November 16, 1832; Cape of Good Hope), a different species.

ERATOENA NANA Reeve.

1865. *Erato nana* Reeve, Conch. Icon., Vol. xv., pl. iii., sp. and fig. 18, ex Duclos MS. March. Locality unknown.

Queensland.

This is included in the Queensland list, but there may be more than one very small species, and perhaps *Erato gemma* Bavay (Journ. de Conch., Vol. lxiii., p. 108, pl. iii., figs. 1, 2, August 31, 1917) may be recognised later here as many Lifu shells occur on the Great Barrier Reef.

Genus LACHRYMA.

1832. *Lachryma* Sowerby, Conch. Illus., pt. 8, Cat., p. 15, November 16. ex Humphrey MS. Haplotype, *Erato lachryma* Sowerby.

The smooth forms may even be later separated, as there is a series of fossils in Southern Australia which show distinctive features, and the southern recent species may be descendants from this source, and thus not congeneric with the tropical shells.

LACHRYMA LACHRYMA Sowerby.

1832. *Erato lachryma* Sowerby, Conch. Illus., pt. 7, fig. 48. November 9. ex Gray MS. Catal., p. 15, pt. 8. November 16. New South Wales.

1832. *Lachryma trifasciata* Sowerby, Conch. Illus., pt. 8, Catal., p. 15. Nov. 16. ex Humphrey MS. As synonym.
New South Wales. Queensland.

LACHRYMA DENTICULATA Pritchard & Gatliff.

1900. *Erato denticulata* Pritchard & Gatliff, Proc. Roy. Soc. Vict., Vol. xiii. (n.s.), p. 133, pl. xx., fig. 5. August. (ex Vol. xii. (n.s.), p. 188, April, 1900, *nomen nudum.*) Western Port, Victoria.
Victoria. Tasmania. South Australia. West Australia.

This has been confused with the preceding, but the characters cited by the authors are valid and allow its separation.

LACHRYMA (CYPRAEERATO) BIMACULATA Tate.

1878. *Erato bimaculata* Tate, Trans. Roy. Soc. South Austr., Vol. i., p. 88 (? December). Aldinga, St. Vincent's Gulf, South Australia.

1901. *Erato bimaculata* Tate & May, Proc. Linn. Soc. N.S.W., Vol. xxvi., p. 375, pl. xxiii., fig. 6.
South Australia. Tasmania (?). West Australia.

LACHRYMA (CYPRAEERATO) GALLINACEA Hinds.

1844. *Ovulum gallinaceum* Hinds, Zool. Voy. Sulphur. Moll., p. 47, pl. xvi., figs. 1, 2. New Guinea.
Queensland.

LACHRYMA (CYPRAEERATO) ANGISTOMA Sowerby.

1832. *Erato angistoma* Sowerby, Conch. Illus., pt. 8, fig. 51. November 16. Catal., p. 16, pt. 8. November 16. East Indies.
Queensland.

LACHRYMA (CYPRAEERATO) BISINVENTA Iredale.

1931. *Lachryma bisinventa* Iredale, Rec. Austr. Mus., Vol. xviii., p. 223, pl. xxii., fig. 16. June 29. Sydney Harbour, N.S.W.
New South Wales.

Family TRIVIIDAE.

Probably as great distinction will be found among the animals of the shells referred to this family as among those of the Cowries proper. The few figures show discrepancies, and the animals seen, but of which we have no paintings yet, differed at sight.

Genus TRIVIROSTRA.

1884. *Trivirostra* Jousseaume, Le Naturaliste, 6th year, p. 415. February 15. Logotype, Roberts, Man. Conch. (Tryon), Vol. vii., p. 161. July 3, 1885. *Cypraea scabriuscula* Gray.

TRIVIROSTRA SCABRIUSCULA Gray.

1827. *Cypraea scabriuscula* Gray, Zool. Journ., Vol. iii., p. 364. December 31. Madagascar.
New South Wales.

TRIVIROSTRA ORYZA Lamarck.

1810. *Cypraea oryza* Lamarck, Ann. Mus. Hist. Nat. Paris, Vol. xvi., p. 104. After August. Asiatic Ocean.
Queensland.

TRIVIROSTRA EDGARI Shaw.

1909. *Trivia edgari* Shaw, Proc. Mal. Soc. (Lond.), Vol. viii., p. 310. July. New name for

1849. *Cypraea grando* Gaskoin, Proc. Zool. Soc. (Lond.), 1848, p. 96. March 13, 1849. Manilla. Not *C. grando* Potiez & Michaud, Gal. Moll. Douai, October, 1838, i., p. 481.
Queensland.

TRIVIROSTRA GASKOINII Roberts.

1869. *Trivia gaskoinii* Roberts, Amer. Journ. Conch., Vol. v., Cat. Porcell., p. 206. New name for

1849. *Cypraea sulcata* Gaskoin, Proc. Zool. Soc. (Lond.), 1848, p. 95. March 13, 1849. Manilla. Not *C. sulcata* Dillwyn, Descr. Cat. Rec. Shells, p. 466, 1817.
Queensland.

TRIVIROSTRA ORYZOIDEA nom. nov.

1917. *Trivia oryza* Odhner, Kungl. Sv. Vet. Akad. Handl. Bd., 52, No. 16, p. 53, pl. 2, figs. 52, 53, text fig. 12. September 19. 45 miles. W.S.W. of Cape Jaubert, North West Australia, 11 fathoms. Not *Cypraea oryza* Lamarck, above.
North West Australia.

TRIVIROSTRA VITREA Gaskoin.

1849. *Cypraea vitrea* Gaskoin, Proc. Zool. Soc. (Lond.), 1848, p. 95. March 13, 1849. Philippines.
Queensland.

TRIVIROSTRA PARGRANDO nom. nov.

1917. *Trivia grando* Odhner, Kungl, Sv. Vet. Akad. Handl. Bd., 52, No. 16, p. 53, pl. 2, figs. 50, 51, text fig. 11. September 19. 42 miles W.S.W. of Cape Jaubert. N.W.A., 11 fathoms. Not *T. edgari* Shaw, above.
North West Australia.

Genus DOLICHUPIS.

1930. *Dolichupis* Iredale, Mem. Queensland Mus., Vol. x., p. 83. August 28. Orthotype, *Cypraea producta* Gaskoin.

DOLICHUPIS PRODUCTA Gaskoin.

1836. *Cypraea producta* Gaskoin, Proc. Zool. Soc. (Lond.), 1835, p. 200. April 8, 1836. No locality.
Queensland.

DOLICHUPIS OBSCURA Gaskoin.

1849. *Cypraea obscura* Gaskoin, Proc. Zool. Soc. (Lond.), 1848, p. 94. March 13, 1849. North West Australia. Dupuch's Island (Dring), Abrolhos Island (Dring).

1917. *Trivia bipunctata* Odhner, Kungl. Sv. Vet. Akad. Handl. Bd., 52, No. 16, p. 53, pl. ii., figs. 54, 55, text fig. 10. September 19. 42 miles W.S.W. of Cape Jaubert, North West Australia, 11 fathoms.
North West Australia.

When Gaskoin published his description, he stated that apparently it had already been described by Kiener under the name *C. napolina* Duclos, but that "Kiener's figures, pl. 53, figs. 3 and 3a, are no representations of his descriptions." Kiener's species belongs to West Africa, and is certainly not the West Australian shell.

DOLICHUPIS PELLUCIDULA Reeve.

1846. *Cypraea pellucidula* Reeve, Conch. Icon., Vol. iii., pl. xxvi., fig. 153. ex Gaskoin MS. March. South Pacific.

1846. *Cypraea pellucidula* Gaskoin, Proc. Zool. Soc. (Lond.), 1846, p. 23. May. South Pacific.
Queensland.

DOLICHUPIS INSECTA Mighels.

1845. *Cypraea insecta* Mighels, Proc. Boston Soc. Nat. Hist., Vol. ii., p. 24. January. Oahu, Hawaiian Group.
New South Wales.

Genus CLEOTRIVIA.

1930. *Cleotrivia* Iredale, Mem. Queensland Mus., Vol. x., p. 83. August 28. Orthotype, *Cypraea pilula* Kiener.

CLEOTRIVIA PILULA Kiener.

1845. *Cypraea pilula* Kiener, Species General, Genus Cypraea, p. 151, pl. liv., figs. 2, 2a (1843). No locality.
Queensland. New South Wales.

Cypraea globosa Sowerby (Conch. Illus. pt. 6, fig. 34, November 2, 1832, ex Gray MS. No locality) is now regarded as an American species, but there are two or three small globose species in Queensland, and these will be worked out later.

CLEOTRIVIA BATHYPILULA nom. nov.

1918. *Trivia globosa* Verco, Trans. Roy. Soc. South Austr., Vol. xlii., p. 150. 40-80 miles west of Eucla, West Australia. 72-81 fathoms. South West Australia.

This deepwater shell is narrower and less elevated than the so-called *pilula* of the east coast, and, of course, it cannot be called *globosa* in any sense. The measurements are: Length, 4 mm.; breadth, 3 mm.; height, 2.5 mm. It will be figured later.

Genus ELLATRIVIA.

1931. *Ellatrivia* Iredale, Rec. Austr. Mus., Vol. xviii., p. 221. June 29. Orthotype, *Triviella merces* Iredale.

ELLATRIVIA MERCES Iredale.

1924. *Triviella merces* Iredale, Proc. Linn. Soc. N.S.W., Vol. xlix., p. 257, pl, xxxv., figs. 16-17. October 24. New South Wales.

1822. *Cypraea australis* Lamarck, Hist. Anim. s. Vert., Vol. vii., p. 404. August. New Holland (Macleay). Not *C. australis* Schroeter, Arch. Zool. (Wied.), Vol. iv., p. 10, 1804.

New South Wales. Victoria. Tasmania. South Australia. South West Australia.

ELLATRIVIA (MERCES) ADDENDA Iredale.

1931. *Ellatrivia* (*merces*) *addenda* Iredale, Rec. Austr. Mus., Vol. xviii., p. 221. June 29. Off Montague Island. New South Wales. 50-70 fathoms.
New South Wales (deep water).

The animal of *Cypraea australis* Lamarck was illustrated by Quoy and Gaimard, and Miss Allan has made a painting of a local animal which will be reproduced later.

Genus FOSSATRIVIA.

1931. *Fossatrivia* Iredale, Rec. Austr. Mus., Vol. xviii., p. 222. June 29. Orthotype, *Trivia caelatura* Hedley.

FOSSATRIVIA CAELATURA Hedley.

1918. *Trivia caelatura* Hedley, Journ. Proc. Roy. Soc. N.S.W., Vol. li., Suppl. p. M71. June 19. New name for

1907. *Trivia avellanoides* Hedley, Rec. Austr. Mus., Vol. vi., p. 293, pl. 55, figs. 17-18. January 23. 80 fathoms, off Narrabeen, N.S.W. (Not *C. avellanoides* McCoy, Ann. Mag. Nat. Hist., Ser. iii., Vol. xx., p. 436, 1867.)

New South Wales.

Genus TRIVELLONA.

1931. *Trivellona* Iredale, Rec. Austr. Mus., Vol. xviii., p. 221. June 29. Orthotype, *T. excelsa* Iredale.

TRIVELLONA EXCELSA Iredale.

1931. *Trivellona excelsa* Iredale, Rec. Austr. Mus., Vol. xviii., p. 221, pl. xxiv., figs. 13, 14. June 29. Off Montague Island, N.S.W., 50-70 fathoms.

New South Wales.

Family PEDICULARIIDAE.

This family may be the product of degeneracy from a Volvid form like *Phenacovolva* or *Pellasimnia,* and consequently the animals will differ in various parts of the world, as indicated by Thiele, who had proposed *Pediculariella* for a Californian species. Schilder has placed our local shell under this, but superficially the local species differs.

Genus PEDICULARIONA nov.

Type, *Pedicularia stylasteris* Hedley.

PEDICULARIONA STYLASTERIS Hedley.

1903. *Pedicularia stylasteris* Hedley, Austr. Mus. Mem., iv., p. 342, figs. 69, 70. October 8. Off Wollongong, New South Wales, 55-66 fathoms.

New South Wales.

The elevated sculptured spire, later buried in the shell, separates this distinctly, and there are representatives of this family in Queensland.

Family AMPHIPERATIDAE.

This family can easily be separated into two subfamilies, those with elongate shells living among the branches of corals, and those with rounded shells, some of which live among soft corals. The subfamily Amphiperatinae covers the latter, the well known *Amphiperas* (*Ovula* olim) *ovum,* being a characteristic species, while the equally well known *Volva* (*Radius* olim) *volva* illustrates the lengthened series.

Subfamily AMPHIPERATINAE.

Genus AMPHIPERAS.

1781. *Amphiperas* Meuschen, Index Zoophyl. Gronov., for p. 293. Logotype, Herrmannsen, Index Gen. Malac., p. 41, 1846. *Bulla ovum* Linné.

1789. *Ovula* Bruguiere, Ency. Meth., Vers., Vol. i., p. xv. Logotype, Anton, Verz. Conch., p. 98, 1839 = 1838 (Oct.) as of Lamarck. *Bulla ovum* Linné.

A second species, known as *tortilis* Martyn, but now to be called *costellata* Lamarck, differs in the animal features, and also in the formation of the posterior canal, and is here made the type of a new subgenus, *Parlicium.*

Amphiperas ovum Linné.

1758. *Bulla ovum* Linné, Syst. Nat., x., ed., p. 725. January 1. First reference, Bonan. recr. 2, t., 252; the second, "Rumph. mus. t. 38, f.Q. Ovum." O. Asiatico. Restricted type locality, definitely, Amboina.

Queensland. New South Wales.

The animal of this pure white shell is black, and has been well figured by Quoy and Gaimard from New Guinea. Their description reads: "The mantle is a beautiful velvety black, covered with little white papillae, simple and little elevated; it is yellowish within. The tentacles are very long, rather thin, white only at the extremity, and black all the rest of their extent. The siphon is short, wide, without fringing."

Amphiperas (Parlicium) costellata Lamarck.

1810. *Ovula costellata* Lamarck, Ann. Mus. Hist. Nat. Paris, Vol. xvi., p. 110. After October. L'ocean des Grandes Indes? = Friendly Isles.

[1786. *Cypraea tortilis* Martyn, Univ. Conch., pt. ii., pl. 60. Friendly Isles. Rejected as non-binomial.]

Queensland.

All the early localities are the Friendly Islands, and thence Quoy and Gaimard described and figured the animal as follows:—"Has the foot very large, subtriangular, much enlarged in front without being auriculate, of a very beautiful white with a wavy border, marked with a line of pure black, and before and above the front edge it is striated with doubled rosy lines. The tentacles are long, pointed, white with two rose bands. The eyes are placed towards their bases, on a peduncle a little more projecting than in other Cowries. The mantle, of a beautiful yellow orpin, is covered with red brown specks, placed very closely. Its tubercles are a little raised, conical, yellowish, darker yellow at their points."

Genus Calpurnus.

1810. *Calpurnus* Montfort, Conch. Syst., pt. ii., pp. 638-9. May. Orthotype, *Bulla verrucosa* Linné.

1840. *Cypraella* Swainson, Treat. Malac., p. 325. May. Haplotype, *Bulla verrucosa* Linné.

Calpurnus verrucosus Linnè.

(Plate viii., figs. 4, a-b.)

1758. *Bulla verrucosa* Linné, Syst. Nat., x. ed., p. 726. January 1. First reference, Rumph. mus. t. 38, fig. 11. "In India, orientali"; therefore restricted type locality is Amboina.

Queensland.

Mr. Melbourne Ward's painting reproduced here speaks for itself. Quoy and Gaimard described and figured a specimen from Tonga Tabu which agrees very closely, but A. Adams has given a figure, unfortunately without locality, in which the mantle shows large black spots like those on the foot. Attention is drawn to this, as the shell shows very little variation in size or form.

Genus Procalpurnus.

1929. *Procalpurnus* Thiele, Handb. Syst. Weicht., 1st teil., p. 272. Haplotype, *Ovula lactea* Lamarck.

PROCALPURNUS LACTEUS Lamarck.

(Plate viii., figs. 3, a, b, c.)

1810. *Ovula lactea* Lamarck, Ann. Mus. Hist. Nat. Paris, Vol. xvi., p. 111. After October. Timor.

Queensland.

This is an addition to the Australian fauna as though Hedley had collected one dead shell at Murray Island, and Whitley and I got four more at Michaelmas Cay, it had not been recorded when Mr. Melbourne Ward sent down the painting and shell from a living animal from Lindeman Island, and this appears to be the first representation of the animal. Mr. Ward's notes read: "Foot pale green, covered with minute black spots. Mantle dark greenish brown, with faint dark blotches. Papillae very minute. Siphon same colour as foot. Tentacles with red band." The lack of the tubercles at the extremities easily distinguish the shell from that of *Calpurnus*.

Genus MARGOVULA nov.

Type, *Ovulum pyriforme* Sowerby.

This group is easily separated from either *Diminovula* or *Prionovolva* by its shape and the columellar features.

MARGOVULA PYRIFORMIS Sowerby.

1828. *Ovulum pyriforme* Sowerby, Zool. Journ., Vol. iv., pp. 148, 151. Oct. "New South Wales" = Queensland.

Queensland.

Genus DIMINOVULA.

1930. *Diminovula* Iredale, Mem. Queensland Mus., Vol. x., p. 85. August 28. Haplotype, *D. verepunctata* Iredale.

DIMINOVULA VEREPUNCTATA Iredale.

1930. *Diminovula verepunctata* Iredale, Mem. Queensland Mus., Vol. x., p. 85. August 28. Queensland = Caloundra.

Queensland. New South Wales.

DIMINOVULA CAVANAGHI Iredale.

1931. *Diminovula cavanaghi* Iredale, Rec. Austr. Mus., Vol. xviii., p. 222, pl. xxii., figs. 13, 14. June 29. Sydney Harbour, New South Wales.

New South Wales. Queensland.

Genus PRIONOVOLVA.

1930. *Prionovolva* Iredale, Mem. Queensland Mus., Vol. x., p. 85. August 28. Haplotype, *Ovulum breve* Sowerby.

PRIONOVOLVA BREVIS Sowerby.

1828. *Ovulum breve* Sowerby, Zool. Journ., Vol. iv., pp. 145, 152. October. Locality unknown = Queensland.

Queensland. New South Wales.

Subfamily VOLVINAE.

The members of this family range from fairly large to very small, and there appears to be many more species in nature than commonly recognised, probably half a dozen yet undescribed from Queensland alone.

Genus VOLVA.

1798. *Volva* Bolten, Mus. Bolten, pt. ii., p. 21. September. Tautotype, *V. textoria* = *Bulla volva* Gmelin = Linné.

1810. *Radius* Montfort, Conch. Syst., pt. ii., pp. 626/7. May. Orthotype, *Bulla volva* Linné.

1840. *Birostra* Swainson, Treat. Malac., p. 325. May. Haplotype, *Bulla volva* Linné.

VOLVA VOLVA Linné.

1758. *Bulla volva* Linné, Syst. Nat., xth ed., p. 725. January 1. For List. Conch., 4, figs. 9, c.9, t.1, fig. 1 and Argenv. Conch., t. 21, fig. I. Jamaica error = Ceylon.

1798. *Volva textoria* Bolten, Mus. Bolten, pt. ii., p. 22. September. For Martini, I., t. 23, fig. 218. Knorr., Verg., 5, t. 1, figs. 2, 3, 6; t. 32, fig. 1. No locality = Ceylon.

Queensland. West Australia.

The animal has been figured by A. Adams, but this figure is not like the animal of the Queensland shell, as far as can be recognised from a spirit specimen collected by the Low Isles Expedition, which will be reported upon later.

VOLVA VOLVA CUMULATA Iredale.

1931. *Volva volva cumulata* Iredale, Rec. Austr. Mus., Vol. xviii., p. 222. June 29. New South Wales.

New South Wales.

The southern form is notably broader than the northern one.

Genus PHENACOVOLVA.

1930. *Phenacovolva* Iredale, Mem. Queensland Mus., Vol. x., p. 85. August 28. Orthotype, *P. nectarea* Iredale.

PHENACOVOLVA NECTAREA Iredale.

1930. *Phenacovolva nectarea* Iredale, Mem. Queensland Mus., Vol. x., p. 85, pl. ix., fig. 6. August 28. Port Curtis, Queensland.

Queensland. New South Wales.

PHENACOVOLVA HAYNESI Sowerby.

1889. *Ovulum* (*Birostra*) *haynesi* Sowerby, Journ. Linn. Soc. (Lond.), Zool., Vol. xx., p. 397, pl. 25, figs. 1, 2. December 31. Exmouth Gulf, North West Australia.

North West Australia.

PHENACOVOLVA PRAENOMINATA nom. nov.

1927. *Radius gracillimus* Schilder, Archiv. für Naturg. (Wiegm.), 91st Yr. Abt. A., heft 10, p. 79. North West Australia. (Not *R. gracillimus* Smith, Journ. Conch., Vol. x., p. 107, 1901.)

North West Australia.

PHENACOVOLVA EXSUL nov.

1912. *Ovula philippinarum* Verco., Trans. Roy. Soc. South Austr., Vol. xxxvi., p. 216. 40 miles west of Eucla, Western Australia. 72 fathoms.

South West Australia.

Genus PELLASIMNIA.

1931. *Pellasimnia* Iredale, Rec. Austr. Mus., Vol. xviii., p. 222. June 29. Orthotype, *Ovulum angasi* Reeve.

PELLASIMNIA ANGASI Reeve.

1865. *Ovulum angasi* Reeve, Conch. Icon., Vol. xv., pl. 10, fig. 43. June. ex A. Adams MS. Port Curtis, Australia.

Queensland. New South Wales.

PELLASIMNIA VERCONIS Cotton & Godfrey.

1932. *Prosimnia verconis* Cotton & Godfrey, South Austr. Nat., Vol. xiii., p. 46, pl. 1, fig. 15. February = April 15. Off St. Francis Island, South Australia. 35 fathoms.
South Australia.

PELLASIMNIA DEPRESSA Sowerby.

1875. *Ovulum depressum* Sowerby, Proc. Zool. Soc. (Lond.), 1875, p. 128, pl. 24, fig. 1. August 1. North West Australia.
North West Australia.

Family UMBILIIDAE.

This family of cold water Cowries includes some of the most interesting forms in existence as most of the species are extinct. The recent forms are placed in the genus *Umbilia*, but most of the fossil shells are referable to the genus *Rhynchocypraea* Cossmann, a most extraordinary development having been separated as a genus, *Palliocypraea*. A still more extraordinary member of the family, if it be rightly placed here, is the gigantic *Gigantocypraea* of Schilder, based on *C. gigas* McCoy, a species reaching almost a foot in length, and with corresponding height and breadth. All these are only known from the fossil beds of Victoria, Tasmania and South Australia, and the existing species live in the deep seas adjoining.

Genus UMBILIA.

1884. *Umbilia* Jousseaume, Le Naturaliste, 6th Year, p. 414. February 15. Haplotype, *Cypraea umbilicata* Sowerby = *C. hesitata* Iredale.

UMBILIA HESITATA Iredale.

1916. *Cypraea hesitata* Iredale, Proc. Mal. Soc. (Lond.), Vol. xii., p. 93. November. New name for

1825. *Cypraea umbilicata* Sowerby, Cat. Shells Tankerville, App., p. xxx., pl. —. January. No locality = Tasmania. Not *C. umbilicata* Dillwyn, Index Lister, p. 32, 1823.

Southern New South Wales. North Tasmania. Victoria.

UMBILIA HESITATA BEDDOMEI Schilder.

1930. *Umbilia hesitata beddomei* Schilder, Zool. Anz., Vol. xcii., p. 77. Port Stephens, N.S.W.
Northern New South Wales.

UMBILIA (HESITATA) HOWELLI Iredale.

1931. *Umbilia (hesitata) howelli* Iredale, Rec. Austr. Mus., Vol. xviii., p. 220, pl. xxiv., figs. 1-2. June 29. South of Cape Everard, Bass Straits. 90-150 fathoms.
Off Bass Straits in deep water.

UMBILIA ARMENIACA Verco.

1912. *Cypraea umbilicata* var. *armeniaca* Verco, Trans. Roy. Soc. South Austr., Vol. xxxvi., p. 213, pl. x. 80 miles west of Eucla, Western Australia. 100 fathoms.
West Australia.

Family CYPRAEIDAE.

The Cowries proper will, very probably, be later subdivided and families separated when the animal characters become known. In this place subfamilies are only utilised as follows: Zoilinae for the West and

South Australian shells with very exsert spires and almost smooth columellar ledge; Cypraeinae, the true Cowries; Talpariinae, the elongate Cowries with specialised radulae; Pustulariinae, quaint little Cowries sometimes associated with the Trivias; Erosariinae, heavy Cowries with coarse teeth; Staphylaeinae, highly coloured pustulose forms with Trivia-like radulae; Nariinae, an odd small species with peculiar columella teeth; Erroneinae, a rather confused association of small species which must be later split up; and Austrocypraeinae, including the small Southern Australian endemic forms and their fossil allies.

Subfamily Zoilinae.

A group almost as interesting as the Umbiliidae, being restricted to West and South Australia, the species with very elongate spires and superficially incomplete apertural features.

Genus Zoila.

1884. *Zoila* Jousseaume, Le Naturaliste, 6th Year, p. 414. February 15. Logotype, Jousseaume, Bull. Soc. Zool. France, Vol. ix., p. 89. July, 1884. *Cypraea friendii* Gray.

Zoila friendii Gray.

1831. *Cypraea friendii* Gray, Zool. Misc., p. 35. February 19. New Holland (Swan River).

1832. *Cypraea scottii* Broderip, Zool. Journ., Vol. v., p. 330, pl. xiv., figs. 1, 2. 3. "September, 1831" = July, 1832. "Angia, Straits of Sunda, Java; Scott."

1930. *Zoila friendii vercoi* Schilder, Zool. Anz., Bd. 92, p. 74. Esperance, West Australia.

West Australia. South Australia.

Note: Gaskoin described *Cypraea marginata* (Proc. Zool. Soc. (Lond.), 1848, p. 91, March 13, 1849), from unknown locality, and the type is still unique in the British Museum; it looks like an immature of this species, but has strong teeth on the inner lip.

Zoila venusta Sowerby.

1847. *Cypraea venusta* Sowerby, Proc. Linn. Soc. (Lond.), Vol. i., p. 314. February, 1847. "Port Adelaide, South Australia" = West Australia.

1869. *Cypraea thatcheri* Cox, Proc. Zool. Soc. (Lond.), 1869, p. 358, pl. 26, fig. 1. September 8. Dampier's Archipelago, west coast of Australia.

1889. *Cypraea venusta* Cox, Proc. Linn. Soc. N.S.W., Vol. iv., p. 187, pl. 15, figs. 1, 2 (variety). Cape Naturaliste, South West Australia.

West Australia.

This rare species appears to be referable to *Zoila*, though it is not typical, and the animal may necessitate revision. Gatliff (Vict. Naturalist, Vol. xxxii., p. 147, text fig., February, 1916) has described *Cypraea venusta* var. *bakeri* also from Western Australia, which looks still less like a *Zoila*.

In a Label List of the Cypraeidae privately printed by Cox there appeared for the variety above-mentioned (1889) the name *"brunea,"* a misspelling only for *brunnea*, but this name has been cited by Hidalgo in his Monograph, as also the var. *"distorta,"* introduced at the same time by Cox for the specimen of *Cypraea vitellus* he illustrated on the same plate. Both varietal names had been previously utilised, but substitutes are unnecessary.

ZOILA THERSITES Gaskoin.

1849. *Cypraea thersites* Gaskoin. Proc. Zool. Soc. (Lond.), 1848, p. 90. March 13, 1849. Hab. ? = South Australia.
West Australia. South Australia.

ZOILA THERSITES CONTRARIA subsp. nov.

1912. *Cypraea thersites* Verco, Trans. Roy. Soc. South Austr., Vol. xxxvi., p. 209. Between 40 and 90 miles west of Eucla, West Australia. 70-100 fathoms.
West Australia (deep water).

The subadult appearance and whitish coloration are very distinctive.

ZOILA DECIPIENS Smith.

1880. *Cypraea decipiens* Smith, Proc. Zool. Soc. (Lond.), 1880, p. 482, pl. xlviii., figs. 8, 8a. October. "North Australia."
West Australia.

Subfamily CYPRAEINAE.

The type of *Cypraea* is *tigris*, and the subfamily centres round that species, including mostly large shells.

Genus MAURITIA.

1863. *Mauritia* Troschel, Das Gebiss der Schnecken, Vol. i., p. 205. (pref. May). Tautotype, *Cypraea mauritiana* Linné.

1884. *Maurina* Jousseaume, Le Naturaliste, 6th Year, p. 414. February 15. Haplotype, *Cypraea mauritiana* Linné.

1884. *Mauxiena* Jousseaume, Bull. Soc. Zool. France, Vol. ix., p. 89. July. Orthotype, *Cypraea mauritiana* Linné.

MAURITIA MAURITIANA Linné.

1758. *Cypraea mauritiana* Linné, Syst. Nat. xth ed., p. 721. January 1. "Mauritio."
Queensland.

Although recorded by Brazier from Torres Straits sixty years ago, it had not been collected recently on the Great Barrier Reef until I found one at Three Isles, but as Father Schwarz had secured many at Cape Bedford it may be a more common mainland form. It was, however, described from Mauritius, and Garrett records it as common all through the Pacific Islands, "more plentiful at the Marquesas than elsewhere."

Quoy and Gaimard have figured and described the animal from New Ireland, thus: "The animal has elongated tentacles of a violaceous brown, the same colour as the respiratory siphon which is fringed at the edge. The foot, voluminous, rounded behind, more developed in front presents here a red brown line behind which is another pale yellow one. In the rest of its extent it is a dirty violaceous.

"The lateral parts are of a more definite violet, darker than that of the mantle, which is garnished with rather short blackish tubercles. The mantle never appears to cover the shell entirely as in some other species."

Individual coloration and form in the shell appear so variable that probably the animal will offer better characters for subspecific separation.

Genus ARABICA.

1884. *Arabica* Jousseaume, Le Naturaliste, 6th Year, p. 414. February 15. Tautotype, *Cypraea arabica* Linné.

ARABICA ARABICA Linné.

(Plate viii., figs. 1, a.)

1758. *Cypraea arabica* Linné, Syst. Nat., xth ed., p. 718. January 1. Straits Sunda.

Queensland. New South Wales. West Australia. North Australia.

Mr. Melbourne Ward's painting of this common Queensland species agrees fairly well with Quoy and Gaimard's figure and description of a specimen from Dorey, New Guinea, thus: "The animal is sombre in colour as the shell. The tentacles are long and slender; they are, as the siphon and mantle, of a vinous brown. The latter is sprinkled with small simple white tubercles. The sides of the foot are a little darker brown and yellow orpin below."

Confused with other species as *"reticulata," "histrio," "eglantina,"* etc., it is difficult to separate shells. The Queensland form, here figured, varies somewhat, but never seems to take on the extreme forms, though resemblances can be seen.

ARABICA WESTRALIS sp. nov.

[1784. *Cypraea reticulata* Martyn, Univ. Conch., Vol. i., fig. 15. Friendly Islands. Non-binomial. Not *C. reticulata* Gmelin, Syst. Nat., pt. vi., p. 3420, 1791.]

In West Australia a shell recalling Martyn's figure occurs alongside the true *arabica* style, and an *"eglantina"* form discussed below. Regarding the different animals, Garrett wrote of *"reticulata* Martyn": "Common all through Eastern Polynesia. This species is quite distinct from *C. arabica,* with which it is sometimes confounded. The animal has a snuff-brown mantle, which is nearly colourless on the margins, and furnished with small, subulate, tentacular processes of a pale grey colour. Upper surface of the foot purple-black, delicately mottled with a lighter shade; creeping disk pale grey. Muzzle and tentacles purple-black, the latter with a basal white spot."

Of *intermedia* Gray, he commented: "This species, which is frequently confounded with *C. reticulata* Martyn, is nevertheless quite distinct. It is more abundant at the Paumotu and Society Islands than elsewhere. . . . The animal has a tawny foot, shaded above with slate, and the siphon and tentacles of the latter hue. Mantle brownish-slate, garnished with small, conical, pale papillae."

Quoy and Gaimard under the name *C. histrio* described a specimen from Tonga Tabu, as follows: "Tentacles very long, pointed, greenish brown at their extremities, of a yellowish white at the base, which is very swollen. The trunk is brown, nearly black on the sides, cerise red at its extremity. The respiratory siphon is fairly long, fringed, and of a greenish colour. The foot is yellow orpin below, and a dirty yellowish green on the sides. The mantle presents some little yellowish much branched tufts. The ground colour is smoky spotted with white, with many blotches of blackish, and some yellowish lunules."

ARABICA PERCONFUSA sp. nov.

Vayssière (Journ. de Conch., Vol. liii., p. 13, pl. 1, fig. 3, May 25, 1905) described *Cypraea arabica* var. *couturieri* from the Island Polillo, Philippine Islands, a large pale coloured form of *arabica,* 73 mm. long by 43 mm. broad and 40 mm. high, showing three indistinct transverse reddish bands. Hedley received many shells from North West Australia which agreed in

shape and general coloration with Vayssières form, but lacked the essential banding upon which the variety was based. Nevertheless, Hedley recorded it under Vayssières' name, but allotted it to a species, *eglantina*, instead of *arabica*. Duclos described *Cypraea eglantina* (Mag. de Zool., Cl. v., pl. 28, dated July 15, 1833) from "California," and the name has been commonly used for a pale yellowish elongate *arabica*-like shell, but Duclos' figure shows a rather small normal *arabica* of a greenish grey coloration, and Duclos' reason for separating it reads: "Il consiste en une tache brune triangulaire placée à côté de la spire," a feature common to all *"arabica."*

The two West Australian species can be described together: *westralis* is stout, heavily flanged and flat based; *perconfusa* is more elongate, not flanged, and the base convex; the former has a pale brownish white ground colour streaked with dark brown with pale spots left, sometimes giving the shell a spotted appearance; the base is pale brownish white with a rosy tinge and the edges are very heavily spotted with large black spots; the teeth are rather small and marked with dark brownish red, numbering about twenty-one to twenty on each lip; the measurements of a norm are, length 63 mm. by breath, 40 mm. The other species, *perconfusa*, has a yellowish ground colour with pale yellow streaks, the paler spotting not being so noticeable; the base is somewhat uniform fawn with the teeth more numerous, from thirty to thirty-five on each lip and only faintly marked with reddish; the sides of the base are somewhat sparsely and obscurely spotted with brown; the measurements of a norm being, length 70 mm. by breadth, 38 mm.

Quite recently, Mr. A. J. Thackway has collected at Caloundra, Queensland, a shell quite like *westralis*, and differing from the long series collected at Low Isles. In the Museum collection there is an immature specimen from Point Cartwright, a little north of Caloundra, procured by Mr. A. A. Livingstone, which is of the same *"westralis"* style suggesting that there may be a relative of that species on the Queensland coast as distinct from the Queensland reef forms. Shirley recorded *histrio* and *reticulata* from Cairns.

Arabica scurra Gmelin.

1791. *Cypraea scurra* Gmelin, Syst. Nat., pt. vi., p. 3409. May 14. Mart. Conch. 1, t. 27, figs. 276-277. Chemn. Conch., 10, 103, t. 144, figs. 1338, a-b. In Mari indico = Amboina.

1791. *Cypraea indica* Gmelin, Syst. Nat., pt. vi., p. 3412. May 14. Rumph. Mus., t. 39, fig. H. "India" = Amboina.

1798. *Cypraea argiolus* Bolten, Mus. Bolten, pt. ii., p. 26. September. For Chemn., 10, t. 144, figs. 1388, a-b. New name only for *C. scurra* Chemnitz = Amboina.

1852. *Cypraea amarata* Morch, Cat. Conch. Yoldi, pt. i., p. 114. August. ex Meuschen, 1787. Not in Index Gronov. New name for *scurra* Gmelin.

Northern New South Wales. Queensland. West Australia.

This curious little species appears to have a distinct animal, as described by Garrett from the Paumotus: "Animal olivaceous brown, with a pale locomotive disk. Mantle with small, rather remote, elongate, conical papillae. Siphon with a terminal fringe."

Genus LEPORICYPRAEA.

1930. *Leporicypraea* Iredale, Mem. Queensland Mus., Vol. x., p. 83. Aug. 28. Orthotype, *Cypraea mappa* Linné.

LEPORICYPRAEA MAPPA Linné.

1758. *Cypraea mappa* Linné, Syst. Nat. xth ed., p. 718. January 1. First reference, Rumph. mus. t. 38, fig. B. "O. Africae" error = Amboina.

Queensland.

LEPORICYPRAEA VALENTIA Perry.

1811. *Cypraea valentia* Perry, Conchology, pl. xxiii., fig. 2. April 1. Amboyna (Lord Valentia).

1824. *Cypraea princeps* Gray, Zool. Journ., Vol. i., p. 75. March. Persian Gulf. (Mus. Sowerby).

Queensland.

Cox recorded (Proc. Linn. Soc. N.S.W., Vol. vi., p. 539, December, 1881) a fine specimen from Warrior Reef, Torres Strait, apparently the only local occurrence.

Genus LYNCINA.

1863. *Lyncina* Troschel, Das Gebiss der Schnecken, Vol. i., p. 205. (pref. May.) Logotype, Tryon, Struct. Syst. Conch., Vol. ii., p. 198, 1883. *Cypraea lynx* Linné = *C. vanelli* Linné.

LYNCINA VANELLI Linné.

(Plate viii., figs. 10, a-b.)

1758. *Cypraea vanelli* Linné, Syst. Nat., xth ed., p. 720. January 1. For Pet. gaz., t. 95, fig. 9. No locality.

1758. *Cypraea lynx* Linné, Syst. Nat., xth ed., p. 721. January 1. For Gualt., test. t. 14, fig. C. Madagascar.

Queensland. New South Wales. West Australia.

The spotted young upon which *vanelli* was based is characteristic of this group, and it may be that subspecies can be based upon the juvenile differences. This spotting is followed by a brown splashing which is overlain by a blue wash with spots. Sometimes the brown persists until senility; in others the blue overruns the whole shell.

Mr. Melbourne Ward's notes read: "Mantle dark brown, irregularly mottled with darker brown, almost black. Papillae of two forms, simple and minute, and large tufted and tree shaped."

Genus PONDA.

1884. *Ponda* Jousseaume, Le Naturaliste, 6th Year, p. 415. February 15. Logotype, Jousseaume, Bull. Soc. Zool. France, Vol. ix., p. 95. July, 1884. *C. achatina* Sol. = *C. ventriculus* Lamarck.

PONDA CARNEOLA Linné.

1758. *Cypraea carneola* Linné, Syst. Nat., xth ed., p. 719. January 1. First reference, "Rumph. mus. t. 38, fig. K., Carneola." "Asia," therefore restricted locality must be Amboina.

Queensland. New South Wales. West Australia.

The animal is black, but no notes were taken. Quoy and Gaimard have figured and described the animal under the name *"isabella"* with a short description only: "The tentacles very slender. They are, the same as all the parts of the body, of a beautiful velvety black, which contrasts

with the orange of the shell." This is of a Tonga Tabu specimen. The type of *Ponda, ventriculus* Lamarck, though sometimes recorded from Queensland, is restricted to the islands of the Pacific Ocean, and the immature agrees generally with that of the present species, and disagrees entirely with that of the preceding group wherein it was placed by Schilder.

Genus MYSTAPONDA.

1930. *Mystaponda* Iredale, Mem. Queensland Mus., Vol. x., p. 83. August 28. Orthotype, *Cypraea vitellus* Linné.

MYSTAPONDA VITELLUS Linné.

(Plate viii., figs. 5, a, b.)

1758. *Cypraea vitellus* Linné, Syst. Nat., xth ed., p. 721. January 1. Sunda, Asia.

Queensland. New South Wales. West Australia.

Mr. Melbourne Ward's painting needs little additional description, but Mrs. Coxen has described the animal as follows: "Mantle creamy white, largely mottled with black, full of minute white dots, also many spicules one-eighth of an inch high, terminating in two or three points; respiratory canal creamy white, with fine yellow fringe at the edge; tentacles black. The little spicules on the mantle are only perceptible when the animal is in the water."

Quoy and Gaimard described an animal from Tonga Tabu, but only figured the under surface and wrote: "The animal has the tentacles very thick at their bases until the place where the eyes are situated, thence for the rest of their length they are more slender, pointed, dull smoky. The foot is of mediocre extent, oval, rounded behind, arched and dilated in front. It is yellowish below, striated lengthwise with orange yellow. The siphon and the mantle are covered with yellow branched appendages. The mantle is spotted with yellow, black and white, but the yellow predominates."

There is variation seen among shells from different localities, but geographic subspecies have not yet been determined. It may be that the coloration of the animals will assist in the differentiation of subspecies. The curious form added below has not yet been recognised from any other place, though quite long series of this comparatively common shell have been examined, and quite a large variation in size has been recognised.

MYSTAPONDA ORCINA Iredale.

1931. *Mystaponda orcina* Iredale, Rec. Austr. Mus., Vol. xviii., p. 220, pl. xxiv., figs. 9, 10. June 29. Sydney Harbour, N.S.W.

New South Wales (perhaps extinct).

Genus CYPRAEA.

1758. *Cypraea* Linné, Syst. Nat., xth ed., p. 718. January. Logotype, Montfort, Conch. Syst., pt. ii., p. 631. May. *Cypraea tigris* Linné.

[1797. *Porcellana* Humphrey, Mus. Calonn., p. vi. May. Later *Porcellana* was used by Jousseaume, who named *argus* as type of Klein's genus, but the name was at that time invalid.]

1863. *Tigris* Troschel, Das Gebiss der Schnecken, Vol. i., p. 204 (pref. May). Tautotype, *Cypraea tigris* Linné.

1884. *Vulgusella* Jousseaume, Le Naturaliste, 6th year, No. 52, p. 414. Feb. 15. Logotype, Jousseaume, Bull. Soc. Zool. France, Vol. ix., p. 90. July, 1884. *Cypraea tigris* Linné.

Cypraea tigris Linné.

1758. *Cypraea tigris* Linné, Syst. Nat., xth ed., p. 721. January 1. Many references. "Madagascar," which must be restricted type locality.

Queensland. West Australia. South Australia. ??

A very variable species, which cannot be easily separated into subspecies, although colour variations recur in a curious manner in various localities and should bear recognisable names.

Quoy and Gaimard's figure has been copied so often that it has become well known; their description of an animal from Tonga Tabu reads: "The tentacles are very long and pointed. The siphon thick, short, wide and funnel shaped, denticulate at the edge. The mouth is elongated in the form of a wide trunk. Greenish throughout. The foot, very large and broad, extends in front and behind the shell. It is of a dirty red brown below, spotted with greenish and yellow on the sides; it is uniformly of this latter colour at the junction with the mantle. This latter is covered with little branches, divided at their extremities in two or three fingers. These are white at the point and at their base, and greenish yellow on the middle. The ground colour of the mantle is of clear yellow, very finely striated lengthwise with black; it is also marked with large black spots in the form of festoons."

Garrett's description reads: "The animal has a creamy-yellow mantle, closely veined longitudinally with deep brown, and marked with a few diffuse spots of the same colour. It is also furnished with small, stout, tentacular processes of an amber-yellow colour, tipped with white; the processes are either cylindrical or slightly compressed, and simple or bifid. Head, tentacles and siphon grey. The upper surface of the foot is marbled with black, deep brown, and fawn-yellow, creeping disk purple brown with darker veins."

[Cypraea pantherina Solander.

1786. *Cypraea pantherina* Solander, Cat. Portl. Mus., p. 50 (ante April 24), for Lister, 681, 28. No locality. Lister gives "Mare Mediter.," error = Red Sea.

1791. *Cypraea vinosa* Gmelin, Syst. Nat., pt. vi., p. 3421. May 14. For Bonann. recr. 3, fig. 253 and mus. Kirch. 3, fig. 252. "In Mare Mediterraneo" = Red Sea.

Brazier recorded *C. pantherina* (Proc. Linn. Soc. N.S.W., Vol. vii., p. 322, 1887) from Rowley Shoals, North West Australia, and therefore Hedley included it in his West Australian List under the name, *C. vinosa* Gmelin. Since then Cotton and Godfrey have recorded *C. pantherina* Dillwyn from South Australia (South Austr. Nat., Vol. xiii., p. 40, 1932), noting, "North Arm (Port River) one, alive (Matthews)." There must be some mistake in each of these records as the true *pantherina* lives only among the coral reefs of the Red Sea, and is unknown elsewhere. Though superficially resembling *tigris* very closely, it may be even referable to a different series, and Sacco introduced *Pantherinaria* (I. Molluschi terr. terz. Piemonte e Liguria, pt. xv., p. 10, April, 1890), with this species as type.

Shirley also recorded *C. pantherina* from Torres Straits, also in error.]

Genus Talparia.

1863. *Talparia* Troschel, Das Gebiss der Schnecken, Vol. i., p. 204 (pref. May). Tautotype, *Cypraea talpa* Linné.

TALPARIA TALPA Linné.

1758. *Cypraea talpa* Linné, Syst. Nat., xth ed., p. 720. January 1. First reference, "Rumph. mus. t. 38, fig. I. Talpa." "Asia." Therefore restricted type locality must be Amboina.

Queensland.

Quoy and Gaimard figured and described the animal of this species from Mauritius as follows: "The animal of this Cowry does not differ. It is dark, as the shell which secretes it, and its mantle is covered with, instead of delicate branches, small rounded tubercles, whitish and reddish. The remainder of its colour is a reddish brown, very dark, almost chocolate. The siphon, the tentacles and the sides of the foot are of the same tint. The latter only is the colour of sombre lake below."

Australian shells vary in shape, some cylindrical like typical *talpa*, others more pear-shape, recalling the Red Sea *adusta*, but with the teeth of *talpa*.

Genus ARESTORIDES.

1930. *Arestorides* Iredale, Mem. Queensland Mus., Vol. x., p. 81. August 28. Orthotype, *Cypraea argus* Linné.

ARESTORIDES ARGUS Linné.

1758. *Cypraea argus* Linné, Syst. Nat., xth ed., p. 719. January 1. The third reference is "Rumph. mus. t. 38, fig. D. Argus." "O. Africae." The restricted type locality is Amboina.

Queensland. West Australia.

Genus BASILITRONA.

1930. *Basilitrona* Iredale, Mem. Queensland Mus., Vol. x., p. 81. August 28. Orthotype, *Cypraea isabella* Linné.

BASILITRONA ISABELLA Linné.

1758. *Cypraea isabella* Linné, Syst. Nat., xth ed., p. 722. January 1. First reference, "Rumph. mus. t. 39, fig. G. Isabella." Therefore, though "Mauritio, Madagascar," is given, restricted type locality must be Amboina.

Queensland. New South Wales. West Australia.

The animal of the Queensland specimens was merely noted as "black," but Garrett has described it thus: "The animal is deep black, with a brown black mantle, which, instead of being garnished with the usual tentacular processes, is simply roughened with fleshy granules. The short siphon is also without the usual terminal fringes."

Quoy and Gaimard figured the animal of *carneola*, under the name *isabella*, from Tonga Tabu, with the very brief description: "The tentacles very slender. They are, the same as all the parts of the body, of a beautiful velvety black, which contrasts with the orange of the shell." This almost equally applies to *isabella*.

Subfamily PUSTULARIINAE.

Very small beaked Cowries, that have often been placed with the Trivias, but which constitute a group perhaps of higher value than a subfamily.

Genus PUSTULARIA.

1840. *Pustularia* Swainson, Treat. Malac., p. 324. May. Haplotype, *Cypraea cicercula* Linné (*globulus* cited as aberrant).

1854. *Epona* H. & A. Adams, Gen. Rec. Moll., Vol. i., p. 269. January. Same type.

PUSTULARIA CICERCULA Linné.

1758. *Cypraea cicercula* Linné, Syst. Nat., xth ed., p. 725. January 1. Gualt. test. t. 14, fig. T. "M. Mediterraneo," error. Restricted type locality is Amboina.

Queensland.

PUSTULARIA GLOBULUS Linné.

1758. *Cypraea globulus* Linné, Syst. Nat., xth ed., p. 725. January 1. First reference, "Rumph. mus. t. 39, fig. L. Globulus." "Asia." Restricted type locality is Amboina.

Queensland. West Australia.

Genus NUCLEARIA.

1884. *Nuclearia* Jousseaume, Le Naturaliste, 6th Year, p. 415. February 15. Logotype, Jousseaume, Bull. Soc. Zool. France, Vol. ix., p. 98, 1884. July. *Cypraea nucleus* Linné.

NUCLEARIA NUCLEUS Linné.

1758. *Cypraea nucleus* Linné, Syst. Nat., xth ed., p. 724. January 1. First reference, "Rumph. mus. t. 39, fig. I. "O. Indiae orientali." Therefore restricted type locality is "Amboina."

Queensland.

The animal is black, but no other notes were taken.

[Genus ANNEPONA nov.

Type, *Cypraea annulata* Gray. =
Pustularia mariae Schilder.

This beautiful little species differs in lack of sculpture, and especially in apertural features from *Pustularia*, the mouth being normal, instead of being very narrowed and rostrate.

ANNEPONA MARIAE Schilder.

1927. *Pustularia mariae* Schilder, Archiv. für Naturg. (Wiegm.), 91st year, Abt. A., heft 10, p. 104. New name for

1828. *Cypraea annulata* Gray, Zool. Journ., Vol. iv., p. 88. July. ex Vol. i., p. 518, Jan., 1825, *nom. nud.* Pacific Ocean.

This species does not occur in South West Australia, although admitted by Schilder at the place cited.]

Subfamily EROSARIINAE.

This subfamily probably needs reorganisation, as the *caputserpentis* series appears discordant, but the other forms have all similar animals.

Genus RAVITRONA.

1930. *Ravitrona* Iredale, Mem. Queensland Mus., Vol. x., p. 81. August 28. Orthotype, *Cypraea caputserpentis* Linné.

RAVITRONA CAPUTSERPENTIS Linné.

1758. *Cypraea caputserpentis* Linné, Syst. Nat., xth ed., p. 720. January 1. Mauritius. Restricted type locality is "Mauritius."

Queensland. New South Wales. West Australia.

Quoy and Gaimard have described the animal from Mauritius as: "The animal has the tentacles red brown and slender tō the point, white and

thick at the base. The respiratory siphon is also white, but the fringes are rose. The foot, a little auriculated in front, is pale yellow below, smoky and spotted on the sides, yellowish at the junction with the mantle. It is red brown, with a brown spot anteriorly, brownish at the extremity. The mantle is covered with whitish branching papillary processes, of which the points are of a pretty red; it is further ornamented with very large greenish spots and besides yellowish ones very difficult to show in the painting."

Garrett described the animal of the shell from the Sandwich Islands, called *"caput-anguis,"* as follows: "The animal has a dark brown mantle, varied with dark green, and garnished with red, or red and white, more or less divided processes. The siphon is dusky-slate, tentacles brown with white bases, and the foot dusky slate with a paler creeping disk."

The name *"caput-anguis"* has been used for many forms, even in connection with Australian shells, but the local shells are certainly of the true *caput-serpentis* style, but seem to develop very slowly. The majority of the shells found in New South Wales are subadult—that is, with teeth formed but without any dilatation of the edges; they are also very dark, some almost black, and almost deserve subspecific separation. However normal shells are sometimes found, and as close as Moreton Bay and the Capricorn Group, normal shells are in the majority, as they are commonly further north.

Genus Erosaria.

1863. *Erosaria* Troschel, Das Gebiss der Schnecken, Vol. i., p. 205. Logotype, Jousseaume, Bull. Soc. Zool. France, Vol. ix., p. 96. July, 1884. *Cypraea erosa* Linné.

Erosaria erosa Linné.

(Plate viii., figs. 7, a, b.)

1758. *Cypraea erosa* Linné, Syst. Nat., xth ed., p. 723. January 1. First reference, "Rumph. mus. t. 39, fig. A.," but localities Mauritio and I. Ascension. The type locality must be Mauritius

Queensland. New South Wales. West Australia.

This species shows great variation over its range, but not much has yet been seen among Australian shells. The animal has been described by Mrs. Coxen thus: "Foot creamy white, mottled with brownish markings; mantle dark brown, covered with long moss-like filaments about one-eighth of an inch in length, some light brown, others of a bluish tint; respiratory canal dark brown with a fringe at the edge; tentacles blackish-brown; around the trunk a light brown fringe."

Of *"erosa* Lin," Garrett wrote: "Not uncommon at all the groups. The animal, when fully expanded, is really a beautiful object. The mantle is cinereous, clouded with dusky, veined with black and white, and ornamented with numerous simple and branched processes of a greyish hue, annulated with opaque-white, and tipped with vermilion-red. The dusky-grey siphon is dotted with diluted white, and the end is fringed with short, blunt, pink tentacular processes. The upper surface of the foot is delicately marbled with light brown and ochre-yellow. Head tinged with cherry-red."

Quoy and Gaimard described and figured an animal from Tonga Tabu thus: "The animal has the tentacles and the siphon, which is large and fringed, yellowish, as the sides of the foot, which has near the edge a brown line. The foot is reddish below. The appendages of the mantle

are numerous, large, very branched and reddish at their extremity. The mouth is of a deep red."

Vredenberg (Journ. Proc. Asiat. Soc. Bengal, n.s., Vol. xv., p. 145, Aug., 1919) described a *Cypraea erosa* var. *purissima* from "Moreton Bay, Queensland," which apparently never came from that locality.

EROSARIA PORARIA Linné.

1758. *Cypraea poraria* Linné, Syst. Nat., xth ed., p. 724. January 1. No references nor locality. Restricted type locality Amboina.

New South Wales.

Garrett has described the animal from the Pacific Isles as "The animal is vermilion-red, with a greenish-grey mantle, which latter is garnished with small crowded, tentacular appendages, varied with white and green. Siphon fringed. Upper surface of the foot dotted with greenish-grey."

EROSARIA WILHELMINA Kenyon.

1897. *Cypraea wilhelmina* Kenyon, Proc. Linn. Soc. N.S.W., Vol., xxii., p. 145. September 17. Western Australia.

Western Australia.

EROSARIA HELVOLA Linné.

1758. *Cypraea helvola* Linné, Syst. Nat., xth ed., p. 724. January 1. No references nor locality. Restricted type locality, Maldive Isles.

Queensland. New South Wales. West Australia.

Garrett described the animal from the Pacific Islands as: "The animal has a brownish-red mantle, which is minutely flecked with greenish-white, and garnished with numerous, more or less divided, lighter-coloured processes, which are dotted with vermilion red. Siphon dotted with light yellow, veined with cherry red. The foot is pale luteous, mottled with cherry red; tentacles of the latter hue."

Off North West Island, Capricorn Group, Queensland, Mr. Melbourne Ward dredged a specimen of this species which had the dorsal colour reddish brown overlaying the normal spotted coloration which only showed near the opening of the mantle on the centre of the back; the edges of the shell are brownish yellow, as is the whole of the base, which is a little darker medially. Unfortunately this was before he took an interest in the animals, so that we do not know whether the animal's coloration varied. From West Australia Brazier has recorded *C. citrina,* but the specimens so named are merely *helvola,* the teeth being coarse, not fine, and the curious greenish brown overlays the normal spotting, but apparently the shell has always been greenish. It may be as well to name the West Australian form *Erosaria helvola citrinicolor* subsp. nov., to note this tendency.

EROSARIA NASHI Iredale.

1931. *Erosaria nashi* Iredale, Rec. Austr. Mus., Vol. xviii., p. 219, pl. xxiv., figs. 5, 6. June 29. Sydney Harbour, New South Wales.

New South Wales. Queensland.

This species has been recorded as *Cypraea flaveola* Linné (Syst. Nat., xth ed., p. 724, January 1, 1758), but that species was described without references or locality, and the earlier attempts at determination were somewhat discordant. Later, Gaskoin's varietal name *labrolineata* or Sowerby's *labiolineata* was advocated, but each is unacceptable.

EROSARIA PERCOMIS Iredale.

1931. *Erosaria percomis* Iredale, Rec. Austr. Mus., Vol. xviii., p. 219, pl. xxiv., figs. 15, 16. January 29. Sydney Harbour, N.S.W.

New South Wales.

EROSARIA METAVONA sp. nov.

I recorded specimens from Sydney Harbour under the name *miliaris* Gmelin, but Gmelin's species (Syst. Nat., pt. vi., p. 3420, May 14, 1791) was made up of forms of *erosa* and the shell later known as *miliaris*, but its basis was undoubtedly the former, and the name must disappear in the synonymy of *erosa*. This was pointed out more than one hundred years ago, and confusion has reigned ever since through attempts to disguise and hide the truth.

Living specimens have been collected at Murray Island by Hedley, and Keppel Islands by Mr. H. Bernhard, and these do not agree with either Reeve's figure of his so-called *miliaris* nor Sowerby's illustration. Consequently, to avoid further error, the Queensland shell is here described. The shell is pyriform, the anterior end a little pinched, the coloration very pale green, spotted with small white spots, the edges and base pure white, the mouth armed with a few strong teeth, fifteen on the inner lip, sixteen on the outer lip, the two anterior projecting outwards. Length, 36 mm.; breadth, 23 mm.; height, 21 mm.

EROSARIA EBURNEA Barnes.

1824. *Cypraea eburnea* Barnes, Ann. Lyc. Nat. Hist., New York, Vol. i., p. 133. September. China.

Queensland.

I have seen no Australian specimens.

Genus MONETARIA.

1863. *Monetaria* Troschel, Das Gebiss der Schnecken, Vol. i., p. 205 (pref. May). Tautotype, *Cypraea moneta* Linné.

1837. *Aricia* Broderip, Penny Cyclopaedia, Vol. viii., p. 256, June, ex Gray MS. Logotype, Herrmannsen, Index Gen. Malac. Suppl., p. 12, 1852. *Cypraea moneta* Linné. Not *Aricia* Savigny, 1822. Cf. Iredale, Proc. Mal. Soc. (Lond.), Vol. xii., p. 34, 1916.

1888. *Mercatoria* Melvill, Proc. Manch. Lit. Philos. Soc. (4), Vol. i., pt. 5, p. 240. Error only.

MONETARIA MONETA Linné.

1758. *Cypraea moneta* Linné, Syst. Nat., xth ed., p. 723. January 1. Many references. Localities given as "Africa," "M. Medit.," but restricted type locality is Maldive Islands.

Queensland. New South Wales. West Australia.

Many subspecies will later be recognised, but owing to Rochebrune providing many names without localities, the determination will be difficult. Probably criticism of the animals will assist, as Quoy and Gaimard have described a specimen from Tonga Tabu thus: "The animal has the tentacles long, slender, whitish; the siphon fringed; the mantle clear yellow, striated transversely with black, and further covered with a mass of appendages white and branched. The foot, fairly large, is also yellowish with brownish transverse striae."

Garrett wrote: "Animal diluted white or creamy-white, the mantle elegantly veined with deep black, and ornamented with numerous simple and dendritic processes which are ringed with opaque white and tipped

with lilac. The tentacles are veined with black. Siphon with a terminal fringe, and the muzzle is light buff yellow."

With regard to the shell some deep yellow ones have been found on the Queensland reefs, but this colour seems more common in West Australia. The shell of this species is easily separated from that of *annulus* by its smaller more crowded teeth.

[MONETARIA OBVELATA Lamarck.

1810. *Cypraea obvelata* Lamarck, Ann. Mus. Nat. Hist. Paris, Vol. xvi., p. 102, post Oct. "New Holland."

Although Shirley has recently recorded this from Queensland, the species only lives in the Eastern Pacific, as pointed out by Garrett sixty years ago.]

MONETARIA ANNULUS Linné.

(Plate ix., figs. 10, a, b.)

1758. *Cypraea annulus* Linné, Syst. Nat., xth ed., p. 723. January 1. First reference, "Rumph. mus. t. 39, fig. D." Amboina.

Queensland. New South Wales. West Australia.

Again it is difficult at present to indicate subspecies, but Quoy and Gaimard have described and figured from Tonga Tabu, a very different animal from ours, thus: "The animal has the tentacles, long, pointed, white at the base, which is swollen, yellowish to the rest of their extent, with two brown lateral lines. The mouth is circled with blackish. The large foot is suboval, nearly square in front, of a yellowish white below, a little smoky on the sides. The mantle is of a beautiful orange, covered with simple tubercles of the same colour and spotted with black."

Mr. Melbourne Ward notes: "There are two forms of papillae, the simple more numerous, the branching ones fewer. Siphon pale grey, its edge with fine fringe, the tentacles pale grey."

My own notes read: "Pale greenish white lined with black; filaments nearly white; siphon long, fringed, greenish; tentacles yellowish." Q'ld.

Subfamily STAPHYLAEINAE.

Troschel (Das Gebiss de Schnecken, Vol. i., pp. 212/213, 1863) has figured the radulae of *"staphylaea"* from the Philippines, and *"limacina"* from Querimba Island. These radulae resemble those of the Triviidae more than those of Cowries, generally speaking, and hence many people have classed these species with *Trivia*. Apparently we have here a group with distinct genera and species, but how many is puzzling, as it has been a common practice to regard them as one species.

Genus STAPHYLAEA.

1884. *Staphylaea* Jousseaume, Le Naturaliste, 6th Year, p. 96. February 15. Tautotype, *Cypraea staphylaea* Linné.

STAPHYLAEA STAPHYLAEA Linné.

1758. *Cypraea staphylaea* Linné, Syst. Nat., xth ed., p. 725. January 1. No references nor locality. Restricted type locality: Mauritius.

New South Wales. Queensland.

Garrett described the animal of *"staphylaea* L." thus: "The animal has a thin elongate, oblong foot, acutely rounded behind, slightly auriculate in front. Tentacles long and slender, bearing the eyes on small basal enlargements. The short siphon is fringed. Mantle processes large, rather crowded, tentaculiform, with a few dendritic ones intermixed. The

creeping disk is pale purple brown, lighter in front, and delicately veined with a darker shade. Siphon and the upper surface of the foot blackish-brown, the mantle deep brown, which, with the upper surface of the foot, is minutely dotted with white."

My own notes were simple: "Brown black animal, covered with single elongate papillae, whitish."

These descriptions refer to the smaller shell known as *"staphylaea"* with the pustulose shell, and the base crossed with brown lines.

A series from North West Isle, Capricorn Group, Queensland, are short, ovate oblong, pale grey, with crowded elevated small pustules, whitish; the base is pale fawn, and the teeth extend right across the base, each tooth having a fine red line at each side; twenty-two teeth on the outer lip, others intercalating at the edge; about the same number on the inner lip, but the intercalating ones increasing marginad; the size of a norm is 23 mm. in length, 14 mm. in breadth, and 11.5 mm. in height. For exact comparisons this may be regarded as a subspecies, with the new name *S. staphylaea descripta* nov.

Genus Purperosa nov.

Type *P. facifer* nov.

The extraordinary animal here figured is so unlike that of *Staphylaea* that a new genus is absolutely necessary. Apparently the radular characters will follow those of the shell which is of the form known as *"limacina,"* the larger shell with white spots but scarcely pustulose, and the base not entirely crossed with lines.

Purperosa facifer sp. nov.

(Plate viii., figs. 6, a, b.)

This kind of shell has been known as *Cypraea limacina* Lamarck, but Lamarck's shell was described (Ann. Mus. Hist. Nat. Paris, Vol. xvi., p. 101, after October, 1810) from unknown locality and certainly not Queensland, where moreover there may be two species of this genus. Under the incorrect name of *Cypraea nucleus*, Quoy and Gaimard described an animal from Tonga Tabu, thus: "This elegant little species is entirely covered by its mantle, which is garnished with long and thick simple filaments of a fiery red, the same colour as the foot, the tentacles and the siphon. The last-named is elongate and equally fringed."

Note that Quoy and Gaimard figure and describe the filaments as "long and simple," whereas the Queensland shell has them very clearly branched, a distinct difference. The shell of the Lindeman Island animal, here figured, measures 33 mm. in length, and 19 mm. in breadth, the height being 16 mm. The figure shows the under surface well and none of the spots on the upper surface is raised. Similar shells have been secured at other places in Queensland and New South Wales, and comparable specimens are known from the Pacific Isles. However, from North West Isle, Capricorn Group, Queensland, a series of about the same shape and size and with similar basal features are very pale above and the white spots are raised, thus similating on the upper surface *"staphylaea."* These are recorded as having a red animal, while living with them are the true *"staphylaea,"* as regards conchological characters, with a black animal very like the picture here given of the animal of *"clandestina."* The exact distinction of the two groups in Australia necessitates a revision of extra-limital shells, and from the specimens available here many species must be admitted, and some will depend on the animal features for generic

location. The pustulose North West Isle shell may be an advanced state of evolution, and thus is of importance in this investigation, and may be referred to as *P. facifer monstrans* subsp. nov., the type measuring 29 mm. long, by 17 mm. broad and 14 mm. high.

[Subfamily Nariinae.

This subfamily only includes at present one genus, *Naria*, whose shell characters are somewhat peculiar, but when the animal is known some of the species allotted to the subfamily Erroneinae may be transferred to this place.

Genus Naria.

1837. *Naria* Broderip, Penny Cyclop., Vol. viii., p. 256, ex Gray MS. Haplotype, *Cypraea irrorata* Gray.

Naria irrorata Gray.

1828. *Cypraea irrorata* Gray, Zool. Journ., Vol. iv., p. 80. July. ex Solander MS. South Seas.
Pacific Islands only.

The Queensland record is erroneous as this small species is restricted to the Eastern Pacific Ocean.]

Subfamily Erroneinae.

Apparently a somewhat heterogeneous association.

Genus Cribraria.

1884. *Criraria* (type error), Jousseaume, Le Naturaliste, 6th Year, p. 414. February 15. Tautotype, *Cypraea cribraria* Linné.

1881. *Ocellaria* Weinkauff, Jahrb. deutsch. Malak. Gesell, 8th Year, p. 133, 148. Same type. Not *Ocellaria* Ramond, Bull. Soc. Philom. Paris, Vol. ii., p. 177, 1801.

[*Cribraria* C. Persoon, in J. Römer, N. Mag. Bot., v. 1, p. 91, 1794, in Nomen. Anim. Gen. et Subgen., but not in Sherborn, Index Anim.]

Cribraria cribraria Linné.

1758. *Cypraea cribraria* Linné, Syst. Nat. xth ed., p. 723. January 1. Many references. No locality. Restricted type locality, Ceylon.
Queensland.

My only note is "the animal is vermilion," but Quoy and Gaimard have figured and described the animal from Carteret Harbour, New Ireland, thus: "This elegant little Cowry has the left edge of the mantle very extended, as anyone can see by the longitudinal line very low down on the right. The tentacles are long and pointed. All the animal is of a pretty cerise red. The filaments on the mantle are white without being branched."

Cribraria exmouthensis Melvill.

1888. *Cypraea cribaria* var. *exmouthensis* Melvill, Proc. Manch. Lit. Phil. Soc., Vol. i., p. 229, June. Exmouth Gulf, West Australia (T. H. Haynes).
West Australia.

Cribraria fallax Smith.

1881. *Cypraea fallax* Smith, Ann. Mag. Nat. Hist., Ser. 5, Vol. viii., p. 441. December. West Australia.
West Australia.

CRIBRARIA CUMINGII Sowerby.

1832. *Cypraea cumingii* Sowerby, Conch. Illus., pt. 1, fig. 5. September 28. Catal., p. 8, November 9, ex Gray MS. No locality = Raiatea. Queensland.

CRIBRARIA GASKOINI Reeve.

1846. *Cypraea gaskoini* Reeve, Conch. Icon., Vol. iii., pl. xxii., fig. 122, Feb., Proc. Zool. Soc. (Lond.), 1846, p. 23. May. No locality. Queensland.

Genus NIVIGENA.

1930. *Nivigena* Iredale, Mem. Queensland Mus., Vol. x., p. 84. August 28. Orthotype, *Nivigena melwardi* Iredale.

NIVIGENA MELWARDI Iredale.

1930. *Nivigena melwardi* Iredale, Mem. Queensland Mus., Vol. x., p. 84, pl. ix., figs. 12, 13, August 28. North West Island, Capricorn Group, Queensland.
Queensland.

Mr. Melbourne Ward noted that the animal was scarlet. It has been suggested that this is a form of *cribraria,* but although the immature of *cribraria* may be pure white, the shells of *N. melwardi* are adult with thickened edges. The form is different from that of *cribraria* which also occurs in Queensland. It may be noted that Garrett recorded that the young shells of *C. gaskoini* Reeve and *C. goodalli* Gray were also pure white, but described the animal of the latter as: "The animal is creamy-white, the upper surface of the foot and mantle dotted with brown. Tentacles yellowish with brown bases. Siphon simple, and the mantle is furnished with small remote dendritic processes."

Genus DERSTOLIDA nov.

Type, *D. fluctuans* sp. nov.

The quaint animal of this shell is so distinct that it cannot be associated with any other so far described.

DERSTOLIDA FLUCTUANS sp. nov.

(Plate ix., figs. 9, a, b.)

Mr. Melbourne Ward notes: "Mantle milk white, transparent, dotted with minute black spots. Papillae more opaque white than mantle, numerous over the surface of the mantle, branching, tree-shaped. Siphon is opaque white, its anterior margins fringed. Tentacles pale yellow. Foot very large, opaque milk white unspotted. When walking, the hinder end of the shell is raised and the greater part of the foot is behind the shell."

Linné's *C. stolida* (Syst. Nat., xth ed., p. 724, January 1, 1758) was based on "Argenv. Conch., t. 21, fig. Y," from unknown locality, and the general acceptance of the shell has the base with the teeth red-lined. None of the Australian shells show this feature, nor do they reach the size of the red-lipped species. The one here figured has no red, and is an elegant little specimen without a dark blotch on the back. All the Lindeman Island shells so far collected agree in size and shape, but a series from Torres Straits shows variation in size and form, becoming stumpy and swollen, and approximating in shape to the shell described by Sowerby as *brevidentata* (Thes. Conch., Vol. iv., Cyp., p. 111, figs. 325, 326, 1870) from Borneo, whose teeth number thirteen to fourteen. The shell figured here

measures 23 mm. long, 13.5 mm. broad and 11 mm. high, and lacks the general dorsal blotch of brown, the spire is sunken and the edges thickened and adult. Another similar specimen had a brown blotch with similar measurements. In the type the number of short teeth on the outer lip is fifteen with seventeen on the inner lip; all teeth pure white. The Torres Straits shells are all more swollen and larger with more teeth, about twenty on each lip and a norm measures 29 mm. long by 20 mm. broad and 16 mm. high. This may be named *D. fluctuans deceptor* subsp. nov., but it may be specifically distinct when the animal becomes known; the teeth are white.

Hedley collected at the Palm Islands a dead shell of the malformation described as *C. crossei* Marie, from New Caledonia (Journ. de Conch., Vol. xvii., p. 16, pl. i., fig. 3, Jan., 1869).

The animal of such a shell would be very interesting, as melanism has been generally associated with these, and its effect on a white animal should be noticeable.

Genus TALOSTOLIDA.

1931. *Talostolida* Iredale, Rec. Austr. Mus., Vol. xviii., p. 219. June 29. Orthotype, *Cypraea teres* Gmelin.

TALOSTOLIDA TERES Gmelin.

1791. *Cypraea teres* Gmelin, Syst. Nat., pt. vi., p. 3405, May 14, for Schroeter, Einl. in Conch., 1, p. 16, t. 1, fig. 7. No locality = Amboina.

1817. *Cypraea tabescens* Dillwyn, Descr. Cat. Rec. Shells, Vol. i., p. 463, ex Solander MS. "Amboina."

New South Wales. West Australia. Queensland.

Under the name *"C. tabescens* Sol." Garrett wrote: "This rather scarce Cowry was found at all the Eastern Polynesian groups. Animal vermilion red, with a pale creeping disk. Siphon dotted with whitish and fringed at the end. The mantle is ornamented with dark red spots, white dots, and studded with dendritic processes."

Hidalgo used *C. punctulata* Gmelin (Syst. Nat., pt. vi., p. 3404, 1791, for Gualt text, t. 16, fig. P. No locality) for this species, but this is an immature unrecognisable shell. This would not have mattered, but unfortunately Hedley recorded a shell from West Australia under this name. Fortunately the shell proves to be a dead worn *caurica,* the coarse teeth easily determining it, but *teres* Gmelin, is also recorded from West Australia by Thiele.

TALOSTOLIDA SUBTERES Weinkauff.

1880. *Cypraea subteres* Weinkauff, Syst. Conch. Cab. (Mart. & Chemn.), ed. Kuster, Bd. v., Abth. iii., pt. 287, p. 27, pl. viii., fig. 4, and pl. xiii., figs. 1, 4. New name for

1832. *Cypraea teres* Sowerby, Conch. Illus., pt. 8, fig. 56, Nov. 16, Cat. p. 7, Nov. 9. Haynam. Not *C. teres* Gmelin supra.

New South Wales. Queensland.

Genus PAULONARIA.

1930. *Paulonaria* Iredale, Mem. Queensland Mus., Vol. x., p. 82, August 28, Orthotype, *Cypraea beckii* Gaskoin.

PAULONARIA BECKII Gaskoin.

1836. *Cypraea beckii* Gaskoin, Proc. Zool. Soc. (Lond.), 1835, p. 203, April 8, 1836. No locality.

Queensland.

PAULONARIA MACULA Angas.

(Plate ix., figs. 7, a, b.)

1867. *Cypraea macula* Angas, Proc. Zool. Soc. (Lond.), 1867, p. 206, ex A. Adams MS. Port Jackson, N.S.W.

1896. *Cypraea interpunctata* Henn, Proc. Linn. Soc. N.S.W., Ser. 2, Vol. x., p. 520, April 29, ex Brazier MS. Port Jackson, New South Wales.

New South Wales. Queensland. West Australia.

Angas wrote: "A good species, unlike any other, and certainly not a variety of *C. fimbriata.*"

Mr. Melbourne Ward notes: "The dark brown spots on the shell are visible through the mantle."

There is no doubt about the distinction of this species, and the West Australian shells at present seem inseparable. I cannot see, however, any close affinity with the species known as *"fimbriata"* here, but at Lindeman Island a larger shell was collected with a darker coloured animal which entirely covered the shell, and this answered fairly well to Melvill's *C. cholmondeleyi,* which was described from Australia. Until more specimens are secured it may be allotted to that species, but it seems to indicate that these species will later be removed from the present genus.

PAULONARIA CHOLMONDELEYI Melvill.

1888. *Cypraea fimbriata* var. *cholmondeleyi* Melvill, Proc. Manch. Lit. Phil. Soc., December 4, Vol. i., p. 216, pl. ii. fig. 15, June. Australia.

This name was introduced for a large shell like *macula,* and it may be that it was founded upon an aberration. It is being used provisionally for a large shell which was collected at Lindeman Island by Mrs. Ward, and which differs from the common shell in animal characters as noted above, but the shell is more pyriform, the anterior end more narrowed, the end blotching almost obsolete, the spotting on the back being larger and more diffuse, the teeth also a little stronger. More material may enable its distinction.

PAULONARIA FIMBRIATA Gmelin.

1791. *Cypraea fimbriata* Gmelin, Syst. Nat., pt. vi., p. 3420, May 14, for Martini, Conch. 1, t. 26, figs. 263, 264, p. 350. No locality.

Queensland. New South Wales.

The determination of this species is involved, through the continual acceptance by many authors of *macula* as a variety. The species, *macula,* is well known here, but the shell we are calling *fimbriata* is nothing like, and can never be considered as a variety. The figures given by Sowerby (Thes. Conch., Vol. iv., Cypraea, pl. xxxii., figs. 390, 391, 1870) are like our small shell, but it is quite constant in size and shape, and never approaches *macula* at all. Probably the animal of our species will be found to differ entirely from that of *macula*; it has been collected alive around Sydney, and also at North West Isle, Capricorn Group, Queensland, but no notes were taken.

Garrett wrote under the name *"C. fimbriata* Gmel." Diffused nearly all over Polynesia. Not by any means common. The animal is cherry-red, with a paler creeping disk, and the cinereous siphon is anteriorly fringed. The mantle is ornamented with simple, scattered, pale tentacular processes."

This reads rather like that of *macula*, but unfortunately none of Garrett's shells are available.

PAULONARIA MICRODON Gray.

1828. *Cypraea microdon* Gray, Zool. Journ., Vol. iv., p. 71. July. Pacific Ocean.

This species is not unlike the preceding in size and form, but differs in the greater number of teeth. Melvill (Journ. of Conch. (Leeds), Vol. x., pp. 117-119, October, 1901) has given details of the type shell establishing exactly its identity. In that place he associated *microdon* Gray, *fimbriata* Gmelin (with vars. *macula* and *cholmondeleyi*) with *irrorata* Gray, which may be a good solution of the problem. Then while *microdon* and *fimbriata* would be classed under *Naria*, the species *macula* and *cholmondeleyi* would not go with them.

Genus EVENARIA.

1930. *Evenaria* Iredale, Mem. Queensland Mus., Vol. x., p. 81, August 28. Orthotype, *Cypraea asellus* Linné.

EVENARIA ASELLUS Linné.

(Plate ix., figs. 5, a, b.)

1758. *Cypraea asellus* Linné, Syst. Nat., xth ed., p. 722, January 1. Third reference is "Rumph. mus. t. 39, fig. M. Asellus." Therefore, though locality is Maldivis, the restricted type locality must be Amboina.

Queensland. New South Wales.

Mr. Melbourne Ward notes: "Mantle, foot and proboscis jet black. Papillae very small, simple, black. Distal portion of tentacles red."

EVENARIA CONTAMINATA Sowerby.

1832. *Cypraea contaminata* Sowerby, Conch. Illus., fig. 21, pt. 4, Oct. 19; Cat., p. 10, November 16, ex Gray MS. No locality.

Queensland.

EVENARIA HIRUNDO Linné.

1758. *Cypraea hirundo* Linné, Syst. Nat., xth ed., p. 722, January 1, for Pet. gaz., t. 30, fig. 3, alone. No locality.

1832. *Cypraea neglecta* Sowerby, Conch. Illus., pt. 2, fig. 12, October 5; Cat., p. 6, November 19. Mauritius.

Queensland. New South Wales.

There has been so much confusion that very probably a revision will be necessary when the animals are known. Some of the Australian specimens look like *owenii*, and others differ so much that they may represent another species. The shells will be reviewed later.

EVENARIA KIENERI Hidalgo.

(Plate ix., figs. 3, a, b.)

1906. *Cypraea kieneri* Hidalgo, Mem. Acad. Cien. Madrid, Vol. xxv.; Obras Malac; Mon. Cypraea, pp. 139, 177, August; pp. 387, 392, August, 1907. New name for

1837. *Cypraea hirundo* Sowerby, Conch. Illus., pt. 128, fig. 174, September. Not *C. hirundo* Linné, as above.

Queensland. New South Wales.

Mr. Melbourne Ward notes: "Foot pale yellowish white with minute black spots. Mantle transparent white. Papillae white and larger. Tentacles black at base, yellow for the greater part of their length."

EVENARIA PUNCTATA Linné.

1771. *Cypraea punctata* Linné, Mantissa, pt. ii., p. 548. No locality. Queensland.

Linné described this species: "C. testa ovata alba; punctis testaceis; testa vix marginata, magnitudo *C. ziczac,* ore albo."

Hanley (Ipsa Linn. Conch., p. 455, 1854), wrote: "Has been usually identified with the pretty little Cowry so designated by Reeve, in his Monograph of that genus (Conch. Icon., Cyp., fig. 101)."

Reeve figured the shell with coloured teeth, stating: "There appear to be two very distinct states of this species, one in which the teeth are yellow and extend partially across the base, represented in the accompanying figure; the other in which the teeth are very fine, short and colourless."

The latter is the true *punctata,* and the Queensland expression has numerous small spots on the back.

Garrett described the animal of *"punctata"* as follows: "The animal is light orange-red, the mantle deeper coloured and profusely sprinkled with white dots; also furnished with pale, dendritic processes. The upper surface of the foot exhibits a few yellowish mottlings. Siphon with a terminal fringe."

This may apply to the next species.

EVENARIA ATOMARIA Gmelin.

(Plate ix., figs. 4, a, b, c.)

1791. *Cypraea atomaria* Gmelin, Syst. Nat., pt. vi., p. 3412, May 14, for Martini, Conch. I., t. 28, figs. 290-291, alone. No locality. Queensland. New South Wales.

Martini's shell has few dark spots and red teeth, and Lamarck's *stercus-muscarum* (Ann. Mus. Hist. Nat. Paris, Vol. xvi., p. 98, after Oct., 1810) indicates the same species, "punctis rubiginosis sparsis, rima flavescente." Although *punctata* and *stercus-muscarum* have been regarded as synonymous, it seems better to keep them separate, especially in view of the case of *staphylaea* and *limacina.*

Genus PALMADUSTA.

1930. *Palmadusta* Iredale, Mem. Queensland Mus., Vol. x., p. 81, Aug. 28. Orthotype, *Cypraea clandestina* Linné.

PALMADUSTA CLANDESTINA Linné.

(Plate viii., figs. 2, a, b.)

1767. *Cypraea clandestina* Linné, Syst. Nat., xiith ed., p. 1177. No references nor locality, but good description; collected by J. Zoega; therefore Gmelin (p. 3410) added: "India." Restricted type locality. Ceylon.
Queensland. New South Wales.

Mr. Melbourne Ward writes: "Mantle black. Papillae apparent to the unaided eye; golden near the edge of the mantle, white elsewhere. Foot black, covered with fine white, irregularly shaped spots. Siphon thick and fringed, with long tapering filaments."

PALMADUSTA SAULAE Gaskoin.

1843. *Cypraea saulae* Gaskoin, Proc. Zool. Soc. (Lond.), 1843, p. 23, July. I. Corregidor, Philippine Is., 7 fathoms.
Queensland.

One of the first shells Mr. Melbourne Ward sent, before he had begun

painting all the species, was a beautiful little shell with the information: "Pale orange foot and mantle," and it has proved to be the very rare species recorded as *Cypraea saulae* Gaskoin. It resembles Reeve's figure in general features, but is more elongate and graceful, measuring 22 mm. in length, 12 mm. in breadth, and ten in height, pale grey with a pale brown irregular dorsal blotch; the spire is sunken and there are a few brown spots on the sides, and the teeth are white, each with a pale golden line between; the teeth numbering on the inner lip eighteen, and on the outer lip seventeen. Until more specimens are secured this may be named as a subspecies as *Palmadusta saulae nugata* nov.

PALMADUSTA HUMPHREYII Gray.

1825. *Cypraea humphreysii* Gray, Zool. Journ., Vol. i., p. 489, January (corrected in errata). No locality.
Queensland. West Australia. New South Wales.

Other names have been used in connection with this species as *Cypraea lutea* Gronov. (Zoophyl., pl. xix., fig. 17, 1781), species indeterminable; *commixta*, Wood (Suppl. Index Test., p. 9, pl. iii., fig. 11, 1828: Indian Ocean) nothing to do with this; and *nivea* Wood (Suppl. Index, Test., p. 9, pl. iii., fig. 12, 1828: S. Seas), probably a synonym.

From New South Wales the shells are all speckled above with broad white zoning, and are very large and elongated; this form occurs through Queensland (whence I have a note that the animal was vermilion) and also in North West Australia.

From Nickol Bay, North West Australia, there is a series of unspotted (above) shells with two narrow white bands, which have been regarded as the juvenile, but, as many juveniles from the East Coast do not show such features, therefore these are named

PALMADUSTA BIZONATA sp. nov.

These agree with Reeve's pl. xx., fig. 110 c., save that they are unspotted above.

PALMADUSTA ZICZAC Linné.

1758. *Cypraea ziczac* Linné, Syst. Nat., xth ed., p. 722, Jan. 1. Bonan. recr. 3, t. 242. List. Conch. 4, figs. 9, c, 3 t. 1, fig. I. No locality.
Queensland. New South Wales.

There has been confusion with regard to this species, but the few records all belong to the present form; the larger *diluculum* Reeve, has not been recognised yet. The series of small dots around the depressed spire are regarded as diagnostic of the present species, and are retained even in very worn shells.

Genus GRATIADUSTA.

1930. *Gratiadusta* Iredale, Mem. Queensland Mus., Vol. x., p. 82, Aug. 28. Orthotype, *Cypraea pyriformis* Gray.

GRATIADUSTA PYRIFORMIS Gray.

1824. *Cypraea pyriformis* Gray, Zool. Journ., Vol. i., p. 371, October. No locality.
Queensland. North Australia.

Gray later added (Zool. Journ., Vol. iv., p. 77, 1828) "New Holland," but as far as can be determined no such shell could have been received from this locality at this date.

Sowerby (Conch. Illus., pt. 4, fig. 23, Oct. 10, 1832; Catal. p. 7, Nov. 9, 1832), however, gave "Ceylon," which is more likely.

GRATIADUSTA SMITHI Sowerby.

1881. *Cypraea smithi* Sowerby, Proc. Zool. Soc. (Lond.), 1881, p. 638, pl. lvi., fig. 8, Oct. 1. North west coast of Australia.
West Australia.

This small shell, like *macula* on the dorsal surface, but with the mouth of the *pyriformis* type, must be kept separate at present, especially as *kaiseri* apparently represents *pyriformis* in the west.

GRATIADUSTA KAISERI Kenyon.

1897. *Cypraea kaiseri* Kenyon, Proc. Linn. Soc. N.S.W., Vol. xxii., p. 145, September 17. Lagrange Bay, Western Australia.
Western Australia.

GRATIADUSTA WALKERI Sowerby.

(Plate ix., figs. 2, a, b.)

1832. *Cypraea walkeri* Sowerby, Conch. Illus., pt. 5, fig. 22, October 26; Cat., p. 7, November 9, ex Gray MS. Persian Gulf.
Queensland. New South Wales.

A subadult specimen, herewith figured, was dredged off Lindeman Island and the animal figured. Mr. Melbourne Ward describes it thus: "Mantle transparent milk white, papillae few and very short, the tips with very short tassels. Tentacles long, slender, pale yellow, eyes apparent as black dots, proboscis salmon pink. Foot narrow, the tail does not extend beyond the shell when the animal walks."

This very beautiful shell is represented by adult shells also from Lindeman Island, as well as other places on the Queensland coast.

The shell figured has the spire sunken through the elevation of the outer lip above it, and the shell is regularly pyriform; the shell is pale green, profusely speckled with small brown spots, but showing the curious immature banding; this appears to be diagnostic. The two bands of square blotches of dark brown are succeeded by a narrow pale line, and between them the ground colour is brownish; the dead shell shows this pattern more boldly. The teeth on the outer lip are not many and small, about twenty-two, those on the inner lip, large anteriorly, crowded and purple posteriorly, about four large white teeth and seventeen smaller. The shell figured, which may be called *G. w. continens* subsp. nov., measures 29 mm. in length, 17 mm. in breadth, and 15 mm. in height.

GRATIADUSTA XANTHODON Sowerby.

1832. *Cypraea xanthodon* Sowerby, Conch. Illus., pt. 3, fig. 18, October 12; Catal., p. 9, pt. 8, November 16, ex Gray MS. No locality.
Queensland. New South Wales.

Our shell does not show the teeth as figured by Sowerby, and has dark spots anteriorly and posteriorly, and grows to a much larger size than the figure.

Genus SOLVADUSTA nov.

Type *Gratiadusta vaticina* Iredale.

The animal figured shows so much distinction from that of *Gratiadusta* (*walkeri*) that the species must be distinguished, and the teeth are also very different.

SOLVADUSTA VATICINA Iredale.

(Plate viii., figs. 9, a, b.)

1931. *Gratiadusta vaticina* Iredale, Rec. Austr. Mus., Vol. xviii., p. 219, pl. xxiv., figs. 19 (not 11) and 12, June 29. Sydney Harbour, New South Wales.

New South Wales. Queensland.

The Queensland shells agree better with *vaticina* than with *subviridis*, which is narrower and more elongate; Vayssière's *Cypraea subviridis* var. *anceyi* (Journ. de Conch., Vol. liii., p. 15, pl. 1, fig. 45, May 25, 1905) resembles our species.

SOLVADUSTA SUBVIRIDIS Reeve.

1835. *Cypraea subviridis* "Lake" = Reeve, Proc. Zool. Soc. (Lond.), 1835, p. 68, September 2. No locality.

West Australia. North Australia.

Genus MELICERONA.

1930. *Melicerona* Iredale, Mem. Queensland Mus., Vol. x., p. 83, August 28. Orthotype, *Cypraea listeri* Gray = *melvilli* Hidalgo.

MELICERONA MELVILLI Hidalgo.

1906. *Cypraea melvilli* Hidalgo, Mem. Acad. Cien. Madrid, Vol. xxv.; Obras Malac.; Mon. Cypraea, pp. 140, 180, 209, August; pp. 425, August, 1907; new name for *ursellus* Kiener, Spec. gen., Cyp., p. 99, pl. 33, fig. 4, 1845. "L'Océan des grandes Indes" = Amboina.

Queensland. New South Wales.

When I introduced the generic name I used *listeri* Gray, as advised by Schilder, but find that it is scarcely applicable as it was only proposed varietally thus: *"cypraea felina y listeri* Gray (Zool. Journ., Vol. i., p. 384, 1824)," for "Martini," t. 28, figs. 283-284, "from the Maldive Islands," and the figures are not much like our species. On the other hand, Hidalgo's basis for his *melvilli* is a good representation, but our form is more elongate, and at the Capricorn Group develops a pathological state approaching that seen in the elongation, malformation and melanism of so many New Caledonian shells.

Genus BLASICRURA.

1930. *Blasicrura* Iredale, Mem. Queensland Mus., Vol. x., p. 84, August 28. Haplotype, *Cypraea rhinoceros* Souverbie.

BLASICRURA RHINOCEROS Souverbie.

1865. *Cypraea rhinoceros* Souverbie, Journ. de Conch., Vol. xiii., p. 156, pl. v., fig. 1, April 1. I. Art, New Caledonia.

Queensland.

A series from North West Isle, Capricorn Group, show great variation in size, some being broad, others narrow, some comparatively large, others comparatively smaller, but the series does not seem separable from the New Caledonian type.

The animal is blackish.

BLASICRURA IRVINEANAE Cox.

1890. *Cypraea irvineanae* Cox, Proc. Linn. Soc. N.S.W., Ser. 2, Vol. iv., p. 659, pl. xix., figs. 7-9, February 3. North west coast (error) = Cape Naturaliste, South West Australia.

South West Australia.

BLASICRURA QUADRIMACULATA Gray.

(Plate ix., figs. 6, a, b.)

1824. *Cypraea quadrimaculata* Gray, Zool. Journ., Vol. i., p. 377, October. No locality.

Queensland. North Australia.

The Australian specimens so determined appear congeneric with

rhinoceros, and it may be noted that for the latter Schilder has used *pallidula* Gaskoin, which was introduced as a varietal name only, thus: *"Cypreae quadrimaculatae* var. *pallidula"* Gaskoin (Proc. Zool. Soc. (Lond.), 1848, p. 97, March 13, 1849), without definite locality. It is pretty certain that Gaskoin's variety did not come from either New Caledonia nor Queensland, so the certain name of Souverbie is here retained.

Shirley would add *interrupta* Gray, but that species again described (Zool. Journ., Vol. i., p. 376, October, 1824) without known locality, has been recognised as the Ceylonese species corresponding to *rhinoceros*, which was the shell intended by the record.

Thiele has recorded from West Australia, *Erronea* (*Stolida*) *pallidula* Gaskoin, which apparently would refer to the species named *irvineanae* by Cox.

Genus Palangerosa.

1930. *Palangerosa* Iredale, Mem. Queensland Mus., Vol. x., p. 81, August 28. Orthotype, *Cypraea cylindrica* Born.

Palangerosa cylindrica Born.

1780. *Cypraea cylindrica* Born, Test. Mus. Caes., p. 184, pl. viii., fig. 10. No locality.

1870. *Cypraea subcylindrica* Sowerby, Thes. Conch., Vol. iv., p. 9, pl. xxvii., figs. 269-270. Indian Ocean, etc.

Queensland. North and West Australia.

The West Australian shells are more pyriform, with teeth extending on inner lip, and have the end blotches of *"quadrimaculata"* so that they have been mistaken for that species. They have also been called *subcylindrica*, but Sowerby's shell is scarcely separable from the typical form and, moreover, his name is untenable.

Genus Erronea.

1863. *Erronea* Troschel, Das Gebiss der Schnecken, Vol. i., p. 205. Logotype, Jousseaume, Bull. Soc. Zool. France, Vol. ix., p. 94, July, 1884. *Cypraea errones* Linné.

[Erronea errones Linné.

1758. *Cypraea errones* Linné, Syst. Nat., xth ed., p. 723, January 1. No references or locality.

The determination of the shell apparently erroneously so called is difficult. Linné's species is shortly described as "C. testa umbilicata: macula testacea aequali," an absolutely inadequate definition.

Hanley (Ipsa. Linn. Conch., p. 191, 1854) has determined it as equalling *olivacea* Lam., and states that Linné's son had added "Martini, 278-279," which is the species with red teeth, named *C. ovum* by Gmelin (Syst. Nat., pt. vi., p. 3,412, 1791).

The common Australian shell has a wide mouth, subcylindrical shell, rather coarse weak teeth and a pallid base, without any red on the teeth at all. It is here below described as an unnamed species in order to clarify the situation.]

Erronea chrysostoma Brazier.

(Plate viii., figs. 8, a, b.)

1881. *Cypraea chrysostoma* Brazier, Proc. Linn. Soc. N.S.W., Vol. v., p. 445, February. As synonym of

1875. *Cypraea sophiae* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 7, April 27. San Christoval Island, Solomon Archipelago.

Queensland.

Apparently this very distinct form is near the true *errones* = *ovum* = *olivacea,* and it is easily recognisable by its shape and apertural characters. The figures of the shell are drawn from a Queensland example, and Mr. Melbourne Ward's figure shows an animal similar to that he also figured of the so-called *errones.* Unfortunately the association of the shell and animal in this case was not quite clear, but is given to assist. Quoy and Gaimard described the animal of *olivacea* from Port Dorey, New Guinea: "Small species in which the animal has the mouth and the tentacles yellow orpin, the mantle greenish with some black spots; it is covered with fairly long bifid whitish filaments. The foot is very finely spotted with black on its sides and yellowish below."

The species, *chrysostoma,* has been found abundantly at Morove Lagoon, one of the Solomons, and with it, very rare but typical and distinct, the next species.

ERRONEA NIMISERRANS sp. nov.

(Plate ix., figs. 1, a, b.)

This common shell shows much variation in size and depth of coloration, so that probably many subspecies may be hereafter distinguished. The juveniles also appear to differ.

Mrs. Coxen has published a description of the animal: "Foot yellowish cream colour, the upper part finely mottled all over with black markings; small lobe under the respiratory canal marked with fine dark lines; tentacles blackish-brown; around the trunk a light brown fringe."

The figured shell measures 28 mm. in length, 15 mm. in breadth and 13 mm. in height, coloration greenish mottled with darker and a dark band across the back; the base yellowish, the teeth weak and few, the mouth open, especially towards the anterior canal, a diagnostic feature. The Queensland shells vary in size and depth of coloration and the presence of a dark spot on the back, but are comparatively uniform.

Queensland. New South Wales. West and North Australia.

ERRONEA COXI Brazier.

1872. *Cypraea coxi* Brazier, Proc. Zool. Soc. (Lond.), 1872, p. 617, pl. xliv., figs. 3, 3a, November 3. Dupuch's Is., N.W.A.

West Australia.

ERRONEA CAURICA Linné.

1758. *Cypraea caurica* Linné, Syst. Nat., xth ed., p. 723, January 1. No references or locality.

Queensland. New South Wales. North and West Australia.

The original description reads: "C. testa margine gibbo inaequali albido fusco-punctato, dorso nebulato-testaceo," and the common shell so described is very variable in form.

Melvill has named *Cypraea caurica* var. *oblongata* (Mem. Proc. Manch. Lit. Soc., Ser. ix., Vol. i., p. 217, pl. 1, fig. 8, June, 1888) from "East Indies, general," and our shell has been so named, but it is even more elongate and apparently never becomes gibbous marginad. As many shells are available from many localities, the Australian shell is named *Erronea caurica longior* subsp. nov., being more cylindrical and narrower than Melvill's variety. The measurements of a large specimen read: Length, 52 mm.; breadth, 25 mm.; height, 19 mm.; the coloration is pale green, speckled all

over with darker green, the juvenile banding showing somewhat obscurely; the sides not expanded and the spotting on the sides rather dull.

Western Australian shells appear to be comparatively broader.

Genus Ovatipsa.

1931. *Ovatipsa* Iredale. Rec. Austr. Mus., Vol. xviii., p. 219, June 29. Orthotype, *Cypraea chinensis* Gmelin.

Ovatipsa chinensis Gmelin.

1791. *Cypraea chinensis* Gmelin, Syst. Nat., pt. vi., p. 3,421, May 14; for Argenv. Conch., t. 18, fig. Z. China.

[1791. *Cypraea cruenta* Gmelin, Syst. Nat., pt. vi., p. 3,420, May 14, for Gualt. test., t. 15, fig. E. No locality. Indeterminate.]

1798. *Cypraea crenata* Bolten, Mus. Bolten, pt. ii., p. 23, September, for Mart. i., t. 29, fig. 303. No locality.

1798. *Cypraea morbillosa* Bolten, Mus. Bolten, pt. ii., p. 27, September, for same figures.

1810. *Cypraea variolaria* Lamarck, Ann. Mus. Hist. Nat. Paris, Vol. xvi., p. 91, after October; Hist. Anim. s. Vert., Vol. vii., p. 387, August, 1822. Indian Ocean = Amboina.

1931. *Erronea* (*Ovatipsa*) *chinensis* Iredale, Rec. Austr. Mus., Vol. xviii., p. 219, pl. xxiv., figs. 11 (not 19) and 20, June 29. Sydney Harbour, N.S.W.

New South Wales. Queensland.

Under the name *"Cypraea variolaria"* Quoy and Gaimard have described and figured a specimen from Dorey, New Guinea: "The mantle of this species is of a red flesh colour. It shows tubercles, a little elongated, simple and white, and these extend further on the left than on the right side. The tentacles and siphon are also of this flesh colour; the latter is ciliated. The proboscis is of sealing wax red. The foot is of a clear rose on the side with reddish spots. It is peculiar in being truncated behind, not attaining the extremity of the mouth. As we only had one individual, we cannot say whether this is a constant feature. We present a drawing of the quadrilateral form of the foot."

This description of the animal indicates the distinction of the group founded upon shell characters, and separates it rather widely from the genus *Erronea* as far as the superficies of the animal is concerned. It is curious that specimens should be found in Sydney Harbour before the species had been received from Queensland, and it had been recorded from New South Wales many years ago. The Sydney shells are more truly oval than usual, but there seems to be little doubt as to their relationship, but better material is necessary before suggesting separation.

Shirley has recorded *"cruenta* Gmel." from Torres Straits, but in that same lot he added *annulata, testudinaria, ventriculus* and *pantherina*, all island shells, none of which occur in Australian waters, so probably his *"cruenta"* was also not a local shell.

Genus Ipserronea nov.

Type *I. problematica* nov.

A beautiful animal was collected at Lindeman Island and the painting made by Mr. Melbourne Ward, but upon death the shell was found to be immature. However, this immature shell appears to be as distinct as the animal, so it is here named for future recognition.

Animal very large, apparently related to that of *Erronea*. Mr. Melbourne Ward noted: "Papillae single and branched. Proboscis reddish brown. Siphon short, fringed with yellow papillae. Tentacles long, slender, pale reddish brown."

Ipserronea problematica sp. nov.

(Plate ix., figs. 8, a, b.)

Shell immature. Spire planate, apical whorls of three or four, dark brown, becoming buried by the advancement of the adult shell, which is ovate in formation; the coloration is pale bluish, showing five bands of brownish, a feature separating it from all other known Australian species. The columella has a longer slender twist, again unlike any species otherwise recalling it. The specimen measures: Length, 21 mm.; breadth, 12 mm.; height, 10 mm.

Subfamily Austrocypraeinae.

This subfamily contains all the recent and fossil small Cypraeid shells from Southern Australia, and these will provide much study in the future. There appears to be many more species than have been allowed until quite recently, and it will be interesting to work out their fossil ancestors.

Beddome as long ago as 1898 admitted four species with three varieties from Tasmania. These May reduced to one species with three varieties in 1921. Schilder in 1927 allowed four species from Tasmania, and one from West Australia, forming a subgenus for the former, and placing the latter in the genus *Austrocypraea*, proposed for a Victorian fossil. Cotton and Godfrey in 1932 arranged the South Australian shells under eight species, and this seems nearest the truth. With fairly good series, there can easily be admitted four outstanding groups, which cannot be confused, and another three or four which are possibly just as separable when a larger number of shells are available.

The only notes on the animals are those given by Angas, who wrote: "The animal of *C. comptoni* is of a bright orange-colour, whilst that of *C. bicolor* of Gaskoin is of a pale lemon." This has been confirmed by Cotton and Godfrey for the same two species, but these workers do not mention the animal-coloration of any of the other local species.

Genus Austrocypraea.

1903. *Austrocypraea*, Cossmann, Essais Paleoconch. comp., livr. 5, p. 164, December. Orthotype, *Cypraea contusa* McCoy.

1927. *Prolyncina* Schilder, Arch. für Naturg. (Wiegm.), 91st Year, Abt. A, heft 10, p. 94. Orthotype, *Cypraea reevei* Sowerby.

Austrocypraea reevei Sowerby.

1832. *Cypraea reevei* Sowerby, Conch. Illus., pt. 8, fig. 52, November 16; Catal., p. 2, pt. 7, November 9, ex Gray MS. Garden Island, Swan River, West Australia.

West Australia. South Australia.

In all essential features the recent species agrees with the fossil, the number of teeth being the only notable distinction. This cannot be regarded as of more than subgeneric value, even if that be allowed. The recent shell has been dredged from deep water in the Great Australian Bight, and the specimens cannot be separated save by their more delicate texture and more notable contusion.

Genus Notocypraea.

1927. *Notocypraea* Schilder, Arch. für Naturg. (Wiegm.), 91st Year, Abt. A, heft 10, p. 110. Orthotype, *Cypraea piperita* Gray.

Schilder introduced this genus for the southern forms admitting four species, *piperita* Gray, *comptoni* Gray, *subcarnea* Bedd (= *angustata* Gray) and *declivis* Sow., all ranging from South West Australia to Tasmania. *C. pulicaria* Reeve, with a range of "Perth to Adelaide," he placed under *Austrocypraea* Cossm., whose type is the fossil, *contusa* McCoy. To the latter belongs *C. reevei* Sowerby, but with this and *pulicaria* there is no affinity, while Verco went so far as to deny the specific distinction of *pulicaria* from *piperita*, so that the relationship of these two latter seems certain. The columellar features, however, clearly separate these groups, the deep fossa and lower projection contrasting with the rather receding columella with obsolete fossa.

Notocypraea piperita Gray.

1825. *Cypraea piperita* Gray, Zool. Journ., Vol. i., p. 498, January, ex Solander MS. New Holland. Restricted type locality. South Australia.

Tasmania. Victoria. South Australia. West Australia.

The determination of the true *"piperita"* appears to depend on the "four, narrow, sometimes slightly interrupted bands," the cylindrical shape and the columellar formation. It must be obvious that Gray confused the South Australian species with some tropical one bearing Solander's MS. name as certainly Solander never saw a South Australian Cowry. It is probable that Gray's specimens were brought back by Flinders, who examined the South Australian coast, and was interested in shell-collecting.

Notocypraea dissecta Iredale.

1931. *Notocypraea* (*piperita*) *dissecta* Iredale, Rec. Austr. Mus., Vol. xviii., p. 220, pl. xxiv., figs. 7, 8, June 29. Twofold Bay, New South Wales, 45 fathoms.

New South Wales.

Notocypraea bicolor Gaskoin.

1849. *Cypraea bicolor* Gaskoin, Proc. Zool. Soc. (Lond.), 1848, p. 92, March 13, 1849. Australia.

Victoria. Tasmania. South Australia.

"Differs from the *Cyp. piperita* in not being cylindrical, but of a pyriform shape; in being very gibbous, and a much heavier and thicker shell; in having only three bands, which are very broad and conspicuous. Long, 90/100ths.; high, 55/100ths.; wide, 55/100ths. of an inch."

I regarded this description as referable to *angustata* auct., the words "very gibbous" suggesting that species, but the measurements deny the association, and the name seems better applicable to the form called *mayi* by Beddome and known as *bicolor* in Victoria.

Notocypraea declivis Sowerby.

1870. *Cypraea declivis* Sowerby, Thes. Conch., Vol. iv., p. 31, fig. 287, 328, 329. Tasmania.

Tasmania. Victoria. South Australia. New South Wales. West Australia.

This distinct species is easily recognised by the pale coloration, spotting on the back, and lack of banding so noticeable in some of the other species

of the same shape. The West Australian shells from Geographe Bay are all more slender and may be regarded as a subspecies under the name *N. declivis occidentalis* nov. It has sometimes been suggested that on account of the spotting this might be the true *piperita*, but the description does not agree, and this is the more uncommon shell, the spots being only on the sides of the shell in *piperita* according to the description.

Beddome's *subcarnea*, according to his specimens, appears to be a colour aberration, through illness, of this species, while *albata* appears also to be founded on albino specimens of any of the species.

NOTOCYPRAEA EMBLEMA Iredale.

1931. *Notocypraea (bicolor) emblema* Iredale, Rec. Austr. Mus., Vol xviii., p. 220, pl. xxiv., figs. 3, 4, June 29. Off Cape Everard Bank, Bass Straits, 70-90 fathoms.

South East Australia (deep water).

In describing this beautiful shell I used the specific name *"bicolor"* to replace the very erroneous *angustata*, but now regard *"bicolor"* as more applicable to a narrower shell, and Cotton and Godfrey have named the South Australian broad shell, *verconis*. I now allow the deep water shells above referred to specific rank.

NOTOCYPRAEA VERCONIS Cotton and Godfrey.

1932. *Notocypraea verconis* Cotton and Godfrey, South Austr. Naturalist, Vol. xiii., p. 41, pl. 1, fig. 8, "February" = April 15; Gulf St. Vincent, South Australia.

South Australia. Victoria. Tasmania. Southern New South Wales.

This is the species regarded as typical *angustata* by Beddome.

[NOTOCYPRAEA COMPTONII Gray.

1847. *Cypraea comptonii* Gray, Narr. Survey. Voy. "Fly" (Jukes), Vol. ii., p. 356, pl. 1, fig. 3. Port Essington.

Although this has been regarded as an erroneous locality and the name used for a Southern Australian shell, the data at present seem irreconcilable. The figure does not agree well with the southern shells so named, and the description is also unconvincing. Moreover, the southern shells so named appear to have a very doubtful specific identity, the majority of the specimens available being colour variations of other species. Although Angas recorded the animal coloration as differing the shell so-called *comptonii* by Angas is not recognisable. The probable elimination of this name is suggested, and the real *comptonii* may be a form of *walkeri*.]

Genus GUTTACYPRAEA nov.

Type, *Cypraea pulicaria* Reeve.

The cylindrical form, the pale coloration and especially the columellar features deserve separation at present, but the future of this species is not yet finally settled.

GUTTACYPRAEA PULICARIA Reeve.

1846. *Cypraea pulicaria* Reeve, Conch. Icon., Vol. iii., pl. xvii., fig. and sp. 84, January. No locality. = West Australia.

West Australia.

Apparently this species is restricted to South West Australia, where, however, it appears to be abundant and constant.

Genus THELXINOVUM.

1931. *Thelxinovum* Iredale, Rec. Austr. Mus., Vol. xviii., p. 220, June 29. Orthotype, *T. molleri* Iredale.

This group was distinguished on account of the elevated spire, the other species of this subfamily having planate spires.

THELXINOVUM MOLLERI Iredale.

1931. *Thelxinovum molleri* Iredale, Rec. Austr. Mus., Vol. xviii., p. 220, pl. xxiv., figs. 17, 18, June 29. Off Twofold Bay, New South Wales, 45 fathoms.
New South Wales.

NOTE: All the specimens here figured were collected on Lindeman Island, Queensland, by Mr. Melbourne Ward.

EXPLANATION OF PLATE VIII.

Figs. 1, a. Animal and shell of *Arabica arabica* Linné.
„ 2, a, b. Animal and shell of *Palmadusta clandestina* Linné.
„ 3, a, b, c. Animal and shell of *Procalpurnus lacteus* Lamarck.
„ 4, a, b. Animal and shell of *Calpurnus verrucosus* Linné.
„ 5, a, b. Animal and shell of *Mystaponda vitellus* Linné.
„ 6, a, b. Animal and shell of *Purperosa facifer* Iredale.
„ 7, a, b. Animal and shell of *Erosaria erosa* Linné.
„ 8, a, b. Animal (?) and shell of *Erronea chrysostoma* Brazier.
„ 9, a, b. Animal and shell of *Solvadusta vaticina* Iredale.
„ 10, a, b. Animal and shell of *Lyncina vanelli* Linné.

EXPLANATION OF PLATE IX.

Figs. 1, a, b. Animal and shell of *Erronea nimiserrans* Iredale.
„ 2, a, b. Animal and shell of *Gratiadusta walkeri* Sowerby.
„ 3, a, b. Animal and shell of *Evenaria kieneri* Hidalgo.
„ 4, a, b, c. Animal and shell of *Evenaria atomaria* Gmelin.
„ 5, a, b. Animal and shell of *Evenaria asellus* Linné.
„ 6, a, b. Animal and shell of *Blasicrura quadrimaculata* Gray.
„ 7, a, b. Animal and shell of *Paulonaria macula* Angas.
„ 8, a, b. Animal and shell of *Ipserronea problematica* Iredale.
„ 9, a, b. Animal and shell of *Derstolida fluctuans* Iredale.
„ 10, a, b. Animal and shell of *Monetaria annulus* Linné.

ICHTHYOLOGICAL GENOTYPES.

By Gilbert Whitley.

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A difficulty which continually confronts modern systematists is the fixation of genotypes for those genera which were originally proposed for more than one species and in which there was neither orthotype nor tautotype. The practice of using the first species or one chosen as the main species or "example" by the "first reviser," without a formal type-designation having been made, has long been discarded as impracticable, yet the modern method of accepting the first logotype selection, for each genus requiring such, involves considerable search through scattered literature. In an effort to simplify matters, I have prepared the following list of ichthyological genotype selectors which, though possibly incomplete, being the first of its kind, may form a basis for future research. The order is, as far as practicable, chronological.

1816-19. Bosc, and others, *Nouvelle Dictionnaire d'Histoire Naturelle.* Nouvelle Edition (1802-1804 ed. not seen).

[Bosc used Cuvier's MS. and published the following names before Cuvier's *Règne Animal* was issued: *Spinax, Alabes, Aleuterus, Anabas, Engraulis, Toxotes, Atropus, Aulopus, Bagrus.* (See also Rec. Austr. Mus., xix., 1934, p. 155.) He latinized *Alticus, Amphiprionum, Brosmus, Cantherus, Cestracion, Porcus, Callorinchus, Chetodipterus,* etc., from the names of earlier authors. Amongst his genotypes, apart from tautotypes, are: *Anabas (testudineus), Engraulis (encrasicholus), Cecilia* and *Apterichthus (Muraena caeca), Toxotes (jaculator), Clupanodon (trissa), Carcharhinus (Squalus carcharias),* etc. The genotype of *Carcharhinus* is important. See Whitley, Mem. Qld. Mus., x., 1934, p. 184.]

1816-30. Cloquet, *Dictionnaire des Sciences Naturelles (ed. Levrault).*

[Slightly later than Bosc and partly earlier than Cuvier. *Leuciscus (alburnus)* etc.]

1820-33. Swainson, *Zoological Illustrations.*

1822-31. Bory de St. Vincent, *Dictionnaire Classique Hist. Nat.*

[Bory gave some quasi-generic names, practically *nomina nuda,* to Glossopetrae or fossil sharks' teeth. Since these have not obtained recognition in Sherborn's *Index Animalium,* it is not thought wise to establish them here. Also in the *Dict. Classique,* Bory emends some well known generic names to their feminine equivalents: *Monacantha, Rhinobata, Antacea, Antennaria, Molliensia,* and *Xystera. Cyprinoides* is introduced as a genus for *Megalops filamentosus* Lacépède. His new genus *Caucus* (Vol. iii., 1823, 283) is a Chilean Cyprinoid. *Hydrocyon* is substituted for *Hydrocynus, Schilbeus* for *Schilbe, Rason* for *Novacula, Oxyrus* for the Oxyure, and *Notognidium* for *Notognidion,* whilst *Lesbius* equals *Lebias.* He emended *Elops* to *Helops* earlier than anyone else (Sherborn) and provided *Amphiprionum* and *Pemphiprion* as variant spellings of *Amphiprion.* (Vol. i., 295, and Lesson, xvi., 326).]

1828. Fleming, *Hist. Brit. Anim.,* 1828 (ed. 2, 1842).

1829-34. Cuvier, *Règne. Anim., ed.* 2, ii., 1829; *ed. Griffith,* vol. x., 1834.

1829-30. Lesson, *Dict. Classique Hist. Nat.* Vols. xv. & xvi., only. Bory *(supra)* wrote the earlier articles on fishes.

I have searched through this dictionary and note the genotypes, excluding tautotypes, as follows:—

Vol.	Page.	Genus.	Genotype.
i.	23.	*Leuciscus* Cuvier.	*Cyprinus alburnus* Linné.
	41.	*Acanthorinus* Blainville.	*Squalus acanthias* Linné.
	129.	*Aetobatus* Blainville.	*Raia aquila* Linné.
	234.	"*Alticus* Commerson."	*Blennius saliens* Lacépède (Vol. ii., p. 347).
ii.	27.	*Aspidophorus* Lacépède.	*Cottus cataphractus* Linné.
	137.	*Porcus* Geoffroy (Vol. xv., p. 434).	*Silurus bagre* Linné.
iii.	260.	*Brama* Schneider.	*Brama raii* Schneider.
iv.	231.	*Thrissa* [Cuvier, 1816].	*Clupea mystus* Linné.
vi.	205.	*Osmerus* Cuvier [= Lacépède].	*Salmo eperlanus* Linné.
	293.	*Erythrinus* auctt.	*Esox malabaricus* Bloch.
vii.	450 & 489.	*Acerina* [Cuvier, 1816].	*Acerina cernua* [but *Perca acerina* Cuv. is tautotypic].
	597.	*Centronotus* Schneider (non Lacépède).	*Blennius gunellus* Linné.
ix.	291.	*Lepidopus* Gouan.	*Lepidopus gouanianus* Lacépède.
x.	52.	*Peristedion* Lacépède.	*Trigla cataphracta auct.*, Bloch (Vol. xvi., p. 370).
xii.	503.	*Ostragus* Rafinesque [= *Orthragus*].	*Tetrodon mola* Linné.
xiii.	99.	*Trygon* Adanson.	*Raia pastinaca* Linné.
	204.	*Terapon* [Cuvier, 1816].	*Sciaena jarbua* Linné, Gmelin [invalid as this species was not mentioned in 1816 account].
xiv.	58 & 65.	*Pleuronectes* Linné.	*Pleuronectes platessa* Linné.
	499.	*Myliobatis* Blainville.	*Raja aquila* Linné, Gmelin.
	708.	*Scyllium* Cuvier.	*Squalus canicula* Linné.
xv.	522.	"Daurade" Cuvier, vernac.*	*Sparus aurata* Linné, Bloch.
	544.	*Sphagebranchus* [Bloch 1795].	*Muraena coeca* Linné [Lesson's selection is apparently invalid as *S. rostratus* Bloch is haplotype; *M. coeca* was later added to the genus by Cuvier].
	598.	*Scymnus* Cuvier. Lesson selected	*Squalus americanus* Broussonet.

* This genus was named *Aurata* Cloquet, 1818, *Dorada* Jarocki, 1822, *Chryseis* Schinz, 1822, and *Eudynama* Gistel, 1848, all of which are synonyms of *Sparus* Linné, 1758. Lesson selected *aurata* as genotype. Compare, however, opinion 69 of the I.C.Z. Nomencl.

Vol.	Page.	Genus.	Genotype.
	728.	*Symphodus* Rafinesque. Lesson picked:	*Symphodus fulvescens* Rafinesque.
xvi.	198.	*Tetraodon* Linné. Lesson designated:	*Tetraodon lineatus* Linné.
	327.	*Trachurus* Rafinesque.	*Scomber saurus* Linné.
	374.	*Trigonobatus* Blainville. Lesson picked:	*Raja pastinaca* Linné.
xvii.	126.	*Pentapodus* [Quoy & Gaimard].	*Sparus vittatus* Bloch (Actually the haplotype is *P. vitta* Q. & G.).]

1833-40. Guichenot, and others. *Dict. pittoresque Hist. Nat.* [Designates *Pomacentrus (pavo)*, *Pterois (volitans)*, etc.]

1833-34. Agassiz, *Poissons Fossiles* [For sharks, etc.]

1833-46. Knight, *The Penny Cyclopaedia;* reprinted as *The English Cyclopaedia,* 1856, and *Natural History,* 1866 [*Arges (sabalo)*].

1837-41. Muller & Henle, *Plagiostomen.*

1838-39. Swainson, *Nat. Hist. Class. Fish. Amphib. Rept.*

1839-45. Valenciennes, *Dict. Univ. Hist. Nat.*; reissued 1861.

1841. Pouchet, *Zool. Classique, ed.* 2, Vol. i.

1842. Richardson, *Ann. Mag. Nat. Hist.*, ix., p. 120 [makes *Caesio georgianus* the type of *Arripis*].

1844. Guerin-Meneville, *Icon. Règne Anim.*

1844-80. Bleeker, many papers. See Weber and Beaufort, *Fish Indo-Austr. Archip.* for bibliography and index. Bleeker selected many logotypes in his *Atlas Ichthylogique,* 1862-78.

1850-73. Kaup, various papers, especially in Wiegmann's *Archiv. f. Naturgesch,* 1853-63; subsequent years should also be consulted.

1853-1911. Gill, numerous papers. Type-designations in the *Proc. Acad. Nat. Sci. Philad.* may be traced from Nolan's *Index,* 1913. Others in *Ann. Lyceum Nat. Hist. N. York, Proc. U.S. Nat. Mus., Proc. Boston Soc. Nat. Hist., Smithson. Misc. Coll., Amer. Nat.,* etc. See Dean, *Bibliogr. Fish.*, i., 1916, pp. 462-473.

1864 to date. Zoological Record.

1874. Desmarest, *Encycl. Hist. Nat. Rept. Poiss (Chenu)—fide* Fowler and Bean; not seen [*Amphacanthus (javus)*].

1882. Jordan & Gilbert, *Bull. U.S. Nat. Mus.*, iii., 1882. Many types selected. Jordan's numerous papers are listed in Dean's *Bibliogr.*

1883. Swain, *Proc. Acad. Nat. Sci. Philad.*, 1882 (1883). Selects types for Swainson's genera, but Bleeker's designations are earlier in some cases.

1895. Goode & Bean, *Oceanic Ichthyology.*

1895 onwards. Jordan & Evermann, *Proc. Calif. Acad. Sci.*; *Check-List Fish. N. & Mid. Amer.*, 1896, and *Bulletins U.S. Bureau Fisher.*

1902-33. Sherborn, *Index Animalium.* [Quotes types of genera in some rare works, such as Jarocki's *Zoologiia,* 1822 (*Carassius,* etc.).]

1910. Eigenmann, *Rept. Princetown Univ. Exped. Patagonia.*

1911. Fowler, *Bull. Geol. Surv. N. Jersey.* [Mr. Fowler kindly supplies the following list of types from this paper: *Aellopos* (*wagneri*), *Thectodus* (*crenatus*), *Prionodon* (*glaucus*), *Cestrorhinus* (*zygaena*), *Pristobatus* (*antiquorum*), *Myliobatis* (*bovina*), and *Beryx* (*decadactylus*).]

1913. Garman, *Mem. Mus. Comp. Zool. Harvard,* xxxvi. [Sharks and rays].

1913. Jordan Tanaka & Snyder, *Journ. Coll. Sci. Univ. Tokyo,* xxxiii.

1917-23. Jordan, *Genera of Fishes,* 1917-20; *Classification of Fishes,* 1923.

1925 to date. Whitley, papers in *Rec. Austr. Mus., Mem. Qld. Mus., Australian Zoologist,* etc.

1926 to date. Biological Abstracts (Philadelphia).

1927. Nichols & Pope, *Bull. Amer. Mus. Nat. Hist.,* liv. [Chinese fishes].

1928. Meek & Hildebrand, *Field Mus. Nat. Hist. Chicago, Publ.* 249 [Fishes of Panama regions].

1929. Fowler & Bean, *Bull. U.S. Nat. Mus.,* 100; still being issued in parts.

1929. McCulloch, *Austr. Mus. Mem.,* v. [Types selected for some of the genera of Meuschen, Schinz, Cloquet, and others.]

1930. Fowler, articles in the *Hong Kong Naturalist.* Mr. Fowler's many papers in the *Proc. Acad. Nat. Sci. Philad.* are also very important.

1930. Jordan, Evermann, & Clark, *Rept. U.S. Comm. Fish.,* 1928, ii., 1930. In this work, as in the classic *Bulletin,* xlvii. (*Fish. N. & Mid. Amer.*), the genotypes are merely bracketed at the end of references to genera without being specifically designated (cf. Jordan's argument regarding opinion 45 of the Inter. Comm. Zool. Nomencl.). This style was often followed by Waite, McCulloch, and others, and may not be strictly considered type-designation. The selection in 1806 by Froriep of "examples" of Dumeril's genera in the *Zool. Analytique* is not regarded as type-designation, nor the bracketing of species, without specific mention of types, in Fleming's *Philosophy of Zoology,* 1822, a copy of which Mr. T. Iredale has kindly lent me.

Many years will probably elapse before all the genotypes mentioned by the above authors will be sifted and examined as to status. In the meantime, confusion may be saved if ichthyologists, monographing a genus, would first consult the earliest selectors and then work towards the present time. Modern workers generally specify types for their new genera, but even nowadays the selection of logotypes is often left for others, and some workers even protest that new genera, proposed without genotypes, be regarded as invalid.

NOTES ON RECENT AUSTRALIAN BRYOZOA, PART I.

By Leo. W. Stach.

This contribution is based upon a small collection of Bryozoa from Green Island (off Cairns, Queensland) made by a party of five undergraduates from the University of Melbourne in January, 1935. Two of the species (*Hincksina pyrula* and *Thalamoporella granulata*) have not been recorded previously from the eastern Queensland coastal area and may be added to Livingstone's check-list of Queensland Bryozoa (1).

Family Hincksinidae Canu and Bassler, 1927.

Genus Hincksina Norman, 1903.

Hincksina pyrula (Hincks, 1881).

(Fig. 1.)

Membranipora pyrula Hincks, Ann. Mag. Nat. Hist. (5), vii., 1881, 31, pl. i., fig. 2. Macgillivray, Prodromus of Zoology of Victoria, decade xiii., 1886, 103, pl. cxxvii., fig. 1. Whitelegge, Journ. Proc. Roy. Soc. N.S.W., xxiii. (2), 1889, 285.

Hincksina pyrula (Hincks), Canu and Bassler, United States Nat. Mus. Bull., No. 106, 1920, 111, 112.

This species is characterised by the eight to ten hollow calcareous, non-articulate spines springing from the margin of the membranous area over which the spines arch. The avicularia are nearly as long as the zooecia and equal in width half that of the zooecium. The mandibles are elongate with spatulate tips. The present specimens, though somewhat damaged, are undoubtedly referable to this species.

Numerous small fragments of pumice which were collected on the windward side of the island proved to be copiously encrusted by zoaria of this species. A specimen of the shell of the cephalopod, *Spirula peronii* Lamarck, collected from the same locality, also proved to be encrusted by this form. The fact that the zoaria are encrusting floating substrata shows them to be truly pelagic, since fixation of the larvae must have taken place while the substrata were floating at or near the surface. Because of their pelagic nature, the exact locality where fixation of the larvae occurred is indeterminate and consequently this record of its occurrence loses its value in the consideration of the distribution of this species. The distribution, from available records, shows it to be a form typical of Bass Strait and the Victorian coast, where it occurs abundantly, principally encrusting algae. Whitelegge, however, has recorded it from Green Point, Port Jackson.

The trend of the currents along the eastern Australian coasts precludes the possibility of the fixation of the larvae taking place in Bass Strait, although it is not unlikely that fixation may have occurred in New Zealand waters.

Family Thalamoporellidae Levinsen, 1909.

Genus Thalamoporella Hincks, 1887.

Thalamoporella granulata Levinsen, 1909 (*sensu stricto*).

(Fig. 2.)

Thalamoporella granulata var. B. Levinsen, Morph. Syst. Studies Cheil. Bryozoa, 1909, 189, pl. vi., a, figs. 1 a-f.

Thalamoporella granulata Levinsen, Harmer, Rept. Siboga Exped., xxviii., b, 1926, 297.

(Not *Thalamoporella granulata* Canu and Bassler, United States Nat. Mus. Bull., No. 100, ix., 1929, 150, pl. xvi., fig. 6, pl. xvii., fig. 3.).

This species is characterised by the sparsely-perforate cryptocyst, lack of adoral acropetalous spines and the lyriform avicularian mandible with a thickened axis approximately one-third the width of the mandible distally from its base.

Levinsen described three varieties (var. A, *stapifera*; var. B; var. C, *tubifera*) of his species *T. granulata,* var. B receiving no trivial designation. Harmer (2) regards these varieties as distinct species and retains the name *"granulata"* for the unnamed var. B. The present specimens agree in detail with the figures and description of Levinsen, no topotype material being available for comparison.

Zoaria of this species were not uncommon, encrusting the lower dead portions of a reef-coral (*Seriatopora* sp.). This constitutes the first record of this species south of Torres Straits in the Queensland area. The form was originally described by Levinson from specimens obtained by Professor A. C. Haddon in 1888 from Torres Straits. Osburn (3) recorded it from the Gulf of Mexico and Canu and Bassler (4) recorded it from the Miocene of San Domingo, but the latter authors (5) now believe these two determinations to be incorrect.

The figures given by Canu and Bassler of zooecia from the Philippine Islands which they place with *T. granulata* (*sensu stricto*) differ from the description and figures given by Levinsen in the following points: 1. The cryptocyst is much more perforate than is shown in Levinsen's figure and in the present specimens. 2. Canu and Bassler's figures show definite adoral acropetalous spines which are not present in this species. Thus it would appear that this species, in the present state of our knowledge, is restricted to north-east Australian waters.

Family Reteporidae Smitt, 1867.

Genus Iodictyum Harmer, 1933.

Iodictyum cf. Phoeniceum (Busk, 1854).

Retepora phoenicea Busk, Catalogue Mar. Poly. Brit. Mus., ii., 1854, 94, pl. cxxi., figs. 1, 2. Macgillivray, Prodromus of Zoology of Victoria, decade x., 1885, 27. pl. xcviii., figs. 1-5.

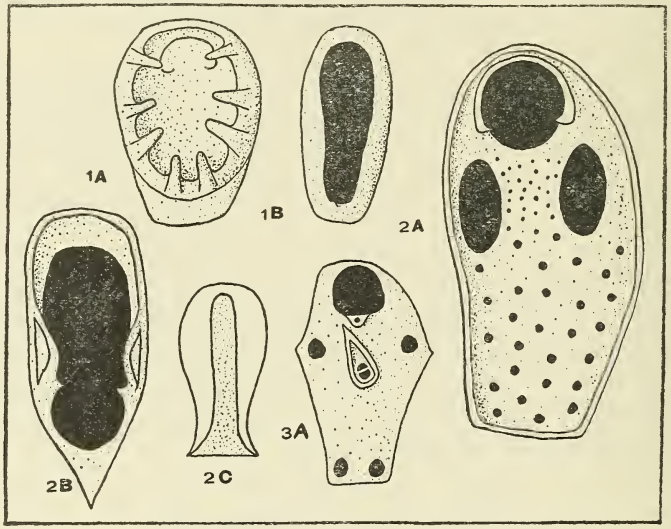
Iodictyum phoeniceum (Busk), Harmer, Proc. Zool. Soc. London, pt. 3, 1933, 624.

A small fragment of the proximal portion of a zoarium referable to *Iodictyum* occurs in the collection. The colony has a delicate violet tint and is somewhat abraded, thus making its identification uncertain, but the size and shape of the fenestrae were identical with those in specimens from Portland Bay. Comparison was made with the figures of Busk and Macgillivray and with specimens from Portland Bay (Victoria), which were pinkish-violet in colour. The avicularia were difficult to distinguish owing to fracture of the cross-bars, and abrasion of the zoaria had obviously altered their shape, but their position appeared to be consistent with the present species. The avicularia, in the better-preserved portions of the fragment, appeared to be sub-circular in outline, but this again may have been an abrasion effect. Two pairs of frontal pores were readily distinguishable on the less abraded zooecia in similar positions to those

of the specimens from Portland Bay. Harmer (6) regards *I. phoeniceum* as restricted in its distribution to Victorian and South Australian waters.

References.

(1) Livingstone, Rec. Austr. Museum, xvi. (1), 1927.
(2) Harmer, Rept. Siboga Exped., xxviii., b, 1926, 297.
(3) Osburn, Pap. Tortugas Lab., Pub. Carnegie Inst. Washington, No. 182, 1914.
(4) Canu and Bassler, Pub. Carnegie Inst. Washington, No. 291, 1919.
(5) Canu and Bassler, United States Nat. Mus. Bull., No. 100, ix., 1929.
(6) Harmer, Proc. Zool. Soc. London, pt. 3, 1933, 624.



(Magnification x 62.)

Fig. 1.—*Hincksina pyrula* (Hincks) from Green Island. A. Zooecium. B. Avicularium. Fig. 2.—*Thalamoporella granulata* Levinsen (*sensu stricto*) from Green Island. A. Zooecium. B. Avicularium. C. Mandible of avicularium. Fig. 3.—*Iodictyum phoeniceum* (Busk) from Portland Bay (Victoria); single zooecium.

A NEW CYCLOSTOMATOUS BRYOZOAN.

By Leo. W. Stach.

INTRODUCTION.

During an examination of Victorian littoral bryozoan assemblages, the interesting species described below was found. The specimens were collected early in January, 1934, amongst seaweed on the beach behind the Warrnambool railway station (Victoria). Three small zoaria were collected. The type specimens have been lodged with the National Museum (Melbourne).

Systematic Description.

Family Crisiidae.

Genus Bicrisia d'Orbigny, 1853.

Crisidia d'Orbigny, 1839 (*non* Milne-Edwards, 1838), "Voyage dans l'Amérique-Méridionale," v., part iv., 7.

Bicrisia d'Orbigny, 1853, "Paléontologie française," Terrain Crétacé, v., 601. Type (by monotypy): *B.* (*Crisidia*) *edwardsiana* (d'Orbigny, 1839).

Bicrisia warrnamboolensis, sp. nov.

(Figs. 1-4.)

Description.—The primary disc was not observed on the present specimens, but the free, articulated, bizooecial internodes were seen to arise from a stolon, adherent to seaweed, consisting of short cylindrical kenozooecia separated by chitinous joints. The free branches begin with the development of an erect, non-adherent, short, cylindrical kenozooecium separated by a chitinous joint from the stolon. From the summit of the erect kenozooecium arises an internode, consisting of a single autozoid which develops, at each upper angle of the zooecium, a long, thin tapering filament composed of four calcareous segments separated by chitinous joints. The bizooecial internodes then commence and continue to develop from chitinous joints arising between the zooecia of the proximal internode until a brood chamber develops. New branches probably arise at intervals of about ten bizooecial internodes from the upper angle of one zooecium (or perhaps both zooecia) of a fertile internode, replacing the segmented calcareous filament present at the abzooecial upper angle of each zooecium. The brood chambers arise between the two zooecia of an internode.

The bizooecial internodes scarcely vary in character, the only noticeable variation being that the first two or three internodes are slightly more elongate than those which succeed them. The greatest width of the internode is approximately equal to its length. The well-developed peristomes are directed obliquely upward and outward. A short distance within the peristome, about five minute spines project from the proximal wall into the circular peristomice. The calcareous frontal wall is dotted with sparsely-scattered pseudopores. The calcareous filaments arising from each upper abzooecial angle slightly below the level of the peristomice, consist of four or five segments which arch over the zooecia and probably offer protection for the protruded polypide.

The brood chamber, dotted with sparsely-scattered pseudopores, is elongate-oval in outline and has the transversely elliptical, narrow, projecting ooeciostome placed a short distance from the summit and facing in the opposite direction from the peristomes.

Dimensions.—Bizooecial internode, length 0.33 mm., greatest width 0.38; unizooecial internode, length 0.32, greatest width 0.22; peristome, diameter 0.07; brood chamber, length 0.43, width 0.29; ooeciostome, width

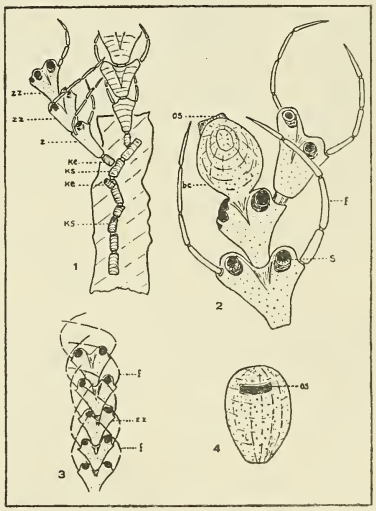
0.12; filament, length 0.8. (All measurements, except those for the unizooecial internode, are taken from the holotype.)

Type Material.—Holotype (Fig. 2), Nat. Mus. Coll., Regd. No. 68,331. Paratypes (Fig. 1), Nat. Mus. Coll., Regd. No. 68,332 (Fig. 3), Nat. Mus. Coll., Regd. No. 68,333.

Affinities.—This species differs from the genotype (*B. edwardsiana*) in the more squat appearance of the internodes, the segmented filaments projecting from each, instead of from one, of the upper angles of the internode and in the more elongate outline of the brood chamber.

From *Bicrisia biciliata* (Macgillivray, 1868) it differs in having a less salient peristome, relatively shorter internodes and a single segmented filament, in place of two filaments to each upper angle. The brood chamber in both species is, however, almost identical.

Observations.—The brittle nature of the zoaria did not permit of full observations on the mode of branching. Only one instance of an attached branch was observed. This occurred on the upper abzooecial angle of a fertile internode, while the upper angle of the other zooecium was unfortunately broken. It is suggested that a branch may arise from each upper abzooecial angle of a fertile internode and that dichotomous branching of this type is the probable mode of development of the zoarium. In only two of the eighty-one internodes examined were two filaments present in place of the normal single filament, and then they arose from one angle of the internode only.



BICRISIA WARRNAMBOOLENSIS, SP. NOV.

Fig. 1.—Proximal region of zoarium illustrating early development. (Paratype, No. 68,332 x 30. Fig. 2.—Fragment of zoarium showing zooecial detail, brood chamber and mode of branching. The brood chamber (bc) is foreshortened owing to its oblique attitude. (Holotype, No. 68,331) x 60. Fig. 3.—Portion of branch displaying the possibly protective function of the filaments. (Paratype, No. 68,333) x 30. Fig. 4.—Unforeshortened view of brood chamber. x 60. bc, brood chamber; f, segmented filaments; ke, erect kenozooecium; ks, kenozooecia of the stolon; os, ooeciostome; s, peristomial spines; z, unizooecial internode; zz, bizooecial internode. (All except Fig. 4 drawn with camera lucida.)

THE RED-STRIPED SPIDER (*LATRODECTUS HASSELTII*, THORELL).

By JOHN MACPHERSON, M.A., B.Sc., M.B., Ch.M., Sydney.

During my residence at Glen Innes, Young, and Double Bay, I had some opportunity of observing this spider, which, although of evil repute, is not repulsive or forbidding in appearance, but has rather a sinister attractiveness. Generally the body is black or dark brown in colour, the limbs being somewhat lighter in hue. In smaller individuals the body may be of a lighter brown. The most conspicuous marking is a bright red median longitudinal stripe (not a spot) on the dorsal aspect of the abdomen. A similar but shorter and broader red stripe is generally, but not always, situated on the ventral surface of the abdomen. One or two specimens dislodged from the usual haunts of the red-striped species, but not captured, seemed to be uniformly black or very dark brown, without any stripes, but I could not say definitely that they were of this species. The contour of the dorsal and ventral stripes varies considerably. As a rule the dorsal stripe is widest anteriorly, tapering and becoming much narrower posteriorly. Or the widest part may be about the middle. Sometimes the anterior end is roughly rounded and separated from the rest by a distinct constriction. The lateral border of the stripe is undulating (crenate) or more angular (roughly dentate). The ventral stripe generally has transversely straight anterior and posterior borders and a concave lateral margin—roughly resembling in outline the body of a human vertebra or a cotton-reel. The anterior and posterior edges may be equal in length or the anterior may be the longer. On the posterior margin there may be a small projection. Less often there is a similar forward process from the anterior border. The free ends of these processes are rounded or rather angular and yellowish in colour. The red stripe on the dorsal surface varies greatly in tint, or it may be orange or yellow or even white. Or the red stripe may be edged with white. The ventral red stripe is generally not so bright in hue as the dorsal one and may have a brownish tinge. It may be small and inconspicuous or barely discerned at all or even absent. The red stripes fade in spirit specimens to a pale yellow or brownish tint or become almost white. On the abdomen there are often subsidiary markings also. An extensive reddish-brown crescentic marking is frequently seen along its antero-superior edge, or such marking may be merely a faint brownish streak, or it may be absent altogether. Between this area and the dorsal longitudinal stripe there is often a transversely oval marking of red, orange or white. On the dorso-lateral aspects of the abdomen there are sometimes situated three streaks directed from before backwards, outwards and downwards and parallel with each other. The most posterior streak is often very small and may be a mere dot, or it may be absent. These streaks are generally seen in the smaller individuals, and all three streaks may be fused on each side into a large crescentic stripe larger than the dorsal longitudinal one. Colour variations are particularly common in the smaller individuals, in which all markings may be white. In one small specimen the body was dark brown, the legs being dark brown or almost black with yellow bands. One wonders what function the bright markings subserve in the spider's struggle for existence. In the creature's dark haunts they probably neither aid nor hinder it. When escaping by flight the spider is a conspicuous object for a few moments and then is soon lost to view.

Haunts and Habitat.—I have never found this spider in-doors, al-

though, of course, particularly in country areas, it is often found in pan or cesspit closets. Most cases of bites occur in such places—the spider lurking beneath the closet seat. The usual haunts are dark places, such as out-houses, heaps of rubbish, wood-heaps, stacks of bags, or of sheet-iron, under the bark of dead trees, empty tins, disused buckets, beneath or between stones, in rockeries, behind stag-horn ferns, about gas or water meters, or old boxes and under shelves of out-houses. At a residence in Double Bay, a small iron carbide shed, in the back yard, housed a colony of them. Egg cocoons were found there, and, although I frequently drove them out by masses of burning paper, they soon returned. As the shed was always kept shut, one wonders how the spiders obtained their food; yet they obviously throve and multiplied. At my residence, in Double Bay, these spiders seemed to have their own special territories, not invaded by other species. Certain portions of the garden fence on the northern and western sides constituted their areas. The fence was of two rails with overlapping palings, and the red-striped spiders occupied the spaces between the palings and the lower rails. I found no other species in the Latrodectus situations, nor did I find any Latrodectus individuals about the top rails, although other spiders were common there. No Latrodectus spiders were found on the eastern or southern fence. The road on the western side sloped considerably, and the fence was continued on the top of a stone wall. But here, again, only the lower rail provided shelter for the Latrodectus. At one place in that area I saw the largest individual of all with two egg cocoons hidden behind the rail. In the north-west angle of the garden specimens were found in flower tubs and between these tubs and the house wall, as well as beneath the stone ledges of the ground floor windows. During the summer of 1933-34 the number of individuals about my Double Bay residence was remarkable. Dr. C. H. Kellaway, of Melbourne, has suggested that the species is most abundant in hot, dry seasons, but the period referred to, as far as Sydney was concerned, was rather the opposite in both respects. I found specimens in the late autumn and again before the middle of August, but none during the depth of winter—however, my search during those months was not diligent.

Web.—The exposed part of the web is thin, scanty, flimsy and irregular; of no particular pattern. The portion concealed in the dark recesses is thick, matted or tangled and shapeless. Dead leaves were sometimes noticed in the webs, but were probably stray and wind-borne, not deliberately placed there. Pellets of excreta and ecdyses were noted in the hidden part.

Food.—Various insects were found entangled in the webs—doubtless constituting the food. These included large ants and various other Hymenoptera and Diptera. Also several species of beetles, of which a small one I rescued alive from the entanglement. Moths also were found and hairy Lepidopterous caterpillars. During the autumn I found small Latrodectus individuals apparently raiding Lepidopterous "looper" larvae, just commencing pupation in flower tubs and flower boxes containing densely foliaged Lotus and shamrock plants. In the webs were also found other species of insects, but the largest prey I discovered was a small Lygosoma lizard, $1\frac{3}{4}$ inches in length and with its tail fastened to the side of its trunk—its struggles being thus hampered. It was dead, shrunken and empty. I have read of much larger lizards being the prey of this species.

Habits.—Whether this species is mainly nocturnal in habits I cannot say, but most people who are bitten suffer such catastrophe at night. The species is shy and not truculent or aggressive; otherwise hands busy in the garden would be more often bitten. I was not bitten when ejecting them from their haunts, although my fingers would be often only a few inches away. The gardener told me that he had never been bitten, although he had often shaken them from his hands. When bites do happen they are mostly on the hand or about the nates or genitals when on a privy seat. In such a case the spider is compelled actively to defend itself, escape being prevented or its haunts invaded. One must not, however, overlook the possibility that the animal is more aggressive at night. By day the spiders remain hidden in their lurking places and are not seen unless driven out. Then they may, especially the smaller ones, be seen swinging on a strand of web. I was first directed to their lairs when watering the garden adjoining the fence. A good deal of water was sprayed on the fence and out came the spiders, dangling head downwards on a strand of web and exhibiting great agitation or anger. Afterwards I frequently produced them by turning the hose or watering-can against the lower part of the fence. Sometimes escape was made by flight which did not seem to be as rapid as that of some other species. Often, especially the larger individuals, would drop like a stone on their backs, with the legs drawn up close to the body, thus completely concealing the red stripes and rendering the individual almost or quite impossible to find on the ground, even at a distance of a few inches. This ruse is very efficacious for concealment, but the same device is used by other species, one of which, being of a general brownish colour of different shades, is amply protected by its inconspicuous appearance and has no need of any such ruse. When the Latrodectus thus disposes itself, it will remain in the same immobile attitude, even when repeatedly molested by a twig. I have left individuals in this position for some minutes and found them unmoved on my return. If, however, they were turned over to the correct walking posture, they always tried to escape by flight. Sometimes, instead of falling on their back, they would fall on their sides, when the dorsal red stripe would still be conspicuous and arrest attention.

Cocoons and Eggs.—Cocoons with eggs were found during March and with newly hatched young in the middle of the same month. Cocoons were often single, but sometimes two or three were found loosely attached together and situated either in the dark recesses, or, less often, in the exposed part of the web. They are of a pale, dirty yellow colour, constrasting with the white cocoons of other species occupying the upper part of the fence. Old weather-beaten cocoons were of a darker brown. In shape they are globular or more oval, varying from the size of a pea to much larger. Generally they are about 7-16 inch (11 millimetres) in diameter. They are composed of a dense, close-textured, felted mass; the external fibres being tough, but the internal ones more flimsy, like "cotton wool." Occasionally there was a faint pinkish tinge on the innermost fibres. Old cocoons contained debris of small linear or curved or irregular yellowish fragments—doubtless the remnants of egg-envelopes. The number of eggs varied greatly. I have counted 15, 24 and 30. The largest individual spider seen by me was associated with two cocoons on March 15th. One of these cocoons, on being opened seemed to contain some hundreds of eggs, but, as I was counting them out of doors, a gust of wind scattered them everywhere. The other cocoon contained a large number, possibly

hundreds, of newly hatched young, which dispersed in all directions when the cocoon was opened. In these young the cephalothorax and legs were light brown and the abdomen of a lighter greyish hue. I fancied that I could detect a faint longitudinal streak on the upper abdomen, where the red stripe would eventually be. The eggs are not attached to each other, round, colourless or pale yellow or white and semi-translucent. In spirit specimens they are opaque white or yellowish.

Enemies.—Some of the cocoons gave evidence of enemy attacks. Minute orange-red and other species of ants were often found in them. One large perforated cocoon measuring $1\frac{1}{8}$ by $\frac{1}{2}$ an inch (28 by 12 millimetres) contained what may have been remains of pupal cases of some hymenopterous insect, possibly an Ichneumon wasp, which was common in the vicinity. Such wasps are known to deposit their eggs in spider cocoons. Another cocoon contained two living but immobile bodies of different sizes suggesting again hymenopterous pupae. One perforated cocoon contained twenty pupal cases of some insect. They were of a light dirty brown colour, long-oval in shape, measuring four by less than two millimetres in diameters. They were all open near one end and seemed to be attached loosely together by fibres of the felted strands of the cocoon. This cocoon measured one inch by half an inch (25 by 12 millimetres) in diameters.

Toxic Effects.—During my residence in Young I saw a number of cases of bites inflicted by this species in the out-lying districts. All the victims were bitten about the thighs, buttocks or genitals when on the seats of the out-of-doors pan or cesspit closets. I have also heard of the hand being bitten. Not one of my cases was in any danger of life, but they all experienced severe suffering, persisting in some cases for many days. There may be very little pain at the site of the bite, or pain may be severe and extend widely from the wound. The wound itself may show only a small red mark with no local swelling. Or there may be a typical urticarial wheal, with surrounding swelling and exudation, or an areola of red with a white or vesicular centre. There may be ecchymoses round the punctures. Local reaction may be very intense and the whole limb swollen and tender. Where much oedema supervenes there is probably sepsis from secondary pyogenic invasion. Constitutional symptoms may arise in two or three hours and, no matter where the bite has been inflicted there may be severe pain in the lower limbs, abdomen, back and praecordia, or all over the body, especially in the feet. These pains may be rapidly aggravated, requiring morphine for their alleviation. Or there may be numbness of the limbs and trunk or a feeling of tingling or pins and needles persisting for some days. There may be shivering, tremors or twitching. Trismus, with stiffness of the jaw muscles and dysphagia or difficulty in swallowing have been recorded, but were not noted by myself. There may be inco-ordination of movements or muscular weakness or actual paresis, making standing impossible. There is often intense mental anxiety and apprehension. There may be lethargy and depression or restlessness, giddiness, headache or delirium. Intense pallor is not infrequent and syncope or collapse occur. The pulse may be slow or, on the other hand, unduly frequent, up to 120 per minute. Oedematous swelling of various parts, including the face and legs has been described. Cough may occur or dyspnoea and cyanosis. Nausea and vomiting are fairly common; diarrhoea is more rare. Abdominal pain and cramps, thirst and hiccough have all been noted. There may be frequency of micturition or

retention of urine. Priapism is rare. Profuse perspiration may occur and erythematous or miliarial rashes on the trunk or limbs. The pupils may be altered. Death has supervened in several instances.

Might I conclude with a note concerning another species of spider? At my residence in Double Bay, in the middle of March, I encountered, in a bed room, a so-called tarantula (*Isopeda* species), with a remarkable bilaterally symmetrical mutilation. The first and second pairs of legs on each side were missing, having been lost level with the thorax. The third pair were directed well forwards to occupy the positions of the first pair. The last pair were normally disposed. The spider did not seem inconvenienced in the least degree as to its movements, whether forwards, backwards or laterigrade. It exhibited its customary agility. It would be interesting to speculate as to the cause of the extraordinary deformity. The specimen was of a reddish-brown colour on the ventral surface of the abdomen; the hairs on the chelicerae being of a brighter red.

CARNIVOROUS HABITS OF THE BRUSH-TAILED OPOSSUM (*TRICHOSURUS VULPECULA*).

The Brush-tailed Opossum feeds on a very wide variety of herbage. It can live entirely on the leaves of a number of species of eucalyptus, it will eat grass, vegetables, rose leaves and fruit. From recent observations it would appear that flesh is also taken when opportunity offers.

When a number of females are kept together, it has been noted that they will kill and eat each other's young. The following letter shows that they will also take living birds. The observation recorded was made by the caretaker of Bulba Island, in Lake Macquarie, where a number of opossums are kept in a wild state.

"After I started with a few fowls on the island, I began to miss one now and again at night, so I locked them up and was not troubled again until about a month ago. I then had a few clutches of chickens, about two months old. These started roosting in the bushes, and vanished at the rate of about three a night. I was determined to find out the cause. One night, soon after dark, hearing a row among the chickens, I rushed out with a lantern, and, much to my surprise, found two silver-grey opossums, each with a chicken in its mouth."

GEORGE RAPER'S FISH PAINTINGS.

By Gilbert Whitley.

(By Permission of the Trustees of The Australian Museum.)

In 1877, Mr. Osbert Salvin, F.R.S., exhibited before the Zoological Society of London a volume of original drawings taken by Mr. George Raper during the voyage of Captain John Hunter to Australia in 1788-1792 in the *Waaksamheyd*. Raper and his paintings have been discussed by Mathews *, but it is of interest to note that there are two volumes of his drawings in the Mitchell Library, Sydney, to which my attention has been directed by Mr. K. A. Hindwood. One volume is marked "Original water-colour drawings of Australian Fishes, by G. W. Raper, in 1794 (submitted by M. Marks, through courtesy of Sir T. G. Carmichael, 2 May, 1911)," and, since such early ichthyological studies are of historical importance, I list the contents of the volume here.

1. Shark 6 ft. 8in. Commerce de Marseilles, G. Raper. July [rest of date overbound. A shark with 9 gill-slits].
2. Dolphin 4 ft. 6 in. By G. W. Raper, 1794. [*Coryphaena hippurus* Linné.]
3. [Leatherjacket, *Meuschenia trachylepis* (Günther).]
4. Salmo. [Sergeant Baker, *Latropiscis milesii* (Cuv. and Val.).]
5. [Red Gurnard, *Currupiscis volucer* Whitley.]
6. [Roundhead, *Paraplesiops bleekeri* (Günther).]
7. [A tunny with 14 vertical bars on body and nine yellow dorsal and anal finlets. Similar to *Pelamis sarda* Cuv. & Val., pl. 217.]
8. [Crimson-banded Parrot Fish, *Pseudolabrus gymnogenis* (Günther).]
9. [Elephant Shark, *Callorynchus milii* Bory.]
10. Fish of Norfolk Island ½ Natural Size. G. W. Raper, 1790. [Pigfish, *Verreo unimaculatus* (Günther).]
11. [A crude drawing, probably not by Raper, apparently representing the Red Gurnard, *Currupiscis volucer* Whitley.]
12. [Rock Whiting, *Neoodax semifasciatus richardsonii* (Günther).]
13. [A Muraenoid eel.]

14 & 15. [Unfinished proofs of copperplates, of Palaearctic invertebrates, apparently from Capt. C. J. Phipps' Voy. North Pole, 1774.]

16. [Rainbow Fish, *Heteroscarus filamentosus* Castelnau.]
17. [Void.]
18. [Snapper, *Chrysophrys guttulatus* (Cuv. and Val.).]
19. [An Opossum-like animal.]

I doubt whether all these drawings were made by Raper himself, as there is a variety of technique; however, Nos. 1, 2 and 10, being signed, are evidently authentic samples of his work, which is superior to that shown in some of the other drawings.

The second volume of paintings in the Mitchell Library contains many paintings of flowers, but some of these incidentally include pictures of various insects (orthoptera, butterfly, caterpillar) and a spider.

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* Mathews, Austral Avian Record, iii., 1915, p. 23, and Birds of Norfolk and Lord Howe Islands, 1928, p. 2, pl. ii.

A FRUIT BAT, DOBSONIA, NEW TO AUSTRALIA.

By Glover M. Allen,
Museum of Comparative Zoology, Cambridge, Mass., U.S.A.

Two genera only of large flying foxes (family *Pteropodidae*) are listed for Australia in the recent Checklist of Mammals by Iredale and Troughton, namely, *Pteropus* with five species, and *Nyctimene*, the tube-nosed bats, with two. It is interesting, therefore, to record a third genus, *Dobsonia*, the naked-backed fruit bat, a genus hitherto not reported from Australia. The record is based on four specimens, comprising three skins and skulls and one in spirit, taken at Coen, Cape York Peninsula, Queensland, by Dr. Philip J. Darlington, who secured them in the course of his field work there in 1932, while collecting for the Museum of Comparative Zoology, Cambridge, Massachusetts, U.S.A. Two were shot on May 26, one on May 27, and one on June 12, as they came at dusk to feed on the fruit of a fig tree. All four were males.

Although of about the same general size as the larger flying foxes, this genus is at once distinguished by having the naked skin of the wings extended quite to the centre line of the back, so that the entire dorsum is hairless to near the root of the tail, which, though short, is nevertheless well developed in contrast to its absence in *Pteropus*. In addition, the claw of the second finger is wanting in the hand, and the claws of the hind feet are white, instead of black. The tooth formula is much reduced over that of *Pteropus*, with only one upper and one lower incisor on each side instead of two; and but two upper premolars on each side instead of three.

Andersen, who monographed the genus tentatively in 1909 (Ann. Mag. Nat. Hist., ser. 8, vol. 4, 528-533) and in detail in 1912 (Cat. Chiroptera Brit. Mus., vol. 1, 448-482) recognized twelve "species" which fall into four "sections," perhaps equivalent to four species with representative races on different islands. As a group the genus is hitherto known from New Guinea and Celebes; the Amboina and Key Islands; the Bismark archipelago, Solomon Islands, and the Moluccas, but has not been reported from Australia. The four specimens taken by Dr. Darlington at Coen, are of maximum size, with forearms measuring 150-152 mm., and conform closely to Andersen's minute description of *D. magna* Thomas (Ann. Mag. Nat. Hist., ser. 7, vol. 16, 423, 1905), type locality Mambare River, British New Guinea. This is one of Andersen's *moluccensis* group (typical in the Amboina and Aru Islands) and is the "New Guinea representative" of the latter animal, differing chiefly in its slightly larger size. With only that author's careful description to go by, it does not seem possible to differentiate the Cape York specimens from the New Guinea animal, thus offering another instance of the close faunal affinity of the two areas.

Dr. Darlington tells me that he was able to distinguish these bats from *Pteropus* when they came to feed at the fig trees, by the noticeably pale outlines of the wings in life, a character that showed clearly when the beam of a hunting light was flashed on them. In the dried skins the phalangeal bones of the fingers as well as the claws of the hind feet are contrastingly whitish. In color the top of the head is shining blackish, the back of the neck pale brownish passing into blackish again across the shoulders; under surface drab brown, with a tinge of ochraceous in the middle of the chest. The wing membranes, which start from the middle line of the back, are hairless and of a dark blackish brown in the dried skin. Dr. Darlington is to be congratulated on having made this interesting addition to the mammal fauna of Australia.

REVIEWS.

Budgerigars in Bush and Aviary. By Neville W. Cayley, Sydney. Angus & Robertson, Ltd., 1933.

Designed alike for the general reader, the amateur keeper of a few cage birds, and the professional breeder of these fascinating little grass parrots, this work appears to supply the wants of all. Besides giving an account of the habits and habitat of the bird in its wild state, the author traces the history of the selective breeding which has resulted in the evolution of so many remarkable varieties of coloration from the original wild species. The green and yellow bird, with its dark outlined plumage, is now transformed into a grey, blue, yellow, cobalt or silver-grey, with numerous intergradations of each colour. And still the process is going on, so that in the future we may anticipate the production of all-red or all-black varieties. Six colour plates, figuring the principal known varieties of this bird, in Mr. Cayley's life-like style, illustrate the work. Numerous other figures depicting subjects of interest to the Budgerigar breeder, add to the attractions of this truly valuable handbook.

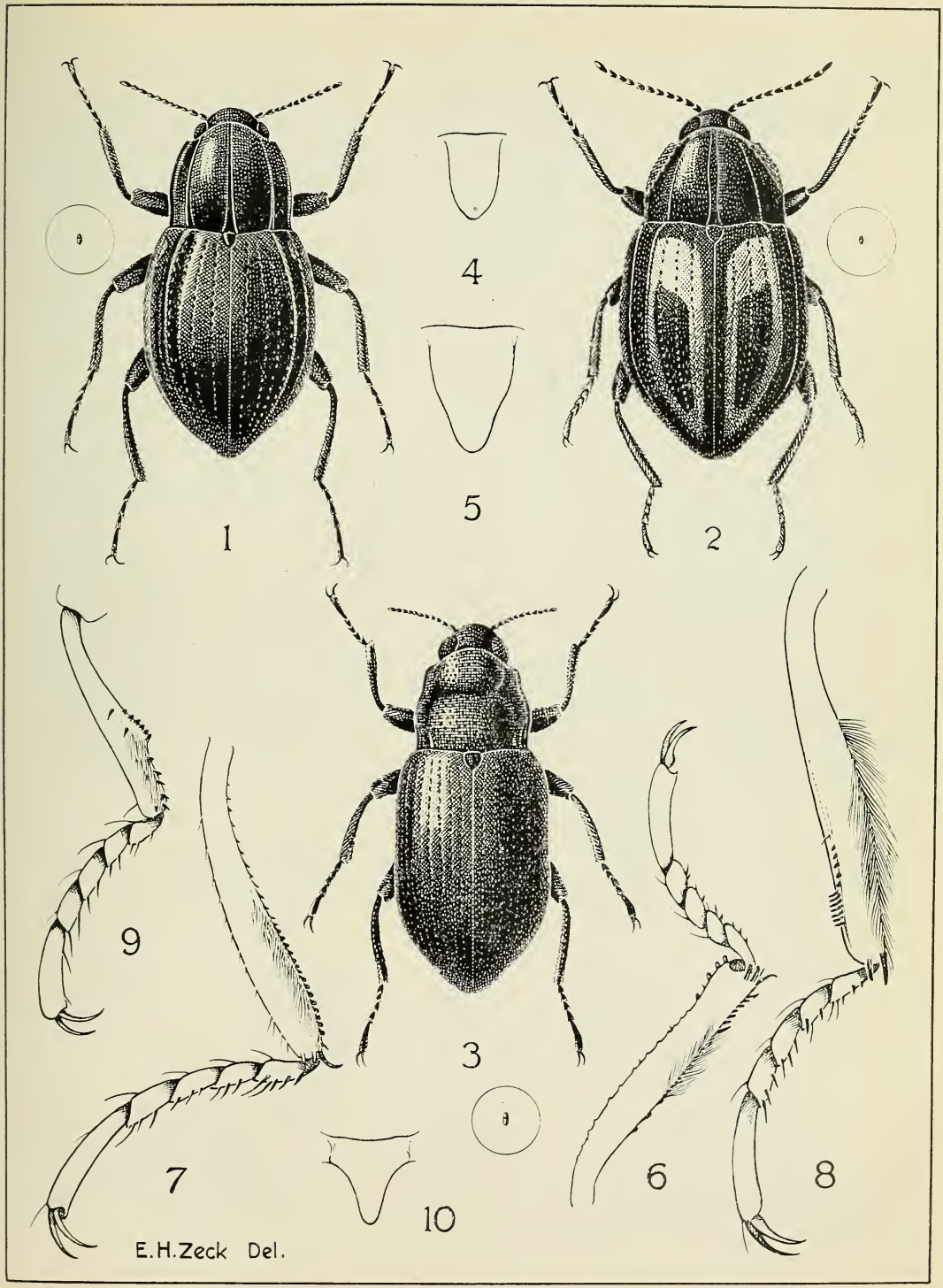
Bird Wonders of Australia. By A. H. Chisholm, 1934.

Insect Wonders of Australia. By Keith C. McKeown, 1935, Sydney. Angus & Robertson, Ltd.

These companion volumes are, we hope, the forerunners of a whole series of nature study books for Australians by Australians. Each author, in his own way, sets out in popular style a most attractive account of the many extraordinary forms of life to be found amongst the birds and insects of this great island continent. Alex. Chisholm is our foremost exponent of the bird life of Australia from the field observer's point of view. His facile pen has already been successfully used to the delight of his readers in his "Birds and Green Places," "Nature Fantasy," and other works, and in this, his latest work, he displays all his original skill in portraying the beauties of the birds and the wonders of their ways in our bushland.

Keith McKeown has a happy way of telling the story of each Australian "Wonder Insect" gained from an intimate personal study of its habits and life history, supplemented by an equally happy selective method of quoting from other authors about their extra-limital congeners.

Both books are profusely illustrated, and the publishers are to be congratulated, not only upon their enterprise in launching such instructive works, but also on their selection of the men to write them.



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A Monograph of the Australian Loricates, by Tom Iredale and A. F. Basset Hull. 168 + xiii. pp., 21 plates and portrait. Price, 5/-. Postage: Australia, 5d. British Possessions, 9d. Foreign, 1/6.

Bibliography of Australian Entomology, 1775-1930, by Anthony Musgrave, F.E.S. 380 + viii. pp. Price, 10/-. Postage: Australia, 6d. British Possessions, 9d. Foreign, 1/6.

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OBSERVATIONS ON THE BIRTH OF A WALLABY.

By David Fleay, B.Sc., Dip.Ed.,
Curator, Australian Section, Zoological Gardens, Melbourne.

(Plate x.)

The particular marsupial from which the observations in this article have been drawn is a member of the group of small wallabies, namely, the Short-tailed species (*Setonix brachyurus*), a hardy, though very timid animal, slightly smaller in size than a hare, which is native to South-western Australia. The little animals form definite tracks or "run-ways" through dense grass and undergrowth and, so short are their hind legs, tails, and ears that at first sight they may easily be mistaken for large rats, particularly when moving along on all fours.

Only one embryo is carried in the pouch at a time and its development —compared with that of larger wallabies, is much more rapid and the rate of breeding is relatively fast. This is emphasised by the fact that the following observations were made on a small female, scarcely three-quarters grown, which arrived at the Melbourne Zoological Gardens only six months before the birth of her pink naked infant, and its journey to the pouch.

At 9 a.m. on the morning of Saturday, 18th May, 1935, J. Slater, a keeper in the Australian Section of the Zoological Gardens, entered the Short-tailed Wallaby paddock on his usual round and found the young female hunched up in the shelter house. She was sitting on her tail, which projected forward between the outstretched hind legs and her head was bent forward hiding the ventral surface. The animal was shivering violently and a muscular contraction of the abdomen was taking place. Then the keeper saw that the little creature was licking the cloaca and also holding her pouch open and cleaning that as well, while between times she cleaned her face with saliva-covered fore-paws.

In this crouching ball-like attitude the cloaca and entrance to the pouch—as tested by later measurements—were no more than 2 inches from each other on a horizontal plane and a definite furrow or parting in the fur of the abdomen formed a pathway between the two openings. On this point the keeper, who is keenly observant, was absolutely definite. A few minutes later, as the animal lifted its head from the licking process, the watcher noticed, for the first time, moving through the fur near the base of the tail, a minute red embryo (later found to measure half an inch in length). The mother took little notice of it, but concentrated on licking away a small quantity of blood and embryonic membrane which had also been extruded. Unfortunately, the sudden scampering movements of other nervous wallabies at the rear of the small house upset the mother whose nervous starts displaced the embryo, and it fell to the ground and commenced to crawl alongside the mother's tail, towards the tip. Evidently lost, its movements grew slower and slower, until half an hour after dropping to the ground, it had passed the end of the tail and collapsed. This prolonged journey of 10 inches, for such a small creature, had ceased owing to its growing coldness, accelerated by the cool nature of the morning. The mother now dashed away and the keeper, considering that she had finished with her unfortunate offspring, collected the apparently dead and dirt covered embryo and laid it on a bench in the food store.

Arriving on the scene at 10.30 a.m. and being immediately informed of events and shown the apparently deceased offspring, I perceived interesting possibilities. Remembering the extraordinary vitality of young mar-

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supials at such an age, I placed the tiny creature between my hands and held it closely. Gradually the little thing revived with the warmth, and within a quarter of an hour it was crawling about slowly but surely once again. Its fore limbs showed the most marked development and possessed definite grasping powers. The only indication of the mouth opening, otherwise sealed, was a tiny round hole at the tip of the muzzle and blue pigment spots marked the position of the eyes.

After some trouble the mother was captured and gently but firmly held down in a similar position to that previously observed. Then the young one was liberated below the pouch opening near the cloaca, where it immediately began to travel slowly but surely through the fur. However, it followed no definite course, and unfortunately no helpful furrow now showed in the fur of the abdomen.

As our own crouching positions and the hold on the wallaby entailed a good deal of strain, the embryo was not permitted to continue its erratic wanderings for very long; and ten minutes later it was placed directly in the pouch.

The opening of this shelter was relaxed and wide open. Four teats, two on each side, one above the other, were well developed, erect and firmly pointed. From the bottom of the moist glandular pouch into which it had rolled, the creature instinctively concentrated on the mammae, moving first to one pair and then to the other. Between each of the two members of a pair grew a small tuft of reddish hairs and the embryo lost no time in grasping these in order to support itself. From this vantage point it made definite efforts to fasten its circular mouth opening to the mammae at various points along their respective lengths. However, these efforts proved very tiring, and repeatedly after three or four minutes of struggling it suspended its activities and lay perfectly still in a resting position. Soon the quest recommenced, and several times after a careful and tenacious climb up the supporting hairs the little creature pressed its mouth opening purposely down on the point of one of the teats. Unfortunately the mother was restless, and her occasional struggles for freedom upset the fixed attitude so necessary for the embryo to remain in position long enough to become firmly anchored, partly by means of its own efforts and partly by stimulation of the teat which causes it to pass far into the mouth cavity, dilating subsequently at its extremity. Several times the puny little creature was accidentally knocked off its precarious perch, and in order to give it a better chance of survival the mother was turned loose in a small cage placed in the shelter house at 11.45 a.m.

During the next two hours, exercising great caution, I approached the house many times and quietly watched the mother wallaby. Not once during her enforced stay there was she observed to sit back in the attitude first described or even to open the pouch and lick the infant. After her experience of being handled she appeared to have thoroughly lost interest in her offspring. At 3 p.m. she was gently re-captured, and on opening the pouch it was found that the much travelled "joey" had at last achieved its goal. It was attached to the lower mamma on the animal's right side. The tiny fore-limbs were still moving as if the embryo was continually working to become more firmly fixed.

Five days later the pouch was inspected again, and the young animal was found to be quiescent and content. It measured ¾ of an inch in length and its bulk was at least twice that observed on the day of birth.

The most striking point observed at this stage was the wonderful

elongation of the stimulated teat to which the young animal was attached. This is shown clearly in the photograph in contrast to the upper mamma of the same pair, which is still represented in its pointed state noticed at the birth of the young one.

On the 18th of July, with the embryo, aged exactly two months, the mother's pouch was again subjected to an examination. Though still blind and attached to the teat, it had grown considerably, and was now a much darker bluish pink in colour. Its shape was quite definite, and the total length of 4 inches consisted of a head and body length of 2½ inches and a tail measurement of 1½ inches.

Once more, on the 7th September, the rather difficult task of capturing the mother was carried out; but her offspring had apparently changed over to the pouch of another female which had lost its own young one accidentally. From this shelter it was rescued, and now at the age of roughly 3¾ months or more correctly 16 weeks—it was simply a well-developed and very wild miniature edition of its mother, about the size of a brown rat. Well able to hop rapidly along the tracks through the grass tussocks in the paddock, it soon hid itself when released. Later, when things were quiet again, its mother arrived on the scene, and the joey somersaulted head over heels into her pouch bulging it practically to its limit. Its husky cries heard on one or two occasions were those common to the young of all members of the kangaroo family.

Several interesting points now listed arise from the preceding observations on this Short-tailed Wallaby:—

I. If the mother does not transfer the young one to the pouch, as she made no attempt, or was too frightened to do, the embryo in this case follows, or is encouraged to follow, the path of least resistance, namely, the parting, "furrow", or depression formed in the fur of the mother's lower abdomen between the cloaca and pouch. When the animal squats forward on her tail this forms the shortest and easiest route from the cloaca opening to the slackened pouch entrance.

II. The embryo, though comparatively undeveloped, possesses, as already proven with the American opossum, the instinctive capability of finding its way to the pouch and attaching itself to the teat without voluntary assistance from the mother.

III. The comparatively rapid development of this small wallaby, emphasised by the fact that it is independent 4¼ months from the time of its birth, is also borne out by the slightly larger Rufous-bellied species (*Thylogale billardieri*), in which I have a record of two young being reared one after the other by the same mother and leaving the pouch within the short period of eleven months.

In addition, as illustrated by the observations of the female referred to in the article, Short-tailed Wallabies may produce offspring before they have attained to three-quarters the adult size.

EXPLANATION OF PLATE X.

I. Young female Short-tailed Wallaby (*Setonix brachyurus*) on which the foregoing observations were made.

II. Embryo five days old (¾ inch in length) at pouch entrance attached to elongated teat. Above is the other mamma of the pair still in its erect pointed condition observed at the time of birth.

III. Young Short-tailed Wallaby, at the age of 3¾ months.

FIVE NEW SPECIES OF AUSTRALIAN DRYOPIDAE.

By H. J. Carter and E. H. Zeck.

(Plate xi.)

Notriolus davidsoni n.sp.

Oblong-ovate, nitid black, elytra with small shoulder spot white, tarsi and basal segments of antennae red, underside black, glabrous.

Head and *prothorax* finely and densely punctate.

Prothorax widest behind middle, the usual convexity at apex, anterior angles subacute, base subtruncate, sides lightly rounded, lateral foliation narrow at middle, widening in front and behind.

Scutellum round, large, and apparently impunctate.

Elytra lightly obovate, a narrow horizontal border throughout, minutely denticulate at extreme margins, disc evenly and lightly convex, striate-punctate, the seriate punctures large and round, increasing in size towards sides, intervals flat near suture, with some minute pustules, intervals from fifth outwards with narrowly raised ridge bordering the striae, these ridges containing small pustules more or less connected. Prosternum finely punctate, its process wide, rounded at apex. Meso- and metasternum with larger and less regular punctures than on prosternum, abdomen minutely punctate. Fore tibiae with line of tomentum on inside.

Dimensions: 4.2 x 1.8 mm.

Habitat: N.S.W., Shoalhaven River. (H. Davidson.)

Two examples given me by their captor show a rather large species, in colour near *N. humeralis*, C. & Z., but differing as follows:—Surface less polished, sides of prothorax more evenly and lightly rounded. (In *humeralis* subangulately rounded.) Elytra with seriate punctures much larger, the lateral intervals narrowly raised (flat in *humeralis*). Holotype in Coll. Carter.

Notriolus setosus n.sp.

Dark brown, antennae and tarsi red, underside black, abdomen with reddish pile.

Head punctate setose, eyes large, scarcely prominent.

Prothorax convex and roundly produced in middle of apex, front angles a little advanced but rounded off, widest behind middle, sides lightly rounded, with well defined horizontal foliation, base rather strongly bisinuate, the medial part with a further hollow for the reception of the scutellum, hind angles rectangular. Disk evenly and rather closely punctate, with short, fine, pale setae, especially at sides and base; near each hind angle a short, wide, subcostate elevation.

Scutellum large, round, elevated, nitid, with a few punctures.

Elytra lightly obovate, a narrow horizontal margin obsolescent towards apex; striate-punctate, the striae with series of large punctures, intervals clearly convex, everywhere with short, pale setae.

Prosternum coarsely and closely punctate, its process widely rounded at apex. Meso- and metasternum coarsely rugose punctate, abdomen finely punctate with short adpressed hairs. Front tarsi with a line of tomentum on inside.

Dimensions: 3.6 x 1.6 mm.

Habitat: N.S.W., Duckmolloi River, Oberon district. (A. E. Church.)

A single example was taken from the stomach of a trout during the investigation by Mr. K. C. McKeown, of the Australian Museum. It is

readily distinguished from its allies by colour, clothing, and the convex elytral intervals, besides the unusual elevation near the hind angles of the pronotum. This species has the sternal process and narrow head of a *Simsonia,* though without the characteristic pronotal transverse sulcus of that genus. It may be termed a "borderline" species. Holotype in the Australian Museum.

NOTRIOLUS TAYLORI n.sp.

Widely ovate, very nitid black above, elytra with two humeral and two subapical spots yellow, underside nitid dark castaneous, glabrous, tarsi and basal half of antennae red, apical half of antennae infuscate.

Head and *prothorax* very finely and closely punctate, eyes not prominent.

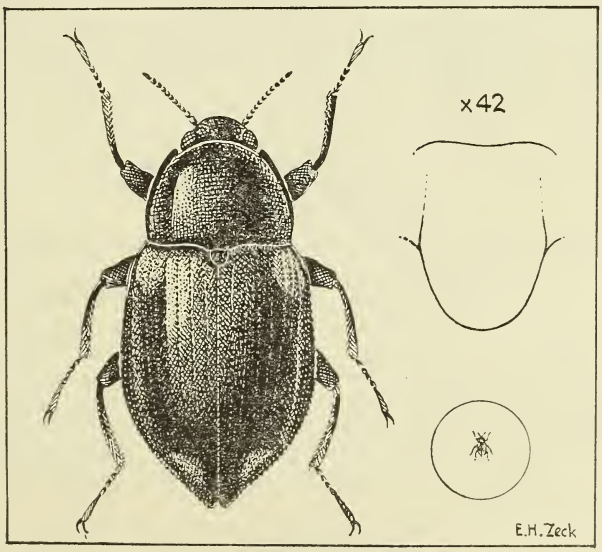
Prothorax widest behind middle, apex and base bisinuate, hind angles subrectangular, sides very lightly and arcuately narrowed to apex, margins narrowly explanate, but widened at all the angles, basal region flattened and limited by a light sulcus; this area with larger punctures than rest; disc with small shallow depression in middle.

Scutellum longitudinally elliptic, punctate.

Elytra widely obovate, sinuately narrowed towards apex; a narrow horizontal margin, continuous to apex, serrulate near apices, these separately rounded; striate-punctate, seriate punctures regular, round and shallow; intervals flat and closely punctate.

Prosternum concave, coarsely punctate, its process wide, truncate at apex, its raised sides forming with apex 3 sides of an incomplete hexagon; metasternum with large, round punctures, abdomen almost impunctate.

Dimensions: 2.7 x 1.3 mm. (approx.).



Notriolus taylori n.sp.
Sternal process, x 42.

Habitat: North Queensland, Ravenshoe and Glen Allyn. (Mr. F. H. Taylor.)

Nine examples examined show a species nearest to *N. subplanatus* (C. & Z.) in form, but the flattened disc of the pronotum is less obvious, and the elytral intervals are more strongly punctate. It is readily distinguished from the other spotted species by its flat, wide form. We gladly dedicate it to its captor, entomologist of the Institute of Tropical Medicine, University of Sydney. Holotype in Coll. Carter.

Simsonia tonnoiri n.sp.

Elongate-ovate, nitid black, antennae (partly) and tibiae dark red, tarsi and apical segments of antenne infuscate.

Head clearly punctate.

Prothorax with usual hood-like apex, anterior angles deflexed, unseen from above, base truncate, sides subsinuate in front, posterior angles rectangular; disc bilobed, the anterior lobe defined behind by arcuate depression extending from the anterior angles to near half way, posterior lobe with a short, well-defined carina at base near each angle, surface of disc uneven, with irregular, sparse, coarse punctures (less coarse on anterior lobe).

Elytra wider than prothorax, seriate (scarcely striate) punctate, the seriate punctures round and unusually large; intervals flat, each with a single row of minute, distant punctures.

Metasternum coarsely rugose-punctate.

Dimensions: 3 mm. long.

Habitat: Mount Kosciusko, Pretty Point Creek. (A. L. Tonnoir.)

Mr. Tonnoir recently took 3 examples, amongst other Dryopidae in December, 1931. The species can easily be distinguished by its evident baso-sublateral carinae, and uneven and exceptionally coarsely punctate surface. The underside of the specimen examined is very dirty and difficult to see, but the metasternum is coarsely punctate with elongate rugosity. Holotype in the Museum of The Council of Scientific Research, Canberra.

The other species taken at the same time and place were *Simsonia nicholsoni* Cart., *S. nicholsoni var. bicolor* Cart., *S. wilsoni* Cart., *Kingolus aeratus* Cart.

Also one example of *Octhebius* sp.

Simsonia allmani n.sp.

Oblong-ovate, dark purplish bronze above and beneath, head and pronotum nitid, elytra opaque.

Head, eyes large, not prominent, front lightly punctate.

Prothorax roundly produced over head, anterior angles emarginate, acute, base subtruncate; widest behind middle, sides rounded behind, sinuately narrowed to apex, posterior angles a little obtuse; with narrow lateral foliation, disc bilobate, the separating sulcus wide and arcuate, disc strongly punctate, the punctures large, deep and sparsely distributed; near each hind angle a short well-defined carina, these carinae connected by a wide transverse sulcus, partly interrupted in the middle; some smooth spaces in middle of disc.

Scutellum large, nitid and laevigate.

Elytra wider than prothorax at base, sides very slightly widening to beyond middle, thence sharply narrowed to apex. Striate-punctate, the striae shallow, the strial punctures vaguely defined, except towards sides,

intervals flat and everywhere finely transversely strigose, giving the opaque surface.

Tibiae very stout, the interior edges straight and strongly fringed with tomentum, the exterior outline arched and pustulose.

Dimensions: 2.3 x 1 mm.

Habitat: N.S.W., Tarana, Fish River. (S. L. Allman.)

A single example is named after its discoverer, Mr. Allman, of the New South Wales Department of Agriculture. It is abundantly distinct from allies by its curious sculpture and the marked opacity of the elytral surface, due to the fine cross wrinkles of the flat intervals. The species form a link between *Simsonia* and *Kingolus* in the pronotal sculpture, but the tarsal claws are those of a *Simsonia*. Holotype in Coll. Carter.

EXPLANATION OF PLATE XI.

1. *Notriolus davidsoni.*
2. *Notriolus setosus.*
3. *Simsonia tonnoiri.*
4. *Simsonia allmani.*
5. Sternal process of *Notriolus setosus,* x 42.
6. Sternal process of *Notriolus davidsoni,* x 42.
7. Sternal process of *Simsonia tonnoiri,* x 42.
8. Sternal process of *Simsonia allmani,* x 42.

ERRATA.

In our Monograph of the Australian Dryopidae there is an erroneous transposition of a line. On p. 53, line 6, the words "parallel to the sides and more or less carinate on its external edge" should follow the words "transverse depression" in line 8. The phrase applies to the sublateral sulcus, but as printed applies to the transverse depression, which is nonsense.

Also p. 54, line 2 of the *Kingolus* table read "Bicolorous" for "Unicolorous".

„ p. 59, line 5 read "middle" or "suture".

„ p. 63. The omitted dimensions of *Austrolimnius luridus* are:

1.2 x 0.6—1.4 x 0.7 mm.

In the Aust. Zool., Vol. VIII., pt. ii., 1935, 79, *Simsonia eborica* is misnamed *Simsonia eborensis* in the explanation of plate.

A NEW SPECIES OF LANTERN FISH FROM NEW ZEALAND,

With remarks on the genus *Serpa* (Family Myctophidae).

By Gilbert P. Whitley,
Ichthyologist, The Australian Museum, Sydney.

(*By permission of the Trustees of The Australian Museum.*)

Family Myctophidae.

Genus Serpa Cloquet, 1827.

Serpa Cloquet, Dict. Sci. Nat., xlviii., 1827, 190. Logotype, *S. crocodilus* Cloquet, selected by Whitley, Rec. Austr. Mus., xix., 1933, 64, q.v. for references and synonyms.

Serpa conspicua, sp. nov.

D. 16; A. 20; P. 15; V. 1/8; C. 22?; L.lat. 38 or 39; L.tr. 3/1/3.

Head (52 mm.) 3.6, depth of body (33) 5.6 in standard length (186).

Eye (11) 4.7, interorbital (12.5) 4 in head.

Head tapering, the lower jaw longer than the upper. Orbital margin not cutting upper profile. Eye large. Cheeks with large weak cycloid scales. Maxillary and mandible extending far back, covered (even externally) with villiform teeth. Similar teeth in small patches on vomer and palatines, pterygoids and hyoid. The floor of the mouth is occupied by the tongue and branchial arches with their low, denticulated gill-rakers.

Photophores and other luminous organs: The photophores are very difficult to distinguish, partly because the specimen is slightly damaged, partly because they do not appear to be bilaterally symmetrical, and owing to the presence of rudimentary or accessory photophores and luminous scales in some places. The photophores are not divided by septa. So far as can be determined, they are as shown in the figure herewith, and their formula appears to be as follows:—

Br: 0. Max: 1. Op: 0. PLO: 1. PVO: 3 plus 1 on base of pectoral and one or two behind same. PO: 5. VLO: 2. VO: 4. SAO: 3. POL: 1. AO ant., about 10, but there is a double series, a second row developing on the small scales along anal base.

PA. (AO post of authors) = **circa** 9. PRC: 3 + 1 at end of L.lat. No photophores above the lateral line.

The photophore at the end of the maxillary is distinctive. The VLO is well below the lateral line. There appear to be accessory photophores developing in the PVO and AO ant. series, whilst the AO post (or PA photophores, as I prefer to call them) run almost continuously into the Prc, though this again is a little uncertain as the tail is damaged. There may be one or two rows of scales between those bearing the ventral photophores and those of the lateral line.

Luminous glands and scales are present, though not always bilaterally symmetrical. Glands are indistinctly defined on preorbital and along posterior parts of mandible. A small antorbital organ. A luminous gland at pectoral axil, and a large patch below caudal peduncle. Some luminous scales just behind termination of anal fin. No luminous glands are apparent above caudal peduncle.

Body and fins: General habit rather robust, caudal peduncle deep. Lateral line scales enlarged. Dorsal fin with sixteen rays, of which the first three are spiniform. Anal fin with twenty rays, the last having its base slightly in advance of the vertical of the adipose dorsal. Pectorals

and ventrals long, reaching to anal. Caudal damaged, with hook-like rays above and below peduncle. Many of the scales are missing, so have been somewhat restored in the accompanying diagram.

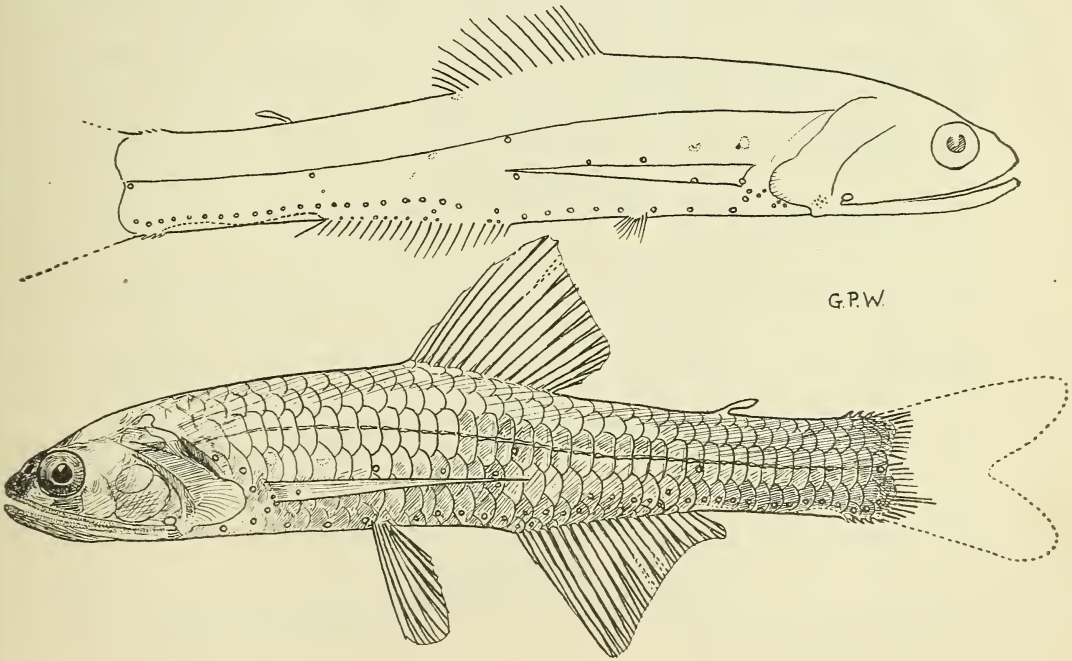
Colour: In alcohol, very dark brown, almost blackish, the fins whiter and the scaleless areas yellowish-brown. Photophores blue with blackish borders. Eye very dark bluish-black; pupil horn-coloured. Interior of mouth blackish.

Material: Described and figured from the unique holotype of the species, a specimen 186 mm. in standard length and probably nine inches overall originally, but the caudal fin has been broken. Austr. Mus., regd. No. IA 6500; specimen returned to the Canterbury Museum, Christchurch, New Zealand.

Locality: Kaikoura, New Zealand, August, 1935. From stomach of a groper caught in 80 fathoms by Mr. J. Timms. Received for identification from Professor R. Speight.

Affinities: The present species differs from its congeners in its large size, the unusual length of the pectoral fin, the number of dorsal and anal finrays and lateral line scales, the arrangement of the photophores, and in general proportions. It may approach the briefly described *S. australis* (Taaning, 1932), but that form is linked by its author with *alatus*, which is a species quite unlike the novelty described above.

The genus *Serpa*, in the broadest sense, embraces the lantern fishes referred to the genus *Lampanyctus* by most authors dealing with the group. These species are numerous and widely distributed and have been admirably reviewed by Parr in the Scientific Results of the Third Oceanographic Expedition of the "Pawnee", published as the *Bulletin of the Bingham Oceanographic Collection*, Vol. iii., Art. 3, December, 1928. His key to the



genus *"Lampanyctus"* treats with forty-six distinct species from various parts of the world, all that were known at the time. To bring this list up to date, it will be necessary to add the following species, which have been described since:—

SERPA AUSTRALIS (Taaning).

1932. *Lampanyctus alatus australis* Taaning, Vid. Medd. Dansk nat. Foren, xciv., 145. Off New Zealand, Australia, and Cape of Good Hope.

1933. *Serpa australis* Whitley, Rec. Austr. Mus., xix., 65. *Ex* Taaning.

1934. *Serpa australis* Whitley, Fish N.S. Wales (McCulloch), ed. 3, suppl.

SERPA BENSONI Fowler.

1934. *Serpa bensoni* Fowler, Proc. Acad. Nat. Sci. Philad., lxxxv., 1933 (1934), 286, fig. 46. Japan.

SERPA BERINGENSIS (Schmidt).

1933. *Lampanyctus beringensis* Schmidt, Copeia, 1933, No. 3, October 15, 1933, 131 and fig. Off Bering Island. 93 fathoms.

SERPA BLACKI Fowler.

1934. *Serpa blacki* Fowler, Proc. Acad. Nat. Sci. Philad., lxxxv., 1933 (1934), 284, fig. 44. Mindanao, Philippine Islands.

SERPA CONSPICUA, sp. nov. *supra.*

SERPA FRASERI (Fraser-Brunner).

1931. *Lampanyctus fraseri* Fraser-Brunner, Ann. Mag. Nat. Hist. (10), viii., 1931, 224, fig. 4. West Africa.

SERPA FRETA, sp. nov.

1931. *Lampanyctus macropterus taningi* Angel and Verrier, Ann. Inst. Oceanogr. (n.s.), x., 5, 1931, 124, fig. 2. North of New Guinea. Name preoccupied by *Lampanyctus taaningi* Parr, Proc. U.S. Nat. Mus., lxxvi., 1929, 3 and 27, from the Bahamas.

SERPA HOFFMANNI Fowler.

1934. *Serpa hoffmanni* Fowler, Proc. Acad. Nat. Sci. Philad., lxxxv., 1933 (1934), 282, fig. 43. North Atlantic Ocean. 781 fathoms.

SERPA IDOSTIGMA (Parr).

1931. *Lampanyctus idostigma* Parr, Bull. Bingham Oceanogr. Coll., ii., 4, 26, fig. 13, on page 33. West of America.

SERPA ISELINI (Parr).

1934. *Lampanyctus iselini* Parr, Bull. Mus. Comp. Zool., lxxvii., 2, 1934, 60, fig. 7. North Atlantic.

SERPA JOUBINI (Angel and Verrier).

1931. *Lampanyctus joubini* Angel and Verrier, Ann. Inst. Oceanogr. (n.s.), x., 5, 127, fig. 3. North of New Guinea.

SERPA MEDITERRANEA (Borodin).

1928. *Lampanyctus gaussi* var. *mediterranea* Borodin, Bull. Vanderbilt Oceanogr. Mus., i., 1928, 12. Sardinia.

[*Lampanyctus peculiaris* Borodin, Proc. N. Engl. Zool. Club, x., Jan. 22, 1929, 111, Mid-Atlantic, has been demonstrated by Parr (Bull. Mus. Comp. Zool., lxxvii., 2, 1934, 48), to be a synonym of *crocodilus* Risso.]

SERPA PARVICAUDA (Parr).

1931. *Lampanyctus omostigma parvicauda* Parr, Bull. Bingham Oceanogr. Coll., ii., 4, 1931, 26, fig. 9. West of America.

SERPA PIABILIS (Whitley).

1931. *Lampanyctus piabilis* Whitley, Rec. Austr. Mus., xviii., 1931, 103, fig. 1. Macquarie Island.

SERPA POLYPHOTIS (Beebe).

1932. *Lampanyctus polyphotis* Beebe, Zoologica, xiii., 4, 1932, 67, fig. 14. Bermuda.

SERPA REINHARDTI (Jordan).

1921. *Nyctimaster reinhardti* Jordan, Proc. U.S. Nat. Mus., lix., 1921, 645, fig. 2. Hawaii.

SERPA SEPTILUCIS (Beebe).

1932. *Lampanyctus septilucis* Beebe, Zoologica, xiii., 4, 68, fig. 15. Bermuda.

SERPA TAANINGI (Parr).

1929. *Lampanyctus taaningi* Parr, Proc. U.S. Nat. Mus., lxxvi., 3 and 27. Bahamas

[For *Lampanyctus macropterus taningi* Angel and Verrier, non Parr, see *Serpa freta, supra.*]

SERPA TURNERI Fowler.

1934. *Serpa turneri* Fowler, Proc. Acad. Nat. Sci. Philad., lxxxv., 1933 (1934), 285, fig. 45. Philippine Islands.

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Phillipps, W. J. Bibliography of New Zealand Fishes. *N.Z. Mar. Dept. Fish. Bull.,* i., 1927, 1-68.

Taaning, A. V. Synopsis of the Scopelids in the North Atlantic. *Vidensk. Medd. fra Dansk naturh. Foren.,* Bd., 86, 1928, 49-69.

Taaning, A. V. Notes on Scopelids from the Dana Expeditions, I. *Vidensk. Medd. fra Dansk. naturh. Foren.,* Bd. 94, 1932, 125-146.

Whitley, G. P. Studies in Ichthyology, No. 4. *Rec. Austr. Mus.,* xviii., 3, 1931, 96-133 (*Lampanyctus piabilis* nov. from Macquarie Island, 103, fig. 1).

Whitley, G. P. Studies in Ichthyology, No. 7. *Rec. Austr. Mus.,* xix., 1, 1933, 60-112 ("Post abdominal (PA)"; photophores defined on p. 63 and the genus *Serpa* Cloquet, 1827, established on p. 64).

EXPLANATION OF TEXT-FIGURE.

Serpa conspicua Whitley. Holotype, 186 mm. in standard length, from off Kaikoura, New Zealand.

Gilbert P. Whitley, *del.*

THE AUSTRALIAN DEVIL RAY,

Daemomanta alfredi (Krefft), with remarks on the Superfamily Mobuloidea (Order Batoidei).

By Gilbert P. Whitley, F.R.Z.S.,
Ichthyologist, The Australian Museum, Sydney.*

(Plate xii. and text-figs. 1-3.)

Devil Rays are giant representatives of the Order of Elasmobranchs, the Batoidei, to which such well known forms as the Stingray, Skate and Eagle Rays belong. They differ from these, however, in possessing two extended fins before the eyes, one on each side of the mouth, into which they serve to guide their food. Because of their large size, specimens are rarely preserved in museums, yet they are apparently fairly common in certain localities at some seasons. There are two very different Australian species: *Mobula diabolus* and *Daemomanta alfredi.*

Recently, when in Queensland, I was fortunate enough to secure a fine specimen of *Daemomanta* for detailed examination, and a description of this specimen, with notes on others which have been recorded from Australia from time to time form the basis of this paper. A less technical account, with illustrations, appeared in The Australian Museum Magazine, vi., 1, 1936.

In the present contribution, I have added a list of the world's species of Devil Rays, giving some of them new names, whilst realizing that probably, in the future, still more species may be recognized than are allowed at present. The generic name, *Aodon,* which has been applied to Devil Rays by some authors, is herein demonstrated to apply strictly to a species of shark.

I desire to express my thanks to those who have helped me during my work on the Australian Devil Ray. Firstly, Mr. Dick Lahou, a Torres Strait islander, residing at Lindeman Island, who killed a Devil Ray for me, and our fellow-workers in the boat at the time: Messrs. Melbourne Ward and Loch Nicolson. Captain A. de S. Nicolson, of Lindeman Island, kindly placed boats at our disposal.

To the Mitchell Librarian and the officers of the Mitchell Library, Sydney, I am obliged for help in looking up old books, newspapers and manuscripts. My colleagues, Messrs. F. A. McNeill and Henry Grant, of The Australian Museum, have given helpful information, and Mr. G. C. Clutton has prepared some excellent photographic illustrations.

Phylum Vertebrata.
(Backboned Animals).

Subphylum Plagiostomata, nov.
(Sharks, Rays, Ghost-Sharks, etc., with Cartilaginous Skeletons).

Class Elasmobranchii.
(Chondropterygii or Antacea of Early Authors.)

Subclass Selachii (Sharks and Rays).
Order Batoidei (Hypotremata).
(Rays, Skates, Torpedo, Sawfish, etc.)

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* By permission of the Trustees of The Australian Museum.

Suborder Masticura (Centrobates).
(Stingrays, Eagle Rays, and Devil Rays.)
Superfamily Mobuloidea, nov.

This new group-designation is desirable for the Devil Rays, for several reasons. Earlier authors have made irregular attempts to propose family names for these animals, which I regard as separable into at least two families, and they have invented names not in accordance with the practice of utilizing the oldest valid generic name as the root of the family name. The establishing of the status of the earliest generic names in this case has been made difficult by the intrusion of the name *Aodon*, which Jordan and others have used for Devil Rays, but my reason for discarding this name, because it refers to a shark, had better appear here before I pass on to the families of true Devil Rays, the Ceratopteridae and the Mobulidae.

Genus Aodon Anonymous, 1798.

Aodon Anonymous, Allg. Lit. Zeit., September 24, 1798, 675. Ex *"Aodon"* Lacépède, Hist. Nat. Poiss., i., 1798, 297, vernac. *Id.* Bosc, Nouv. Dict. d'Hist. Nat., ed. 1, i., "1803" = December, 1802, 511. *Id.* Duméril, Zool. Analyt., 1806, 103 *et ibid* (ed. Froriep), 1806, 103 (example: *massasa*). *Id.* Cuvier & Valenciennes, Hist. Nat. Poiss., i., 1828, 191, *ex* Risso. *Id.* Jordan, Gen. Fish., i., 1917, 55. Logotype, *Squalus messasa* Bonnaterre, Tabl. Encycl. Meth. Ichth., 1778, 13, *ex* "Massasa" Forskal, vernac; following Jordan & Evermann, Rept. U.S. Commis. Fish., 1895, Append. v., 1896, 225. Not *Aodon* Lesson, Compl. Buffon, i., 1828, pl. 3, a genus of whales.

Anodon Agassiz, Nomencl. Zool., Index Univ., 1846, 24 & 27. Emendation for *Aodon* Lacépède. Preoccupied by *Anodon* Smith, 1829, a reptile genus; *Anodon* Oken, 1815, mollusca; and *Anodon* Wagler, 1830, in mammalia—*teste* Nomencl. Anim.

The genus *Aodon* was founded on two species of supposedly toothless elasmobranchs called *Squalus massasa* and *S. kumal* by Forskal (Descr. Anim., 1777, x., Nos. 17 & 19), to which a third species, the "Aodon cornu", was added from the *Squalus edentulus* of Brunnich.

The logotype of *Aodon* is *Squalus messasa* Bonnaterre, *ex* Forskal, non-binom., but that species, like the others, is insufficiently characterized, and subsequent authors have even doubted whether a shark or a ray was intended by the original account.

Forskal's account is non-binomial, his names having been properly latinized by subsequent writers.

His definition of the species in question is as follows:—

17. Squalus: a) massasa, *Djiddae;* mafreka, *Lohajae.* Dentibus nullis; pinnis pect. longis. A Charcharia diversus.

[Note that *massasa* and *mafreka* are purely native names and not Latin specific names at all.]

19. c) kumal. Dentibus nullis; pinnis pect. brevibus; cirrhis oris quatuor.

On page 20, under *Squalus,* Forskal merely adds the vernacular name *Masasa* in italics and Arabic letters. The meagre details supplied point to some kind of shark rather than a ray, yet one is at loss to account for the toothless condition. The oral cirrhi of *kumal* suggest some kind of Catshark.

Coming now to Brunnich's *Squalus edentulus* (Ichth. Massiliensis, 1768. 6), which was published well before Forskal's work was issued, we read:—

"14. SQVALUS EDENTULUS.

Squalus capite lato, plano, maxillis osseis edentulis, superiore longiore, lateribus capitis prominentibus.

Massiliae piscibus adnumeramus Squalum in opposito portu Liburnensi aliquoties captum, cujus caput restat asservatum in Museo Academiae, quae *Pisae* floret, ubi cum venia celeberrimi Professoris Dni Attilii sequentia annotabam:—

Descr.: *Caput* latum, planum, antice quasi truncatum, latera sub oculis prominent duabus laciniis cutaceis longis acutis, et in siccato specimine contortis. *Maxilla superior* longior, intus munita osse transversali, cujus latitudo pollicem fere aequat, superficies limae instar scabra, introrsum membrana laxa continuatur. *Maxilla inferior* cartilagineo-ossea edentula laevis. *Latitudo* capitis circiter 3 spithamas aequat. *Latera* corniformia ultra caput 1½ spithama prominent. *Oculi* laterales magni.

Not. Piscem hunc descriptum nescio. *Bovis* mentionem è genere cartilagineo facit *Salvianus* ejusque descriptionem in secundo suo libro, nunquam edito, frustra promisit. *Squalum edentulum* anno praeterlapso observasse et descripsisse Septentrionis nostri decus, *Nidrosiensium Episcopum S. Venerab. Dnum* Gunnerum literis mihi communicavit amicus, sed an eundem vel à nostro diversum docebit dies."

This description by Brunnich might well apply to a Devil Ray, in which the teeth had been overlooked. The longer upper jaw shows that it is a *Mobula* rather than a *Manta*. Jordan and Fowler (Proc. U.S. Nat. Mus., xxvi., 1903, 665) use the genus *Mobula* Rafinesque for Brunnich's species and remark: "The name *Aodon,* accepted for this genus by Jordan and Evermann, was originally based on a shark of the Red Sea, *Aodon massasa,* said to have microscopic, serrated teeth, and very large pectoral fins. It may belong to the *Scyliorhinidae*".

The first genotype-designation for *Aodon* which I have been able to trace is that of Jordan and Evermann in 1896, who picked *massasa*. This makes *Aodon* a doubtful genus of Arabian sharks, so that it may be dismissed from further consideration here.

Since *Aodon* does not affect the choice of a family name for Devil Rays, it is necessary to discover the next named genus. This is *Mobula* Rafinesque (Index ittiol. Sicil., 1810, 48 & 61—*fide* Sherborn), a genus apparently characterized by an inferiorly situated mouth. Lack of literature unfortunately prevents me from checking the references to *Mobula* and its synonyms, so I am obliged to follow modern authors with regard to them. It is, however, established that *Mobula* must form the root of the family name: *Mobulidae*.

Swainson, in 1839, proposed Pterocephalinae as a subfamily for the Devil Rays, and Hill (Intell. Observer, ii., 1862, 174) is said to have proposed the term *Massenoideae*. Jordan and Evermann (Bull. U.S. Bur. Fish., xxiii., 1, 1903 (1905), 50) stated "The family name *Mantidae* must give way to *Mobulidae,* inasmuch as the same name is used for the group of insects typified by the genus *Mantis*". Fowler (Proc. Acad. Nat. Sci. Philad., lxxxvi., 1934, 351) later provided *Ceratopterinae* with *Manta* as the type genus of the subfamily, and called the other subfamily *Mobulinae* (*Cephalopterinae* Fowler, *olim.*). In view of the marked differences in the mouth regions of these two groups, I propose to raise them to family rank, whilst following Fowler's nominations.

The Devil Rays of the world may now be classified into families, subfamilies, and genera, as follows, commencing, for convenience's sake, with the large Australian species.

Family CERATOPTERIDAE.

(Mantidae, olim.)

Large Devil Rays with the mouth wide and terminal. Cephalic fins usually directed forward (Garman, Mem. Mus. Comp. Zool., Harvard, xxxvi., 1913, 448).

Two subfamilies:—

Teeth on lower jaw only. *Ceratopterinae,* et incertae sedis, infra.

Teeth on both jaws. *Indomantinae.*

Subfamily CERATOPTERINAE.

Genus DAEMOMANTA Whitley, 1932.

Daemomanta Whitley, Rec. Austr. Mus., xviii., 6, April 20, 1932, 327. Orthotype, *Manta alfredi* Stead = *D. alfredi* (Krefft).

Desmomanta Fowler, Mem. Bern. P. Bish. Mus., xi., 1934, 386. *Errore.*

Differs from *Manta* (*birostris*) of authors in the shape of the pectoral fins and in dentition, there being over 200 rows of teeth in lower jaw.

DAEMOMANTA ALFREDI (Krefft).

(Plate xii. and text-figs. 1-3.)

Deratoptera alfredi Krefft, Illustrated Sydney News, v., July 11, 1868, 3 & 9, woodcut fig. Port Jackson, N.S. Wales. Holotype (No. I.1731) in Australian Museum.

Ceratoptera alfredi Krefft, Industr. Progress N.S. Wales, Rept. Intercolonial Exhib., 1870, Sydney, 1871, 778. *Id.* Hill, Sydney Mail, May 27, 1871, 394 (near Watson's Bay, Sydney). *Id.* Macleay, Proc. Linn. Soc. N.S. Wales, vi., September 12, 1881, 381, and Descr. Cat. Austr. Fish., ii., 1881, 317 (Manly Beach, err. pro. Watson's Bay). *Id.* Tenison-Woods, Fish and Fisher, N.S. Wales, 1882, 99. *Id.* Ramsay, Cat. Exhib. N.S.W. Court, Fisher. Exhib., 1883, 22. *Id.* Ogilby, Cat. Fish. N.S. Wales, 1886, 6. *Id.* Ogilby, Cat. Fish. Austr. Mus., i., Palaeich., 1888, 23.

Dicerobatus sp. Ramsay, Cat. Exhib. N.S.W. Court, Fisher. Exhib., 1883, 22.

Manta alfredi Waite, Mem. N.S.W. Nat. Club, ii., November 7, 1904, 11 (undescribed). *Id.* Stead, Fish. Austr., 1906, 233 and 238. *Id.* McCulloch, Austr. Zool., i., 7, November 27, 1919, 227, pl. xviii., fig. 43a (type); Austr. Zool. Handbook, i., 1922, 13, pl. iii., fig. 43a; Austr. Mus. Mem., v., 1929, 31. *Id.* Whitley, Austr. Mus. Mag., iv., 1931, 284, figs. (Cape Hawke, N.S.W.). *Id.* Fowler, Mem. Bish. Mus., xi., 1934, 386.

"Diamond Fish" McCulloch, Sunday News (Sydney), April 22, 1923, 23 (Cape Hawke, N.S.W., 14 feet wide). *Id.* McCulloch, Illustr. Austr. Encycl., i., 1925, 368 (habits in Queensland).

? *Ceratoptera alfredi* Waterhouse, Roviana and English Dict., 1928, 168 (Roviana, Solomon Islands).

"Sea Devil" Marshall, Queensland Nat., viii., 1932, 41 (Cowan Cowan, Moreton Bay, Queensland; 13 feet).

Daemomanta alfredi Whitley, Rec. Austr. Mus., xviii., 6, April 20, 1932, 328, pl. xxxvii., figs. 1-4 (type figured, also Cape Hawke specimen, and notes *ex* Ramsay, MS.). *Id.* Barrett, Water Life, 1933, 12, fig. *Id.* Whitley, Austr. Mus. Magazine, vi., 1, "January" = February 21, 1936, 4, and 10 figs. (Maher Is., Cumberland Group, Queensland, and general history of the species).

"Devil Ray" Embury, Sydney Morning Herald, September 29, 1932, photo (Hayman Is., Queensland; about 800 lb.).

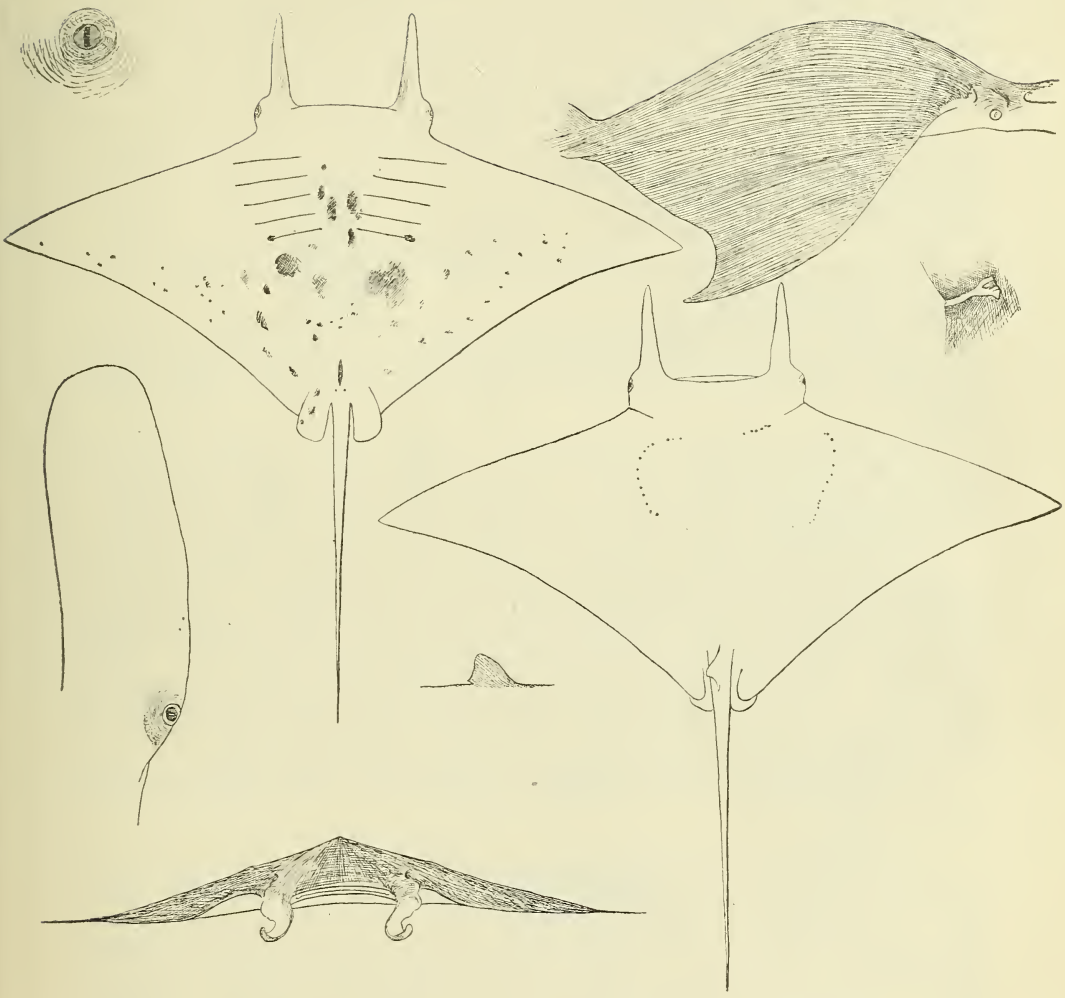
Manta Caldwell, Sydney Mail, September 4, 1935 (a disabled Queensland specimen attacked by a shark).

Description of Maher I. Specimen.

Dimensions:—	feet.	inches.
Total length, without tail	4	8
Tail	5	2¾
Length overall	9	10¾
Width of disc	11	8
Mouth to base of dorsal fin	4	5½
Mouth to pectoral arch, between parallels	2	4
Pectoral arch to vent	2	0
Anterior pectoral margin	5	2½
Depth through middle of body, approx.	1	2
Interorbital space	3	0½
Maximum diameter of eye	—	0¾
Dark area around eye	—	3
Eye to mucus pores on cephalic fin	—	4
Width at the "neck"	3	0¼
Corner of mouth to eye	—	7
Level of mouth to tip of cephalic fin	1	6¼
Centre of eye to tip of cephalic fin	1	8¾
Distance between cephalic fins	1	11¼
Maximum depth of cephalic fin	—	7
Spiracle	—	4½

Situation of gill-openings:—	inches.
Level of mouth to first gill-slit	10
Outer corner of first gill-slit to edge of body	3½
Outer corner of first gill-slit to that of fifth gill-slit	17½
Inner corner of first gill-slit to that of fifth gill-slit	15½
Opening of first gill-slit	14
Opening of second gill-slit	15
Opening of third gill-slit	14
Opening of fourth gill-slit	12¾
Opening of fifth gill-slit	10
Distance between 1st pair of gill-slits	15½
Distance between 2nd pair of gill-slits	13½
Distance between 3rd pair of gill-slits	11¼
Distance between 4th pair of gill-slits	9
Distance between 5th pair of gill-slits	7½
Distance between 1st and 2nd slits on each side	4½
Distance between 2nd and 3rd slits on each side	4¼
Distance between 3rd and 4th slits on each side	4
Distance between 4th and 5th slits on each side	3½
Outer margin of third gill-slit to tip of wing	53½

Further dimensions:—	feet.	inches.
Lower lip	1	9½
Width of mouth	1	10
Band of teeth	1	3
Posterior tip of pectoral to the posterior insertion of that fin	—	7½



Text-Figure 1.

Daemomanta alfredi (Krefft) from Maher Island, Queensland. Eye. Ventral view. Partly lateral view. Outline of cephalic fin showing mucus pores before the eye and commencement of shagreen just behind the eye. Lateral view of dorsal fin. Dorsal aspect of whole specimen showing lateral line pores, etc. Spiracle. Anterior aspect of whole specimen.

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Base of dorsal fin	—	8
Height of dorsal fin	—	6
Maximum length of dorsal fin	—	$9\frac{1}{8}$
Inner length of ventral fin	—	$8\frac{1}{4}$
Outer length of ventral fin	—	9
Width of ventral fin posteriorly	—	$5\frac{1}{2}$
Distance between anterior (outer) insertions of ventral fins	—	11
Vent	—	$5\frac{3}{4}$
Distance between abdominal pores	—	2
Tail, from behind dorsal base	4	$8\frac{3}{4}$
Width of tail at its ventral base	—	$3\frac{1}{2}$

Shrinkage was noticeable even a day after death and, of course, continued rapidly thereafter.

The cephalic fins (caropteres, horns, flippers or ears as they are variously called) are the most distinguishing features of Devil Rays. In my specimen, each fin was about one inch thick, but was usually curled when the animal was out of the water. Its shape is shown in an accompanying figure.

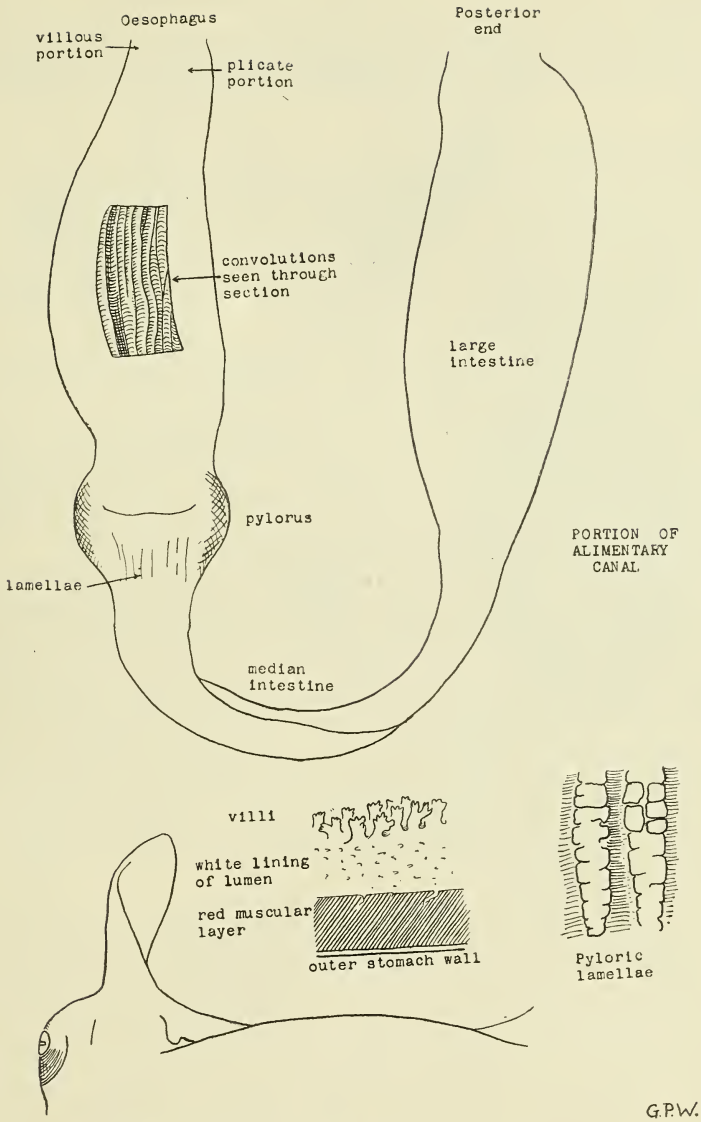
The cephalic fin is supported by a cartilage which I may term the *cephalopterygium,* which is apparently continued from the propterygium. Correlated with this development, which is consequent upon the planktonic feeding habits, are the terminal mouth and widely separated nostrils.

The strong tubercles of shagreen cease behind the eye, which occupies a naked area. There is nothing resembling a nictitating membrane, the margin of the eye being continuous with the surrounding skin. Pupil vertical, slot-shaped. Some distance before the eye are two circular mucus pores, quite inconspicuous. The main mucus-system consists of a series of spaced pores, asymmetrically disposed, across the nape between the spiracles. A row of a dozen or so, along each side of the body outside the propterygium, forms an indistinct "lateral line". Much of the body-surface is studded with smaller pores between the tubercles of the skin.

The spiracles are oblique furrows, connected by a groove with the side of the head.

Dentition:—

At first sight, the jaws appear to be edentulous, but whilst such is the case with the upper jaw, the lower jaw is found to bear teeth which, however, are obviously no longer functional, being covered by a smooth white skin which is joined to the front of the mouth by fibrous tissue. If this connecting tissue be cut, the skin can be rolled back and the teeth exposed. These teeth lie in a strip along the top of the Meckelian cartilage and can be gradually lifted off by means of a scalpel. Near one side, the band of teeth was discontinuous, apparently due to injury or disease. The band of teeth is 380 mm. long and 10 mm. wide at the ends or 16 mm. wide at the middle. The teeth are not in quincunx formation, but are regularly arranged, one behind the other, in numerous rows, seven to nine deep, sometimes with developing teeth behind them. There are 212 of these back-to-front rows, the 80th and 114th from the left-hand side being slightly broader than the others, whilst the 131st and 132nd tend to fuse with their neighbours; the gap, previously mentioned as being probably due to injury or disease, separates the 201st and 202nd tooth-rows. Thus there are, in all, between 1,500 and 2,000 teeth. They are well shown in the



Text-Figure 2.

Daemomanta alfredi (Krefft) from Maher Island, Queensland. Alimentary canal and parts of its lining (see also Plate xii., fig. 5). Also portion of head, from below.

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photographs published in The Australian Museum Magazine, Vol. vi., No. 1, 1936, 10, fig.

The prebranchial and branchial apparatus formed very beautiful strap-gills and strainers, such as have been recently described by Delsman and Hardenberg (De Indische Zeevisschen en Zeevisscherij, Batavia, 1934, 109 and fig.).

General characters:—

Broadly diamond-shaped, without a ridge along the back and having the general features shown in the figures. Lower jaw the longer.

Body covered with rough shagreen, which becomes coarsest on the upper surface of the tail, and fairly rough on the back towards ventral fins and tail. No enlarged denticles along middle of back. Tubercles almost everywhere except on eyes, in spiracles, in mouth, and on lips.

Dorsal fin well developed. No anal fin.

Tail elongate, rough; there is a low ridge along the upper and lower surface, but no fin-fold nor any spine or bony boss (Plate xii., figs. 1 & 2).

Abdominal pores nearer to vent than to base of tail.

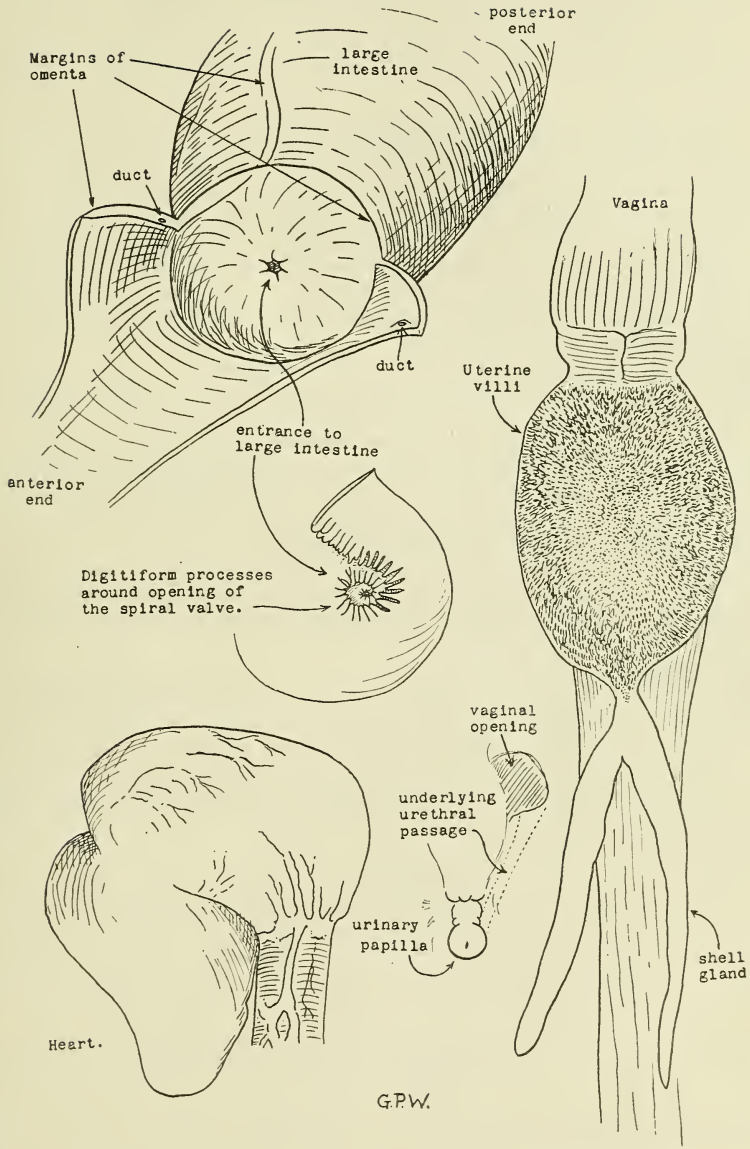
Colour.—Upper surface very dark slate grey, tinged in parts with bluish, though the blue is subdued by the darker grey. Towards the upper lip the grey turns to powder blue and gradates to white on the upper lip itself, the powder blue tinge being continued laterally on to each cephalic fin. Nostrils and interior of spiracles white. The well-developed dorsal fin is dark grey, like the disc. Upper surface of tail also dark grey.

Ventral surface white, with large irregular and asymmetrical steel blue blotches on chest and belly, some extending to hinder parts of pectoral fin and on the right (but not the left) ventral. Under surface of the tail white, except towards the end, where it is blue or very dark grey, almost black. There is a very narrow fringe of dark blue near tips of pectoral fins.

Outer surfaces of cephalic fins white, inner surface dusted with dark powder blue. Iris very dark bluish grey. Pupil dark-brown with a black vertical slit centrally. Below the eye is a suffused powder blue area.

Alimentary canal.—The stomach and intestine, with the omenta removed, are shown in the accompanying figure, which may be compared with the illustrations to Mazza's paper on the corresponding structures of *Cephaloptera giornae* (Ann. Mus. Civ. Storia Nat. Genova (2), x., 1891, 519-536, 2 pls.), as follows:—

In the Queensland Devil Ray, the anterior portion of the lumen of the oesophagus is lined with numerous villi (*papille faringee* of Mazza), seven millimetres or so high. Some of the villi are much branched, others papilliform, and they are soon replaced by a transversely plicated portion (*mucosa esofagea pieghettata in senso trasversale*) leading directly, where Mazza shows a *cingolo gastroesofageo*, into the soft, liver-brown or reddish, spongy interior of the stomach whose walls are thrown up into long convolutions (*Pieghe longitudinali della mucosa (regione cardiaca dello stomaco) colle scissure trasverse*). Just before the pylorus, the muscular walls of the alimentary canal are much thickened and there is a pronounced bulge on each side (*Rilievi delle pareti dello stomaco (porzione pilorica) formanti le valvole a colonna*). Between the lateral bulges, the walls of the lumen resume their papilliform nature and, towards the pylorus, are elevated as longitudinal lamellae with their crests thrown up into folds rather recalling the crowns of molars (text-fig. 2). There are nineteen small lamellae and nineteen large ones, though some bifurcate posteriorly. Immediately behind these comes the narrow post-pyloric lumen,



Text-Figure 3.

Daemomanta alfredi (Krefft) from Maher Island, Queensland. Entrance to large intestine, urino-genital organs, and heart.

Gilbert P. Whitley, *del.*

which Mazza calls the *Intestino medio* (*prima porzione*), and which is without any papillae, processes, villi, or lamellae whatever, and this leads into the bag-like large intestine. See plate xii., fig. 5 and text-figure 3.

The appearance of the entrance into the large intestine is shown in the opposite sketch (text-fig. 3). A duct has been cut through, just before the origin of the large intestine. The entrance is small and the spiral turns of the valve commence immediately, their inner edges being thrown into digitiform processes. There are forty-four turns of the spiral valve before the rectum (*dilatazione cloacale*) is reached. The outermost wall of the large intestine is white and tough like gristle, but the pinkish walls of the spiral valve are soft and increase in height backward until some of them are over three inches high. The digitiform processes at the commencement of the spiral valve become more spaced and lobe-like further back, the most posterior being reddish. Some parts of the spiral valve are encrusted with white matter as if food had solidified over slightly inflamed areas. No internal parasites were observed.

Food.—The stomach contained only a dirty reddish-yellow fluid, and the contents of the spiral valve of the intestine were a syrupy dirty yellow liquid. In this are remains of minute crustacea, probably copepoda.

Parasites.—Some Cymothoid crustacea, the Praniza-larvae of *Gnathia* sp., were found in the branchial cavities, but otherwise there were no parasites on the body, in the alimentary canal or on gills. Neither was the Devil Ray attended by Pilot or Sucker Fishes.

Internal anatomy.—The heart was a large purplish-red organ, 7¼ by 5½ inches, lying just before the pectoral arch. There were some blackish marks near the dorsum, where the specimen might have been harpooned or otherwise injured previously.

Some partially formed ova, about 10 to 12 mm. in diameter, in the Graafian follicles. Near the rectum was a bag-like structure with very muscular walls and a dendritic formation interiorly. No embryos could be found. Both uteri are functional and above them are the many-lobed kidneys. The uterine villi were dull reddish and the shell-gland pale yellow. At the neck of the uterus is a constricted area with transverse muscles, followed by a longitudinally plicate lumen leading to the vagina. A rounded urinary papilla (text-figure 3).

The skull and brain are unfortunately damaged by the harpoon, but the top of the skull is 1¼ inches thick and the cranial cavity is approximately 5 inches wide, with extensive prolongations to the nostrils, and tapering at its posterior end. The nostril flaps are broad. There is a broad *velum maxillare* in the mouth. This organ, which has recently been treated with by Gudger (Journal of Morphology, lvii., 1935, 91 and figs.) is apparently the *Gaumensegel* of Müller and Henle (Ber. Verh. K. Pr. Akad. Wiss., Berlin, 1837, 111), the *Soupape* of Bosc (Nouv. Dict. Hist. Nat., xix., 1803, 170), and the velum, maxillary breathing valve, frenum, or buccal flap of English authors. This structure is common to many elasmobranchs and fishes, and is strikingly shown in Greene's figure of the Toadfish *Porichthys* reproduced by Jacobs (Natur und Volk, lxv., 1935, 161 and fig.).

The minute food of the Devil Ray is apparently swallowed whole, regurgitation and straining through the gills being prevented by the velum maxillare and the loofah-like prebranchial apparatus.

Native name, in the language of the Whitsunday Passage aborigines, *Mungoona*.

Described and figured from a specimen, 11 feet 8 inches across the

pectoral fins, from Maher Island, Cumberland Group, Queensland; July 20, 1935. Pieces of skin, tail, teeth, stomach-contents, etc., preserved in The Australian Museum, where they are registered No. IA.6550.

The following account of its capture is taken from The Australian Museum Magazine:—

"Saturday, July 20, 1935, was a fine, sunny, winter day, with a calm, sparkling sea between Lindeman and Maher Island, our destination. Here Devil Rays were known to congregate at this time of the year until about November, and several were seen cruising in the vicinity of the inshore reefs. They swam rather slowly, apparently undulating the body, and with their mouths open and the cephalic fins ("ears", "horns", caropteres, or flippers) extended on either side; often one would break the surface, or they curled one or both tips of the wing-like pectoral fins right out of the water. At other times they swam well below the surface or perhaps even sank to the bottom (especially when we wanted to get near them). The launch anchored, I embarked in a small dinghy with Messrs. Melbourne Ward, Loch Nicolson, and Dick Lahou, a Torres Strait islander. After a while, a fine Devil Ray was seen approaching the bows of the dinghy, where Dick stood with harpoon poised and rope coiled ready; he also had a knife within reach to cut us loose in case of danger. Soon we were nearly on top of the monster and, with a powerful plunge, Dick rammed the barb into the creature's skull. To our surprise, the victim did not run away with the boat, as we had expected, neither did it flap or struggle; it simply subsided in the water and died. Dick was greatly excited; he had speared many turtles and dugong, but this was his first Devil Ray. "I kill him. I bin *kill* him", he yelled, and then we set to work to prevent the prize from sinking. Its head was pulled to the surface, when it was found that the steel harpoon had bent under the great weight; a rope was passed through a hole cut in one cephalic fin, and the trophy borne in triumph to a beach nearby. Blood crimsoned the water for many yards around, and we tugged the ray ashore as quickly as possible for fear of sharks. After taking photographs, I removed the stomach and intestines as I was anxious to ascertain the food of such a monster (it was over 11½ feet wide). Only a little syrupy pulp was found in the alimentary canal, however, and this contained the remains of minute crustacea. So, like some whales, the giant Devil Ray must feed on the smallest floating creatures, the plankton.

The launch towed the ray back to Lindeman Island, where I was able to measure and sketch, photograph and dissect the specimen confirming in all detail its identification as a Prince Alfred's Ray. The specimen was so heavy that it was necessary to wait for the tide to help lift it at high water. No sharks were seen anywhere in the vicinity of the dead ray, but sea-eagles and gulls kept a watchful eye on my activities. I threw some scraps to them, and those eagles were as attracted to pieces of liver as if they had been torn from Prometheus himself."

After the capture of the Maher Island Devil Ray, I occasionally saw others. On an August afternoon, in a mainland bay near Saddleback Island, I noticed a large black fin rise from the water near a submerged coral reef, to be followed immediately by a white fin. At first, I took them to be those of the black and white "porpoises" of the Bowen district, but saw through the ship's telescope that they were joined by a large black body. A better view showed that the fins were the tips of a Devil Ray's pectorals, and I watched the animal systematically cruising along the reef, and sketched it off the western shore of the bay. . . . It would not venture

over the reef into the shallows over the sand flats. . . . Presently another ray joined it and they cruised in company, one behind the other, then, in less than one hour, both had gone out to sea.

Another specimen seen in Gloucester Passage, a few miles away from the above locality.

Now that game fishermen are paying more attention to our tropical waters, it is probable that more specimens of these giant rays may be caught. We have certainly much to learn concerning them. The male has yet to be described; an embryo specimen is much to be desired; and the structure of the brain and nervous system would repay study. These rays are apparently harmless creatures, though they sometimes fall foul of ropes or anchor-chains, but it is extremely doubtful whether they would attack man, notwithstanding the fearsome reports of ancient writers. I would, however, plead that they be not senselessly slaughtered, for they are unique animals and probably breed slowly. They are apparently the product of a very ancient line of evolution, as, although they outwardly resemble Eagle Rays and other stingrays, but for the "horns", the terminal mouth, and other characters modified in accordance with their mode of existence, they are really not very closely related to those commoner creatures, as their skeletons and internal structure show. Once reduced in numbers by unsportsmanlike anglers, these curious animals might well become extinct, instead of continuing to enjoy themselves harmlessly and afford amusement to sightseers in the future.

History of the Australian Devil Ray or Prince Alfred's Ray.—In view of the fact that local workers have confused the type-locality and other details concerning the Australian species, *Daemomanta alfredi,* it seems worth while to recapitulate the history of the species from the year 1868, when it was first discovered.

Here is the first notice of the Australian Devil Ray, taken from the "Sydney Morning Herald" of Tuesday, 31 March, 1868, page 4, column 2:—

Curious Fish.—On Sunday morning, at 11 o'clock, a curious fish was caught near the old pier at Watson's Bay, being harpooned by a man named Wallace. It measures 14 feet 6 inches across, 20 inches through the thickest part. It very much resembles a tortoise, only on the back portion of the body it has two tails, one running out flat, and the other like a whip through. Its mouth measures 2 feet 6 inches from side to side, and when open it is about 9 inches all along. The liver weighs about one hundredweight, and when boiled it is expected it will yield about seven gallons of oil. There are two large flappers on each side of the mouth by which it forces its food in, and there are ten strainers on the belly, five on each side. We understand the name of this strange-looking animal is the devilfish.

On searching through newspaper files in the Mitchell Library, Sydney, I found, in the "Illustrated Sydney News" of July 11, 1868, p. 3, and fig., the first picture of the Devil Ray, which was reproduced, by courtesy of the Librarian, in The Australian Museum Magazine, with the following description, anonymous, but evidently by Gerard Krefft, then Curator of The Australian Museum:—

DERATOPTERA ALFREDI (Prince Alfred's Ray).

It was a "royal fish" indeed those bold fellows battled with not long ago at Watson's Bay, and the "fool at one end and the worm at the other" could never have caught such a monster. Downright hard work, harpooning and hauling, secured the prize, which fetched a considerable number

of sixpences from the curious, and a five pound note from the Museum Trustees, who did well to secure this fine specimen. Few persons know the labour of successfully preserving so large a fish, and they will perhaps scarcely credit it, that it took Mr. Tost, the able taxidermist, fully three weeks to finish it. It is now exhibited (free of charge, of course) in the Museum, College Street. The fish is some fourteen feet broad, and, including the tail, about eight long. He, or rather she (it is a female), has gills like a shark, and a curious pair of head-fins on each side, which are used for the purpose of feeding; in fact, the fishermen state that the fish shovels the prawns and other cray-fish down its capacious throat with these fins, which look exactly like a pair of gigantic ears. The mouth is very large, and, without exaggeration, reaches from "ear to ear". The teeth are very small, so diminutive that they can only be detected by close examination. Coloration—bluish above, white, with some darker markings, below. The Sea Devil is quite a harmless kind of fish, though of great strength, and wonderful tales are current of the pranks this playful giant frequently plays. De Kay, in his natural history of New York, mentions that one of them had hold of the cable of a good-sized schooner, and towed it forwards and backwards through the harbour for some time. The present specimen is the largest fish of this kind which has ever been preserved, and it is well worth a visit to the Museum to inspect it. The specific name of Alfredi was given to it, with the permission, and in honour of, His Royal Highness the Duke of Edinburgh, who accepted a number of photographs taken shortly after the fish was caught. The photographs are by Mr. Henry Barnes of the Museum.

Hill, in a series of articles on fish and fishing in New South Wales, wrote as follows regarding our species ("Sydney Mail", May 27, 1871, 394):—

"The devil-fish (as it is called) is of the family *Myliobatidae*, and of the genus *Ceratoptera Alfredi*. The disc is very broad, in consequence of the great development of the pectoral fins, which, however, leave the sides of the head free, and at the sides of the mouth is a pair of detached fins. This fish was caught in the vicinity of Watson's Bay, some months ago, and is now deposited in the Sydney Museum, and which affords a fine specimen of the family *Raia*—measuring across the wings or fins not less than fifteen feet, and must have weighed something more than even the famous ones recorded by Cook."

Hill says the specimen was caught "some months ago", but so far I can trace it it was about three years before, but perhaps publication of his manuscript may have been delayed. The rays caught by Captain Cook's men were Dasyatidae rather than Devil Rays.

All the preceding accounts refer to Krefft's type, which is still in the Museum, the width of which has been variously given as 11 feet, 12 feet 9 inches, 13½ feet and 15 feet! The type-locality is now established as Watson's Bay, at the entrance of Sydney Harbour, not Manly, as stated by Macleay, and the year of capture was 1868, not about 1870, as suggested by Hill, nor 1874 as stated by Tenison-Woods.

I have been unable to find any mention of Devil Rays in the old Annual Reports of the Australian Museum, in the Illustrated Sydney News prior to June, 1868, in books and cuttings relating to Prince Alfred's visit to Australia in the "Galatea" in 1868, nor in the eight volumes of Krefft's MSS. and papers in the Mitchell Library, Sydney.

A small example, 4½ feet wide (Austr. Mus., regd. No. I.1732, but now

missing), was recorded from Middle Harbour, near Sydney, by Ogilby, in 1886, and the late E. P. Ramsay made sketches of a local specimen, perhaps this very one, whilst photos of it are bound in Austr. Mus. photo. album Fishes, p. 69. The species is apparently rare in New South Wales, no further specimen having been noticed until 1923, when Mr. G. E. Tanner, of the Amateur Fishermen's Association, caught one off Cape Hawke. This was figured in The Australian Museum Magazine, iv., 1931, 284, fig., and in the paper wherein *Daemomanta* was first named. The specimen was not, however, preserved. Mr. Henry Grant, Chief Taxidermist of The Australian Museum, informs me that he saw a Devil Ray caught at Shellharbour some years ago; this is the southernmost record.

Evidently, it is a tropical species, which only occasionally drifts so far south. McCulloch, in the *Illustrated Australian Encyclopaedia*, wrote that these fish are not uncommon on the coast of Queensland (he had seen some near the reefs off Cairns some years previously), and T. C. Marshall, in the *Queensland Naturalist*, 1932, noted a Sea Devil, 13 feet wide, which had been stranded at Cowan Cowan, Moreton Bay. These were all the Queensland records known to me until reports came from tourists accompanying the Embury Bros. parties to North Queensland that Devil Rays could be caught at Hayman Island, and pictures of the monsters appeared in the press* and in angling papers. I implored game fishermen to try to secure measurements, teeth, relics of any kind, but was generally informed that the rays sank to the bottom when killed, and were usually too heavy to remove from the water, even to photograph. Finally, in 1935, the specimen described above was secured and the first published record, in any detail, of a Devil Ray from Queensland was published in The Australian Museum Magazine. There are, it is true, Horned Rays or Diamondfish figured in Saville-Kent's book on *The Great Barrier Reef*, but they belong to a very different smaller species, *Mobula diabolus* (Shaw), which has the mouth situated well below the head, not at the end of it as in the giant Devil Ray, and this kind is dealt with later on in the present thesis.

Having dealt with the Australian Devil Ray in, I hope, sufficient detail to enable the next person who catches one to make further notes for comparison, I propose to list, briefly, the synonymy of the remaining nominal species of Devil Rays in the world.

Genus MANTA Bancroft, 1829.

Manta Bancroft, Zool. Journ. (Vigors), iv., May, 1829, 454. Haplotype, *Manta americana* Bancroft = *M. birostris* of authors. Not *Mantis* Linné, Syst. Nat., ed. 12, 1767, 689, a genus of orthopterous insects, derived from *mantis*, a soothsayer, whereas Bancroft's name is from *manta*, a blanket.

Ceratoptera Müller and Henle, Ber. Verh. K. pr. Akad. Wiss., 1837, 118 (here based solely on Lesueur's *"Cephaloptera"*) and Plagiost., iii., 1841, 186. Haplotype, *Ceratoptera lesueurii* Swainson = *Manta birostris*, as here restricted.

Brachioptilon Newman, Zoologist, vii., 1849, 2358. Haplotype, *B. hamiltoni* Newman.

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*In the Sydney Morning Herald, September 29, 1932, is a fine photograph of a Devil Ray with the caption "Weighing 800 lb., this huge Devil Ray was harpooned recently by the advance party of the ninth Embury Scientific Expedition, domiciled on Hayman Island, Whitsunday Passage, Queensland". See also the Daily Telegraph (Sydney), September 11, 1934, for a fine photo. of another Hayman Island specimen.

Diabolichthys Holmes, Proc. Elliott Soc. Nat. Hist., i., 1856, 39. Orthotype, *D. elliotti* Holmes—*fide* Jordan, Gen. Fish., ii., 1919, 270.

The genus *Manta* is here used to include a number of species which may prove, with better acquaintance, to be divisible into more than one genus. The Australian form is not congeneric with the typical *Manta birostris,* and the Red Sea *Manta ehrenbergii* may be another species of *Daemomanta.* It is possible that some new generic names may yet have to be proposed for some of the species.

MANTA BIROSTRIS (Donndorff).

"Divel-Fish" Catesby, Nat. Hist. Carolina, 1731, 32, Carolina. Not seen.

"Raja birostris, etc.", Walbaum, Artedi Ichth. (3), ed. 2, 1792, 535. Non-binomial. Type-locality, Carolina, selected by Fowler, Mem. Bish. Mus., x., 1928.

Raja birostris Donndorff, Zool. Beytr., iii., 1798, 876. [Carolina.]

"Raje-Diable" Gallus, Tableau de Cayenne où de la Guiane française, Paris, 1799, 132. Not seen.

Raia fimbriata Lacépède, Hist. Nat. Poiss., iv., 1802, 671 and 677, pl. xvi., fig. 3. North Atlantic Ocean.

Cephalopterus vampyrus Mitchill, Ann. Lyc. Nat. Hist. N. York, i., 1824, 23, pl. ii., fig. 1. Delaware Bay, U.S.A. Perhaps published in 1823.

Cephaloptera giorna Le Sueur, Journ. Acad. Nat. Sci. Philad., iv., 1824, 115, pl. vi. Delaware. Not *Raia giorna* Lacépède.

Raia cornuta Le Sueur, Journ. Acad. Nat. Sci. Philad., iv., 1824, 120. Azore Islands, etc. Published November, 1824, thus later than Mitchill.

Cephalopterus manta Bancroft, Zool. Journ., iv., 1829, 453. Jamaica. *Id.* Bancroft, Proc. Comm. Sci. Zool. Soc., 1830, 134.

Manta americana Bancroft, Zool. Journ., iv., 1829, 454. Jamaica.

Cephalopterus giorna Hunter, Cat. Roy. Coll. Surg., ii., 1834, 38 and 84, *et ibid,* iii., 1836, 148, *et ibid,* iv., 1838, 51. Not *Raia giorna* Lacépède.

Ceratoptera lesueurii Swainson, Nat. Hist. Classif. Fish. Amphib. Rept., ii., July, 1839, 320, fig. 100. *Ex* Le Sueur, 1824. Delaware.

Cephaloptera diabolus Valenciennes, Règne Anim. (Cuvier), Disciples' edition, 1839, pl. cxix. *Ex* Mitchill. America.

Ceratoptera johnii Müller and Henle, Plagiost. (3), 1841, 186, pl. lix. Jamaica.

Cephaloptera vampirus Dekay, Faun. N. York, 1842, Pisces, 377, pl. lxvii., fig. 219.

? *Brachioptilon hamiltoni* Newman, Zoologist, vii., 1849, 2358. West coast of Mexico; *vide infra.*

Diabolichthys elliotti Holmes, Proc. Elliott Soc. Nat. Hist., i., 1856, 39. Charleston, South Carolina, U.S.A.

Ceratoptera vampirus Duméril, Hist. Nat. Poiss., i., 2, Elasm., 1865, 660.

Ceratoptera vampyrus Gunther, Cat. Fish. Brit. Mus., viii., 1870, 498.

Manta birostris Jordan and Gilbert, Bull. U.S. Nat. Mus., iii., 16; Smithson. Misc. Coll., xxiv., 1882, 52; and of most modern authors.

? *Manta raya* Baer, Bull. Mus. Hist. Nat. Paris, v., 1899, 112. Zorritos, Peru.

Manta brevirostra Holder, Big Game at Sea, 1908, 17, figs. 1-4. *Ex* "Outing" Magazine, 1900. Florida reef. *Errore pro M. birostris.*

Manta vampyrus Gill, Smithson. Misc. Coll., lii., 2, 1908, 155-180. "The Story of the Devil Fish"—an excellent resumé.

Manta birostris Garman, Mem. Mus. Comp. Zool. Harvard, xxxvi., 1913, 454. *Id.* Hubbs, Copeia, 37, 1916, 87 (Los Angeles county ?). *Id.* Coles, Amer. Mus. Journ., xvi., 4, 1916, 217, figs. (Florida—capture and casting

of large specimen). *Id.* Gudger, Science, lv., 1922, 338 (Block I—most northerly rec. in U.S.A.). *Id.* Townsend Bull. N.Y. Zool., Soc., xxii., 6, 1919, 140, fig. (Bahamas—22 feet wide). *Id.* Walford, Calif. Fish and Game, xvii., 4, 1931, 404, fig. (San Pedro, Cal.).

The American Devil Fish, usually called *Manta birostris,* following Jordan and Gilbert, is the one most figured in natural history books and encyclopaedias. The specific name should be credited to Donndorff, since Walbaum's original account is non-binomial:—

"Raja, birostris, rostro bifido; corpore cruciformi pinnis pectoralibus praelongis, attenuatis, W.

Diabolus marinus Willugby App., p. 5, tab. 9, fig. 3.

Cutis versus caput fuscis lituris pingitur. Longitudino 7 pedum et ultra.

The Divel-Ray. Pennant arct. Zool., suppl. 104.

The Divel-Fish. Catesby, App., xxxii."

Donndorff's account is similar to Walbaum's but binomial.

Garman's next synonym is *Raia manatia,* but Lacépède distinctly mentioned the inferior mouth in his description, so that this is a *Mobula,* not a *Manta,* and will be considered later, under the family *Mobulidae.*

The *Raja banksiana* of Lacépède is evidently a Devil Ray of the *Manta* kind from the East (or West ?) Indies, and has the advantage of a proper binomial name. However, I propose to employ Lacépède's name for the East Indian representative of *Manta birostris.* Perhaps the eastern American Devil Ray might be better known as *Manta fimbriata* (Lacépède), Walbaum's description being mainly based on the "Indies" specimen.

Dean's *Bibliography of Fishes* gives numerous references to Devil Rays, and I have consulted every one of these which is available in Sydney, but there are many papers not accessible to me.

Raia cornuta Le Sueur, 1824, and *Manta raya* Baer, 1899, appear to be hitherto unrecorded synonyms of *Manta birostris,* auct.

MANTA HAMILTONI (Newman).

Brachioptilon hamiltoni Newman, Zoologist, vii., 1849, 74. Gulf of California, west coast of Mexico.

Manta hamiltoni Beebe, The Arcturus Adventure, 1926, 123, 134, 206 and 304, 415, figs. 30 and 35. Galapagos; 18 ft. specimen, weighed 2,310 lb.

Manta sp., Pinchot, To the South Seas, 1930, 66 (only). Cocos Island, between Galapagos and Central America.

Manta hamiltoni Jordan, Evermann, and Clark, Rept. U.S. Comm. Fish., 1928, ii. (1930), 32.

This species is regarded as the Pacific American form of *Manta birostris,* whose range is given as from "San Diego; Gulf of California to Panama" and Pinchot's Cocos Is. *Manta* is probably conspecific.

MANTA ? BANKSIANA (Lacépède).

Raja banksiana Lacépède, Hist. Nat. Poiss., ii., 1800, 105, pl. v., fig. 3. East Indies (Fabroni). Based on the Sea Devil of Nieuhoff, Gedenkwaerdige Zee en Lantreize, 1682, 275 and fig. *Id.* Shaw, Gen. Zool., v., 2, 1804, 292, pl. cxlv. East Indies (drawing sent to Banks) and Barbadoes. Modified figure after Nieuhoff, Willughby, and Lacépède.

Dicerobatus banksianus Blainville, Bull. Sci. Soc. Philom. Paris, August, 1816, 121. *Ex* Lacépède—*teste* Sherborn.

Cephalopterus banksianus Cloquet, Dict. Sci. Nat., vii., 1817, 409.

Dicerobatis eregoodoo Wood-Jones, Coral and Atolls, 1910, 321, 323 and 347, fig. 74. Cocos-Keeling Atoll. Not *D. eregoodoo* Cantor, 1850.

The large Devil Ray of the East Indies has not yet been satisfactorily described, although recorded from there for many years. The earliest illustration I have seen is that of Johan Nieuhoff's Gedenkwaerdige Zee en Lantreize, 1682, wherein a specimen, evidently from the East rather than the West Indies, is described as follows:—

"Zee-duivel. Wel te recht wort dit Slagh van visschen een *zeeduivel,* van wegen zijne ijsselijke en vervarelijke gedaente, by d'onzen genoemt. D'oogen staen aen d'eene zyde, en de bek in de holligheit, voor by de kop. Sy hebben een roggen steert, en aen ieder zyde twee lange lellen, die allengs spits toe-loopen. De huit is voor aen de kop vol bruine stipjes, en het lijf op zommige plaetsen doorkerft. Eenigen zijn heel groot, en wel zeven of acht voeten lang. Het is mede een geslaght van roggen; maer sterk en gros van visch, en zwaer om te verteeren."

Nieuhoff's figure was copied by later authors, sometimes with tendrils issuing from the cephalic fins to catch fish. Perhaps the early artists confused the "Zeeduivel" with the Squid, also known as Devil Fish, an animal which has two extra long arms for catching its prey.

Wood-Jones, speaking of the fishes of Cocos-Keeling, remarks:—

"The largest of all the atoll fish is the *Ikạn pareh,* or "devil-fish" (*Dicerobatis eregoodoo*), and it is to a certain extent a useful fish, for a quantity of oil can be prepared from its liver, and its skin makes excellent sand-paper. The Pareh is the royal game of the islands, and the spearing of one which measured 13 feet across was the most exciting fishing expedition that I have been privileged to take part in. The Pareh is a curious fish, which comes to the lagoon only at certain times of the year, and generally on a rising evening tide. At such times I have seen as many as twenty in the sail between Pulu Tikus and Pulu Selma; but for long periods not one will be seen anywhere in the neighbourhood of these islands."

Wood-Jones' illustration shows a Devil Ray with terminal mouth, a species of *Manta,* possibly *banksiana,* and not an "Eregoodoo". He states (loc. cit. 321) that the body of the speared Devil Fish was attacked by sharks.

Mr. F. H. Davies writes from Nauru Island, Central Pacific (*in. lit.* 18 November, 1935; Austr. Mus. file, 537/35), as follows:—

"Recently I came across the carcase of a *Manta birostris* or more commonly known as the Devil Fish or Sea Devil, washed up on the reef on this island. It measured 8 feet 6 inches from tip to tip of the pectoral fins. For curiosity's sake I cut it open, and I discovered a distinct uterus containing a fully developed young, which I preserved as a proof of my statement as the majority of the people of this island flout the idea that the Devil Fish is a mammal."

I have not yet seen Mr. Davies' specimen, but it may be a *Manta banksiana,* so too may be the Devil Ray from the Solomon Islands mentioned in Waterhouse's Roviana and English Dictionary.

MANTA ORISSA (Lloyd).

Ceratoptera orissa Lloyd, Rec. Ind. Mus., ii., 2, July, 1908, 176, pl. v., figs. 1-3; pl. x., figs. 1 and 2 (skull), and text-figure 1. Puri, Orissa coast, India. *Id.* Annandale, Mem. Ind. Mus., ii., 1909, 4.

A Bay of Bengal species, sometimes united by authors with *ehrenbergii* from the Red Sea. Lloyd's specimen was very incomplete, but he gave some important anatomical details and demonstrated the ordinal distinction between the Devil Rays and Eagle Rays (*Myliobatidae*) which had been regarded as related families.

MANTA PINCHOTI, sp. nov.

Manta birostris Fowler, Proc. U.S. Nat. Mus., lxxx., 6, 1932, 2. Marquesas Islands. Not *"Manta birostris* Walbaum". Part referring to the Marquesas "Sea Bat" of Pinchot, To the South Seas, 1930, 405, et seq., and 480, plate opp. p. 410 and figs. on 417-419, also coloured cover.

A White-shouldered Devil Ray, distinguished by its conspicuous markings, as figured by Pinchot. These shoulder marks do not, however, unite to form a chevron.

Total length, including cephalic fin and tail, fourteen feet, two inches. Breadth of disc, eighteen feet, five inches.

Locality.—Near Hat Island (Teuaua), Ua Huka, Marquesas Islands (Pinchot). The Marquesan vernacular for this species was *Ipuohotea,* but their *Toake* is probably also this species.

Fowler (*loc. cit.,* 1932) mentions, from Pinchot's expedition, the "Jaws of a large example as a dry preparation, without exact data. Upper edentulous jaw 920 mm. wide. Lower jaw 1,200 mm. wide, dentary area 610 mm. as measured over surface. Teeth estimated in 416 transverse rows, in which there are 7 to 10 short truncate or obtuse small teeth, the crown of each from nearly level to convex".

It is a pity that the locality was not noted, as the large number of teeth in the lower jaw is noteworthy. Possibly (deducing from Pinchot's writings), this was a large Marquesan example, and it may not be a true *Manta,* but rather a new genus. In the absence of better evidence, however, I only tentatively regard this description as applying to *Manta pinchoti.*

The new species is named in honour of Governor Gifford Pinchot, author of "To the South Seas", and collector of several very interesting Pacific Devil Rays.

MANTA FOWLERI, sp. nov.

Manta birostris Fowler, Bull. Bernice P. Bishop Mus., xxxviii., 1927, 3, pl. i., figs. D-G. Fanning Island, Oceania. Not *"Manta birostris",* etc., Walbaum, 1792, from Carolina.

Fowler's figures are quite unlike any other Devil Ray known to me, and I have much pleasure in associating his name with what is evidently a new species. The chevron-marks on the back rather recall those of certain Eagle Rays, figured in Russell's "Fishes of Vizagapatam" and Shaw's "General Zoology".

The squat diamond shape of the body and the narrow gill-slits appear to differentiate this species further.

Fowler's description reads:—

"Disk nearly twice as wide as long; tail broken terminally so now less than disk length. Pectorals rather narrowly triangular terminally, front edge slightly convex, hind edge concave. No upper teeth; lower (in 139 rows in lower jaw) estimated about 280 in entire series lateral are about ¾ extent of lower jaw width. Body and tail rough with small tubercles; external thoracic region very rough, with enlarged, scattered, small buck-

lers, rasping to touch. Dorsal base extends slightly before front ends of pectoral bases. Ventrals small, obtuse, extend little beyond hind ends of pectorals and claspers still further. No caudal spine.

"Back blue-black, with two V-shaped ashy bands, angles forming at vertebral line and pointed backward. Eyes black. White ventrally, with bluish wash along hind edges of fins. Deep blue spots scattered on belly and lower posterior surfaces of pectorals."

Fanning Island. Width of head about 700 mm. Cephalic fin 300 mm. Fowler remarked: "The specimen . . . differs from any I can find in its coloration, possibly also a condition of youth. For the present I include all the nominal forms under *Manta birostris*".

MANTA PAKOKA, sp. nov.

Under the Polynesian vernacular name *Pakoka,* Pinchot (To the South Seas, 1930, 406, 408 and 421 and fig.) described what is apparently a new species of Devil Ray. He says:—

"This *Manta* was far swifter and more aggressive than the white-spotted one [*Manta pinchoti,* mihi—G.P.W.]. Wings black underneath. Total breadth across the back, seventeen feet six inches. Total length, fore and aft, ten feet eight inches."

Locality.—Near Hat Island (Teuaua), Ua Huka, Marquesas Islands (Pinchot Expedition).

The size of the specimen indicates that it is not the young of some described species, and the black ventral surface is a unique feature.

MANTA EHRENBERGII (Müller and Henle).

Ceratoptera ehrenbergii Müller and Henle, Plagiost (3), 1841, 187. Red Sea. And of later authors.

Cephaloptera stelligera Günther, Cat. Fish. Brit. Mus., viii., 1870, 498. *Ex* Hemprich and Ehrenberg MSS. Red Sea. *Id.* Hemprich and Ehrenberg, Symb. Phys., 1899, Zool., pl. ii.; Zoot., pl. x.—*fide* Garman.

Manta ehrenbergi Barnard, Ann. S. Afr. Mus., xxi., 1925, 87. *Id.* Anon., Rept. S. Afr. Mus., 1925 (1926), 7 and 10, fig. 2. *Id.* Barnard, Ann. S. Afr. Mus., xxi., 2, 1927, 1015. *Id.* Biden, Lonsdale Library, xvii., 1934, Sea Fishing, 268 (Durban, 24½ feet across). *Id.* Fowler, Proc. Acad. Nat. Sci. Philad., lxxxvi., 1934, 409, figs. 2-3 (Embryo has teeth in both jaws. Natal).

Müller and Henle named this species after one of the authors of the "Symbolae Physicae", of which the part dealing with the Devil Ray is not available to me, but both Lloyd (1908) and Fowler (1927) comment on Hemprich and Ehrenberg's figure. The South African records quoted above are of considerable interest. See also Van Kampen's paper in Bull. Dépt. Agric. Indes-Neerl., xxxv., 1910, 9-13.

Subfamily INDOMANTINAE.

Genus INDOMANTA Whitley, 1936.

Indomanta Whitley, Austr. Mus. Mag., vi., 1, "January" [= February 21], 1936, 11. Haplotype, *I. tombazii* Whitley.

In The Australian Museum Magazine, I wrote . . . *"Indomanta* is a hitherto unnamed Giant Bat Ray, 22 feet wide and with teeth in upper and lower jaws. It has but recently been described from off Karachi, India, by Tombazi*, after whom it may be named *Indomanta tombazii*".

*Tombazi, Journ. Bombay Nat. Hist. Soc., xxxvii., 1934, p. 227 and pl.

Indomanta tombazii Whitley.

Dicerobatis eregoodoo Tombazi, Journ. Bombay Nat. Hist. Soc., xxxvii., 1934, 227 and pl. Cape Mouze, 20 miles from Karachi, India. Not *D. eregoodoo* Cantor, 1850.

Indomanta tombazii Whitley, Austr. Mus. Mag., vi., i., 1936, 11. New name for Tombazi's species.

A Giant Indian Bat Ray, 22 feet wide and 17 feet from head, excluding cephalic fins, to tip of tail. Teeth in both jaws.

Tombazi states:—"Teeth small, file-like, extending practically the full length of the mouth; I counted seven rows of these on the lower jaw and six on the upper."

The tail bears a spine.

Weight estimated at four or five thousand pounds.

Vernacular name: *Karanj.*

Family Mobulidae.

Smaller Devil Rays with the mouth less extensive and situated well underneath the head. Cephalic fins frequently rolled outwards. The typical species is the Mediterranean *Mobula edentula,* but the "Eregoodoo" (*M. diabolus*), from Indian Seas and extending its range to Queensland, is also well known. Many nominal species have been described from various parts of the world and are listed hereunder, but it is possible that they are not all of equal status and further revision of them is desirable.

Two subfamilies:—

Teeth on both jaws—*Mobulinae.*

Teeth on upper jaw only—*Ceratobatinae.*

Subfamily Mobulinae.

Genus Mobula Rafinesque*, 1810.

Mobula Rafinesque, Ind. Ittiol. Sicil., May, 1810, 48 & 61. Haplotype, *M. auriculata* Rafinesque—*fide* Sherborn, Index Anim.

Apterurus Rafinesque, Ind. Ittiol. Sicil., May, 1810, 62. Type, *Apterurus fabroni* Rafinesque—*fide* Jordan, Gen. Fish.

Cephalopterus Risso, Ichth. Nice, 1810, 14. Two species: *Raia giorna* Lacépède and *Cephalopterus massena* Risso. Logotype, *Raia giorna* Lacépède, selected by Bancroft, Zool. Journ., iv., 1829, 452.

Name preoccupied by *Cephalopterus* Geoffroy, Ann. Mus. Hist. Nat., Paris, xiii., March, 1809, 238, a genus of birds.

Dicerobatus Blainville, Bull. Sci. Soc. Philom., Paris, July, 1816, 120; Journ. de Physique, 1816, 262—*fide* Sherborn. Type, *Raia mobular* Bonnaterre.

Cephaloptera Cuvier, Regne Anim., ed. 1, ii., "1817" = December, 1816, 138. Attributed to Duméril, but actually feminine of Risso's genus. Tautotype, *Raia cephaloptera* Bloch and Schneider. *Id.* Fleming, Phil. Zool., ii., 1822, 378 (*fide* Sherborn) and of Gunther, Muller and Henle, Rüppell, etc.

Dicerobatis Blainville, Faun. Française (Poissons), April, 1825, 40—*fide* Sherborn. Bancroft selected *Raia fimbriata* Lac. [= *Manta*] as type.

Apturus Cuvier and Valenciennes, Hist. Nat. Poiss., i., 1828, 215. Equivalent to *Apterurus ibid.,* 195, *ex* Rafinesque.

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*As early as 1803 Bosc (Nouv. Dict. Hist. Nat., ed. 1, xix., 1803, 178) wrote " . . . espèces si monstreuses sont dans le cas peut-être de former un genre particulier".

Pterocephala Swainson, Nat. Hist. Fish. Amphib. Rept., ii., July, 1839, 192 and 321. Haplotype, *Raia giorna* Lacépède.

Diarobatus Agassiz, Nomencl. Zool., Pisces, 1845, 22. *Id.* Cantor, Journ. Asiat. Soc. Bengal, xviii., 2, 1850, 1419, and Cat. Malay Fish., 1850, 437, attributed to Bloch! Obviously an error for *Dicerobatis* Blainville.

Horned Rays, generally much smaller than *Manta,* and having the mouth below the anterior part of the head. They have been noted from the Mediterranean, particularly, since classical times.

MOBULA EDENTULA (Brunnich).

Squalus edentulus Brunnich, Ichth. Massiliensis, 1768, 6, No. 14. Marseilles, France.

Raia mobular Bonnaterre, Tabl. Encycl. Meth. (Ichth.), 1788, 5. Mediterranean.

Raja vespertilio Donndorff, Zool. Beytr., iii., 1798, 876. [Marseilles.]

Raja fabroniana Lacépède, Hist. Nat. Poiss., ii., 1800, 104, pl. v., figs. 1-2. Livourne, Mediterranean.

Raja manatia Bloch and Schneider, Syst. Ichth., 1801, 364. Based on the *"Raie manatia"* of Lacépède, Hist. Nat. Poiss., i., 1798, 160, pl. vii., fig. 2, vernac. from equatorial America, which is described as having the mouth well behind anterior end of head.

Raja cephaloptera Bloch and Schneider, Syst. Ichth., 1801, 365. Pacific, etc.

Raja giorna Lacépède, Hist. Nat. Poiss., v., 1803, 662. Nice.

Aodon cornutus Latreille, Nouv. Dict. Hist. Nat., xxiv., 1804, 72. Based on the *"Aodon cornu"* of Lacépède, Hist. Nat. Poiss., i., 1798, 297, vernac. *Id.* Daudin, Dict. Sci. Nat., ii., 1816, 265. Equivalent to *Squalus edentulus* Brunnich.

Mobula auriculata Rafinesque, Ind. itt. Sicil., 1810, 48 & 61—*fide* Sherborn, Index Anim.

Apterurus fabroni Rafinesque, Ind. itt. Sicil., 1810, 48. *Ex Raja fabroniana* Lacépède—*fide* Sherborn.

Cephalopterus massena Risso, Ichth. Nice, 1810, 15. Nice.

Only the primary specific references to synonyms are given in the above synonymy. This species has also appeared in a vast and scattered literature as, amongst other names, *Cephalopterus giorna, Dicerobatis mobular, Dicerobatis giornae, Cephaloptera fabroniana, Mobula mobular, Cephaloptera edentula,* etc. There are a number of papers on the anatomy of this species, many of them unfortunately not accessible to me.

I have already given, *supra* under *Aodon,* a copy of Brunnich's original description.

MOBULA DIABOLUS (Shaw).

Raja diabolus Shaw, Gen. Zool., v., 2, 1804, 291. Based on the "Eregoodoo-tenkee" of Russell, Fish. Vizagapatam, 1803, 5, pl. ix., Vizagapatam, India (type) and Saint Helena. *Id.* Swain, Proc. Acad. Nat. Sci. Philad.. 1882 (1883), 308.

Dicerobatis eregoodoo Cantor, Journ. Asiat. Soc. Bengal, xviii., 2, 1849 (1850), 1420; Cat. Malayan Fish., 1850, 438. Coromandel and Sea of Penang. And of later writers, *ex* Cuvier, vernac.

Cephaloptera eregoodoo Duméril, Hist. Nat. Poiss., i., 2, Elasm., 1865, 655, pl. vi., figs. 2-5 (teeth).

Ceratoptera sp. Ogilby, Cat. Fish. Austr. Mus., i., Palaeich., 1888, 23. New Hebrides.

Dicerobatis eregoodoo Saville-Kent, Great Barrier Reef, 1893, 306, pl. xlviii., figs. 2-3. Palm Islands, etc., Queensland.

Mobula tenkee Jordan and Evermann, Bull. U.S. Bur. Fish., xxiii., 1903 (July 29, 1905), 51.

Mobula eregoodoo-tenkee Garman, Mem. Mus. Comp. Zool. Harvard, xxxvi., 1913, 451. *Id.* Fowler, Copeia, 58, 1918, 62; Proc. Acad. Nat. Sci. Philad., lxxix., 1928, 256.

Mobula eregoodoo Ogilby, Mem. Q'ld. Mus., v., 1916, 90 and 95; *et ibid.*, vi., 1918, 97 (Moreton Bay, Q.). *Id.* McCulloch and Whitley, Mem. Q'ld. Mus., viii., 1925, 130. *Id.* McCulloch, Austr. Mus. Mem., v., 1929, 31.

Mobula diabolus Whitley, Austr. Mus. Mag., vi., 1, 1936, 6 and 11.

This is the Ox Ray or Smaller Devil Fish of Indian Seas, apparently extending its range to Queensland, from which State there are specimens in the Museum at Brisbane. The Australian Museum has an Indian example (No. B.3019) purchased from Dr. Francis Day. Russell's figures represent Indian and Saint Helena specimens, which may not be conspecific. Certainly the Saint Helena specimen differs from Saville-Kent's figure. Some of the remarks in Saville-Kent's text are doubtless referable to rays of the genera *Aëtobatis* and *Daemomanta,* rather than *Mobula.*

An immature female, four feet wide, mounted in the gallery of the Australian Museum, as *Aodon* sp. and without data may be the example catalogued by Ogilby in 1888. (In that case, it is No. I.1730 and came from the New Hebrides, having been purchased from Captain Braithwaite.)

However, it is now numbered I.5311, registered in May, 1902, as having no data. Mr. T. C. Roughley has photographed a Hayman Id. (Queensland) specimen.

MOBULA DRACO (Günther).

Dicerobatis draco Günther, Jottings Cruise Curaçoa (Brenchley), 1873, 412, pls. 26-27. Misol.

Mobula draco Van Kampen, Bull. Dépt. Agri. Indes-Néerl., xxxv., 1910, 9.

Well described and figured by Günther from Misol.

MOBULA MONSTRUM (Klunzinger).

Dicerobatis monstrum Klunzinger, Verh. Zool.-Bot. Ges. Wien., xxi., 1871; Syn. Fische Roth. Meeres, ii., 1871, 687. Red Sea.

An undoubted *Mobula,* described from a foetus, 54 cm. across the disc.

MOBULA KUHLII (Müller and Henle).

Cephaloptera kuhlii Müller and Henle, Plagiost. (3), 1841, 185, pl. 59, fig. 1. Indian Seas. Name *ex* Valenciennes MS.

Cephaloptera kuhlii Duméril, Hist. Nat. Poiss., i., 2, Elasm, 1865, 654, *et seq.*, pl. vi., figs. 9-9a (teeth). Notes on type.

Ceratoptera kuhli Heeckeren Tot Waliën, Nat. Tijdschr. Ned. Ind. (9), v. or lvi., 1897, 30, pl. East Indies. *Id.* Vorderman, *ibid.*, 40-43.

Mobula kuhli Barnard, Ann. S. Afr. Mus., xxi., 1925, 86, pl. v., fig. 2. Original figure of S. African specimen which has shorter tail, smaller horns, etc., than those in Müller and Henle's figure.

Mobula kuhlii Garman, Mem. Mus. Comp. Zool. Harvard, xxxvi., 1913, 452.

A nominal species from the East Indies, most likely a synonym of *M. diabolus,* only the original figure has a longer tail. Müller and Henle wrongly thought that the "Eregoodoo-tenkee" might have been the Brazilian *olfersii* = *hypostoma* and described *kuhlii* as a distinct species. Duméril remarks upon the type of *kuhlii* and regards the teeth as different from the "Eregoodoo-tenkee".

MOBULA HYPOSTOMA (Bancroft).

Cephalopterus hypostomus Bancroft, Proc. Comm. Zool. Soc., 1830, 134. Jamaica. *Id.* Bancroft, Zool. Journ., v., 1834, 411.

Cephaloptera olfersii Müller, Abh. Akad. Wiss. Berlin, 1834 (1836), 311. Brazil—skull dsecribed.

? *Cephaloptera massenoidea* Hill, Intell. Observer, ii., 1862, 176, 3 figs. Jamaica.

Mobula hypostoma Garman, Mem. Mus. Comp. Zool. Harvard, xxxvi., 1913, 453, pl. xxxviii., figs. 1-6 (refs.) and anatomical figs. New York to Brazil.

Garman's beautiful figures were probably made from New York specimens, and for the Brazilian form, if distinct, the name *olfersii* is available, and has been employed as such by Coles (Copeia, 32, 1916, 45). An important paper on its dentition has been contributed by Gudger (Journ. Elisha Mitchell Sci. Soc., xlix., 1933, 92, pl. ii., figs. 1-4), who also recorded Coles' field notes in an earlier volume of the same Journal, February, 1913, 5. Pellegrin's paper (Bull. Soc. Philom. Paris (10), iv., 1912, 1-8) "Sur le dentition des Diables de Mer" is not available to me.

MOBULA ROCHEBRUNI (Vaillant).

Cephaloptera rochebruni Vaillant, Bull. Soc. Philom. (7), iii., 1879, 187. Senegal. *Fide* Zool. Rec. *Id.* Rochebrune, Act. Soc. Linn. Bordeaux, vi., 1882, 1, pl. i., figs. 1-2.

The literature dealing with this species is unfortunately not available to me. Garman describes it as "Deep blue, with reddish on the frontal region, in a longitudinal band behind the head along the middle of the back, and on dorsal, ventrals, and tail. Rows of teeth, 50, occupying about half the width of the jaws.

Senegal.

MOBULA TARAPACANA (Philippi).

Cephaloptera tarapacana Philippi, Ann. Mus. Nac. Chile, i., 3, 1892, 8, pl. iii., fig. 2; Chilen. Fische, i., 1893, 9, pl. iii., fig. 2. Iquique, coast of Chile. *Id.* Gill, Smithson. Misc. Coll., lii., 2, 1908, 176.

A South American species which has, according to Philippi's figure, a remarkable "long-necked" appearance.

MOBULA THURSTONI (Lloyd).

Dicerobatis thurstoni Lloyd, Mem. Ind. Mus., ii., 1908, 179, pl. iv., fig. 2 and text-fig. 3. Madras, India.

Teeth separate, in 140 series, with upstanding cusps, unlike the low-lying ones of *diabolus,* extending nearly to the angle of the mouth. In lower jaw could not be counted, but apparently as numerous. Tail smooth, less in length than the disc, and without a spine. Proportions generally like *diabolus*, but cephalic fins relatively shorter. . . .

Based on a dried and shrunken specimen 160 cms. wide with a 53 cm. tail.

Madras.

MOBULA JAPANICA (Müller and Henle).

Cephaloptera japanica Müller and Henle, Plagiost. (3), 1841, 185. Japan.

Cephaloptera japonica Temminck and Schlegel, Faun. Japon., Pisces, 1850, 310. *Ex* Müller and Henle.

Dicerobatis japonica Günther, Cat. Fish. Brit. Mus., viii., 1870, 496. *Ex* Müller and Henle.

Mobula japonica Jordan and Evermann, Bull. U.S. Fish. Comm., xxiii., 1903, i., July 29, 1905, 50. Honolulu market (fragments only). *Id.* Jordan and Fowler, Proc. U.S. Nat. Mus., xxvi., 1903, 666, fig. 10. Misaki (foetus), Volcano Bay and Nagasaki, Japan. *Id.* Fowler, Bull. Bern. P. Bish. Mus., xxxviii., 1927, 3, pl. i., figs. A.-C. Honolulu market. *Id.* Fowler, Mem. Bish. Mus., x., 1928, 26.

A species recorded from Japan and Hawaii. The reference to *Mobula japonica* in Anderson's "Myths and Legends of the Polynesians", 1928, 392 and 479, doubtless refers to the Spotted Eagle Ray, *Aëtobatis*.

Jordan and Fowler (1903) figured a foetus and mentioned other Japanese specimens.

Fowler (1927) gave figures of the head of a Hawaiian adult with the following notes:—

"Honolulu market, July 17, 1924, 1 specimen. The first adult to be reported. Head width 320 mm., mouth width 200 mm. Teeth bands extend to mouth angles, 84 rows above, 101 rows below. Head above, dark dusky-brown; below, creamy-white. Eye pale. Edge of lower lip and upper edge of snout neutral grey, also inner surfaces of cephalic fins."

Subfamily Ceratobatinae.

Genus Ceratobatis Boulenger, 1897.

Ceratobatis Boulenger, Ann. Mag. Nat. Hist. (6), xx., August 1, 1897, 227. Haplotype, *C. robertsii* Boulenger.

This genus is compared with *Mobula,* but has teeth restricted to the upper jaw.

Ceratobatis robertsii Boulenger.

Ceratobatis robertsii Boulenger, Ann. Mag. Nat. Hist. (6), xx., August 1, 1897, 227. Jamaica. *Id.* Gill, Science (2), xviii., 1903, 473—*fide* Zool. Rec. *Id.* Gill, Smithson. Misc. Coll., lii., 2, 1908, 176. *Id.* Garman, Mem. Mus. Comp. Zool. Harvard, xxxvi., 1913, 454.

Known only from the type. Width of disc, 780 mm. Mouth inferior, wide.

EXPLANATION OF PLATE XII.

Daemomanta alfredi (Krefft). Views of a specimen, 11 ft. 8 in. wide, from Maher Island, Cumberland Group, Queensland.

Fig. 1. Upper surface of tail showing lack of spine or bony boss.
Fig. 2. Lower surface of tail showing naked base and low fold.
Fig. 3. One of the dark spots on the belly, showing denticles of the skin.
Fig. 4. Shagreen from the dorsal surface.
Fig. 5. The alimentary canal cut open along its entire length (see also text-figures).
Fig. 6. Mouth-opening, seen from the front, the ray lying on its back.

Photos by G. C. Clutton (1-4) and M. Ward (5-6).

ICHTHYOLOGICAL GENOTYPES: SOME SUPPLEMENTARY REMARKS.

By Gilbert Whitley *

(1) *The First Edition of the Nouveau Dictionnaire.*

In my paper on "Ichthyological Genotypes" on pp. 136-139 of this volume of the "Australian Zoologist", I gave a chronological list of books in which type-designations for genera of fishes might be found. This list commenced with the *Nouveau Dictionnaire d'Histoire Naturelle* which I had been obliged to quote from the new edition of 1816-1819, remarking "1802-1804 ed. not seen". Fortunately, my colleague, Mr. Tom Iredale, has recently purchased from Europe a set of the scarce first edition of this dictionary, so I am now in a position to make known the quite important features of its ichthyological contents. The dates of publication of the livraisons have been provided by Osgood (*Proc. Biol. Soc. Washington,* xxvii., February 2, 1914, 3, from C. W. Richmond's data. See also Sherborn's *Index Animalium*), but these must be slightly modified in the light of Patrin's observations (*Nouv. Dict.,* ed. 1, xvii., 1803, 524), the revised dates being as follows:—

Livraison.	Volumes.	Published by
1	i.-iii.	3 Dec., 1802
2	iv.-vi.	4 Feb., 1803
3	vii.-ix.	14 Apr., 1803
4	x.-xii.	13 June, 1803
5	xiii.-xv.	20 July, 1803
6	xvi-xviii.	8 Nov., 1803
7	xix.-xxi	22 Dec., 1803
8	xxii.-xxiv.	7 Mar., 1804

At this early period, before the time of Cuvier and his disciples, little advance had been made on the work of Lacépède, nevertheless Louis Bosc, the author of the fish articles in this dictionary, made a few innovations, and in the twenty-fourth volume, Pierre Latreille gave a very up-to-date classification of fishes, in which several new names or latinizations of other authors' vernaculars appear. Louis Augustin Guillaume Bosc (1759-1828) was an excellent zoologist and botanist, and, as an ichthyologist, was something of a pioneer. He crossed to America, to take up consular duties at Charleston, and en route made field notes on flying fishes, dolphins, and sharks. He caught numerous fishes around Charleston and some of these were described in Lacépède's *Histoire Naturelle des Poissons,* but in this *Nouveau Dictionnaire,* Bosc described as new several species which have apparently been overlooked by American ichthyologists. Some of them were vernacularly named by Bosc and latinized by Pierre André Latreille (1762-1833), the famous entomologist. Most of these are synonyms of earlier species, as follows:—

(a) *Makaira albicans* Latreille, Nouv. Dict. d'Hist. Nat., ed. 1, xxiv., March 7, 1804, Tabl. Meth. 104. Latinization of "le Makaira blanchatre", Bosc, *ibid.,* xiii., 1803, 558. Vernac. name for a sailfish figured in Marcgrave's *Brazil,* p. 171.

This is the earliest name for an American swordfish and replaces *Histiophorus americanus* Cuvier and Valenciennes (Hist. Nat. Poiss., viii., "1831" = January, 1832, 303), likewise based on Marcgrave's figure. This species was recently added to the British fauna by Norman (Nat. Hist.

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* By permission of the Trustees of The Australian Museum.

Mag., ii., 9, 1929, 32 and figs.; Journ. Mar. Biol. Assoc. U.K. (n.s.), xvi., 1, 1929, 67-70, 2 figs.), and should now be known as ISTIOPHORUS ALBICANS (Latreille).

(b) *Squalus carolinianus* Latreille, Nouv. Dict. d'Hist. Nat., ed. 1, xxiv., 1804, Tabl. Meth. 71. New name for "Le Squale carolinien" Bosc, *ibid.*, xxi., 1803, 190, from Carolina.

This is evidently a synonym of RENICEPS TIBURO (Linné).

(c) *Pleuronectes argiolus* Bosc, Nouv. Dict. d'Hist. Nat., ed. 1, xviii., 1803, 130, pl. M. 8, fig. 9, from Carolina. *Id.* Latreille, *ibid.* xxiv., 1804, 79.

This flounder is obviously PARALICHTHYS DENTATUS (Linné), previously described from Carolina, whence it has been figured by H. M. Smith (N. Carolina Geol. and Econ. Survey, ii., 1907, 386, fig. 178).

(d) *Lophius laevis* Latreille, Nouv. Dict. d'Hist. Nat., ed. 1, xxiv., 1804, Tabl. Meth. 73. New name, credited to Bosc, for "La Lophie Unie" Bosc, *ibid.* xiii., 1803, 313, pl., found on floating weed between Europe and America.

This may be a *Histrio*, but I cannot be sure. Unfortunately, Latreille's name antedates *Lophius laevis*, a name proposed for an Australian fish by Lacépède (Ann. Mus. Hist. Nat. Paris, iv., May, 1804, 210), so the Australian species may now be called SYMPTERICHTHYS UNIPENNIS (Cuvier) instead.

(e) *Raja scabra* Latreille, Nouv. Dict. d'Hist. Nat., ed. 1, xxiv., 1804, Tabl. Meth., 72 and footnote 2. New name for *Raia tuberculata* Bonnaterre, *non* Lacépède.

This new name was unnecessary, as *Raia tuberculata* Bonnaterre (Tabl. Encycl. Meth., Ichth., 1788, 3), which is apparently the British Shagreen Ray (*Raja fullonica* Linné) has priority of publication over *Raja tuberculata* Lacépède (Hist. Nat. Poiss., ii., 1800, 104, pl. iv., fig. 1) from Cayenne. In any case, Latreille's name is preoccupied by *Raja scabra* Linné (Mus. Adolph. Frid., ii., 1764, 52) from the Mediterranean.

So much for the new species (ignoring latinizations), now for the genera. In this dictionary, Bosc selected genotypes for various classes of animals and plants. The ichthyological ones, in his own words, are as follows, my comments being added in square brackets:—

Vol. vii., 72. CYNAEDE, nom donné par Gronovius à un genre qui fait partie des *spares* de Linnaeus. Il a pour type le *spare sargue.*

[This is the first known selection of a logotype in ichthyology; the fact that it is stated in vernacular form does not, in my opinion, invalidate the selection. *Cynaedus* Gronov. = *Cynedus* Scopoli, 1777, and the genotype, according to Bosc, is *Sparus sargus* Linné, 1758.]

Vol. vii., 477. ELEOTRIS, genre de poissons établi par Gronovius, mais qui fait partie des *gobies* de Linnaeus. Il a pour type la *gobie noire.*

Vol. vii., 541. ENCHELYOPE, genre de poissons établi par Gronovius, mais qui a été confondu par Linnaeus parmi les *blennies.* Il a pour type la *blennie ovovipare.*

Vol. viii., 74. ERICHELYOPE, nom donné par Gronovius à un genre de poissons qui fait partie des *blennies* de Linnaeus. Il a pour type le *blennie vivipare.*

["Erichelyope" is evidently a misprint for "Enchelyope", or *Enchelyopus* Gronovius, 1760; genotype, *Blennius viviparus* Linné.]

Vol. ix., 569. GONORYNCHE, genre de poissons établi par Gronovius, mais fondu par Linnaeus parmi les *cyprins.* Il a pour type le *cyprin* de ce nom.

Vol. xiii., 86. LEPIDOPE, genre de poissons établi par Gouan, mais réuni

aux *trichiures* de Linnaeus. Il a pour type le *trichiure caudé.*

Vol. xv., 10. MOLENAER, nom donné par Gronovius à un genre de poissons qui fait partie des *gades* de Linnaeus. Il a pour type le *gade merlan.*

[I have been unable to trace any such generic name, the group of cods to which *Gadus merlangus* Linné belongs was later called *Merlangus* by Cuvier, but his name was apparently invalidated by *Merlangus* Rafinesque. In the second edition of the *Nouv. Dict.* (Tome, xxi., 1818, 259), Bosc briefly remarked: "MOLENAER. Genre de poissons qui fait partie des GADES de Linnaeus." In the previous tome, Bosc cited *Gadus merlangus* as type of the subgenus *Merlangus* Cuvier. Sherborn quotes a genus *Merlangius* Geoffroy, Desc. 719 Plant, etc., 1767, 401.]

Vol. xv., 323. MYSTE, genre de poissons établi par Gronovius, mais qui fait partie des *silures* de Linnaeus. Il a pour type, le *silure alasias.*

Vol. xvii., 244. PERCIDI, genre de poissons établi par Scopoli, mais réuni aux *cottes* par Pallas. Il a pour type le *cotte du Japon.*

Vol. xvii., 407. PHOLIS, nom d'un genre de poissons établi par Gronovius mais qui fait partie des *blennies* de Linnaeus. Il a pour type le *blennie gunelle.*

Vol. xviii., 555. PTERACLIDE, genre de poissons établi par Gronovius, mais confondu par Linnaeus avec les Coryphenes. Il a pour type le *coryphaena velifera.* Lacépède a rétabli ce genre sous le nom d'Oligopode.

I have searched carefully through the first edition of this dictionary, but the above are all the genotype designations I have been able to find.

(2) *Bancroft's types of Devil Rays.*

E. N. Bancroft, in the *Zoological Journal,* Vol. iv., 1829, 452, designated two genotypes for Devil Rays:—

Dicerobatus Blainville (type, *Raia fimbriata* Lacépède).

Cephalopterus Dumeril (type, *Raia giorna* Lacépède).

(3) *Jordan and Evermann, and bracketed genera.*

As mentioned in my previous paper, genotypes were often indicated, without being specifically designated as such, by being bracketed at the end of references to genera by Jordan, Evermann, and their colleagues. "This style was often followed by Waite, McCulloch, and others, and may not be strictly considered type-designation" (Austr. Zool., viii., 1935, 139). I am now pleased to be able to accept all such quotations as type-designations in view of the statement, validating them, made by Jordan and Evermann (Rept. U.S. Fish. Comm., 1895, append. v., December 28, 1896, 210): "The name in parenthesis following the reference to the generic name is that of the species taken by the describer as the type of the genus."

(4) *Type-designations by G. S. Myers.*

Dr. George S. Myers, of the Smithsonian Institution, United States National Museum, Washington, having read my earlier paper, informs me (*in lit.,* 7 November, 1935):—

"I designated some generic types in Cyprinidae and Characidae in *Amer. Mus. Novit.,* numbers 265 (page 4) and 342 (page 6). Also some Achirids in *Copeia,* No. 171, 1929."

The following references may therefore be added to, or rehabilitated in, my earlier list:—

1802-04. Bosc, *Nouv. Dict. d'Hist. Nat.,* ed. 1.

Cynaedus Gron. [= *Cynedus* Scopoli]: Type, *Sparus sargus* Linné.

Eleotris Gron. [= Meuschen]: *Gobius niger* Linné. [Invalid selection, because *Eleotris eleotris* Meuschen or *Gobius eleotris* Linné is tautotype. If *niger* were type, *Eleotris* would equal *Gobius*.]
Enchelyopus Gron.: *Blennius viviparus* Linné.
Gonorynchus Gron. [=Scopoli]: *Cyprinus gonorhynchus* Linné.
Lepidopus Gouan: *Trichiurus caudatus* Euphr.
"Molenaer", vernac. [? *Merlangius* Geoffroy]: *Gadus merlangus* Linné.
Mystus Gron.: *Silurus clarias* Linné.
Percis Scopoli: *Cottus japonicus* Pallas.
Pholis Gron.: *Blennius gunnellus* Linné.
Pteraclis Gron.: *Coryphaena velifera* Pallas.

1829. Bancroft, *Zoological Journal*, iv., 1829, 452.
Dicerobatus Blainville: Type, *Raia fimbriata* Lacépède.
Cephalopterus Dumeril: Type, *Raia giorna* Lacépède.

1854. Agassiz, *Amer. Journ. Sci. Arts* (2), xvii., 297-308 and 353-365. [Alabama fishes.]

1877. Jordan, and others. *Proc. Acad. Nat. Sci. Philadelphia.* [Freshwater fishes of North America.]

1896-1900. Jordan & Evermann, Check-List Fish. N. & Mid. America, in *Rept. U.S. Fish. Comm.*, 1895, Append. v., and the monumental *Bulletin U.S. Nat. Mus.*, xlvii.

1899 onwards. Waite, various papers. For bibliography, see Hale, *Rec. S. Austr. Mus.*, iii., 4, 1928, 345. Waite only began to mention genotypes in his "Thetis" Report of 1899.

1910 onwards. Opinions rendered by the International Commission on Zoological Nomenclature.

[The Opinions have been published by the Smithsonian Institution and summarized or quoted from time to time in other journals (*Proc. Biol. Soc. Washington*, xxxix., 1926; *Nature; Zoologischer Anzeiger;* etc.) and should be studied for methods and practises of type-designation. Types of fish genera are mentioned in opinions 14, 16, 19, 20, 21, 22, 23, 26, 33, 42, 44, 45, 47, 54, 58, 68, 69, 75, 77, 92, and 93, some of which may need revision in the light of fresh data. Opinions 94 to 123 (January, 1931), the last available to me, do not concern fishes.]

1921. McCulloch. Check-List of the Fishes and Fish-like Animals of New South Wales. *Austr. Zool. Handbook*, i., ex *Austr. Zool.*, and other papers. For bibliography, see Whitley, *Rec. Austr. Mus.*, xv., 1926, 143.

1929, etc. Myers. Papers in *American Museum Novitates, Copeia, Smithson. Misc. Coll., Ann. Mag. Nat. Hist.*, and various American and Chinese publications.

1932. Gross. Antiarchi, *Fossilium Catalogus*, i.; Animalia, part 57.

[The previous parts of this Catalogue dealing with fishes, were Nos. 24, Otolithi Piscium, and 33, Pisces Triadici, in which I cannot see any logotypes.]

More recent papers are too numerous to mention and will be familiar to working ichthyologists, but I should be glad to learn of any fresh references to genotype-selectors which may come to light, if their finders would kindly communicate them to me at The Australian Museum, Sydney.

TWO NEW TREE KANGAROOS FROM PAPUA, WITH NOTES ON ALLIED FORMS.

By E. Le G. Troughton, C.M.Z.S., and A. S. Le Souef, C.M.Z.S.*

The tree kangaroos of north-eastern Queensland, New Guinea, and several adjacent islands, are of remarkable interest within their family in having undergone an unusual twist or secondary phase of evolution which is reflected in their peculiar habits and appearance. Following upon the long period of entirely terrestrial existence in company with their fellows, which moulded a typical kangaroo-like appearance, the ancestral members of the genus *Dendrolagus* reverted to the trees again for food and shelter, with a corresponding reversal in general structure towards the arboreal type.

The secondary phase or readaptation is clearly shown in the re-acquired shortening and broadening of the hind feet, which have cushioned soles with serrations to prevent slipping, while the forepaws are very large and powerfully clawed for grasping branches, and the long tail has become slender and more possum-like, with a somewhat brushy tip, so that it acts as a rudder during long leaps or a prop when climbing.

Another result of readaptation to their favoured habitat is that the natural attitude of tree kangaroos has become more squatting or possum-like so that the back is almost horizontal, though the degree varies in several species. The variation in posture is indicated by the position of single or paired whorls at the point of reversal of the thick fur of the back, which acts as a natural rain-turning device adjusted to the carriage of the body. The situation of these "crowns" or whorls is generally regarded as of specific importance, as it is considered that animals having the hair reversed on the shoulders would naturally be more erect than those with the reversal on the mid-back or rump.

Tree kangaroos are essentially tropical forest-loving marsupials, the two Australian species being restricted to the mountainous tableland region of north-eastern Queensland. In New Guinea, however, the numerous high mountain ranges and extensive river systems with their tropical forest zones have favoured the development of many confusingly varied and interrelated forms, with the result that no less than thirteen species have been described from the mainland of New Guinea, and two from adjacent islands.

During preparation of "The Wild Animals of Australasia"[1], published in 1926, it became evident that several of the species described by Paul Matschie were not clearly differentiated and with a view to clarifying the position every effort has since been made to acquire additional specimens, while during long vacation abroad in 1930 Troughton examined Matschie's types in Berlin, and those of *Dendrolagus matschiei* and *goodfellowi* housed respectively in the Rothschild Museum at Tring and the British Museum, with a view to furthering the work as material offered.

As a result of the close co-operation existing between the Taronga Park Trust and the Australian Museum an excellent topotypical series of *D. matschiei* was added to the Museum collection and has proved invaluable as a basis for comparison. Personal inquiries conducted by Le Souef

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* Contribution from the Australian Museum.

[1] Le Souef and Burrell; Chiroptera by Troughton.

further resulted in the acquisition of the skin of a hitherto undescribed species, obtained by the late Captain G. F. W. Zimmer between the Upper Awarra and Strickland Rivers. A second specimen, a semi-adult skin and skull, of this species was later obtained from the Bamu River district by the very helpful co-operation of Mr. A. J. Bates, on behalf of the Government Secretary of the Territory of Papua, and the Resident Magistrate at Daru in the Western Division.

Two fine specimens of an undescribed species allied to *D. goodfellowi* were also received from the Taronga Park Trust at the end of 1933 from Mount Pratt, in the north-west of the Delta Division, doubtless through the co-operation of the Papuan authorities. The grateful acknowledgments of the authors are tendered to all who assisted in providing the material upon which the descriptions and comparisons are based, and to the authorities of overseas museums who facilitated the examination of collections.

Dendrolagus spadix sp. nov.

Diagnosis.—A uniformly dark reddish brown species relieved only by the slight golden or ochraceous buffy edging to the tail-base, small rump-spot, and irregular flecks on the tail. At once distinguished from *D. notatus* and *dorianus* by having the hair whorl in middle of back, and by differences in coloration. Habitat: Area between the Bamu, Upper Awarra, and Strickland Rivers, Western Division of Papua.

Colour.—General colour of back nearest dark chestnut (Ridgway's "Color Standards") tinged with mars brown, only the extreme base of the fur (barely 2 mm.) being light coloured, about ochraceous buff, the hairs thence shading from russet to dark chestnut brown. Snout not sharply contrasting with head, sparsely covered with short cinnamon to Prout's brown hairs which shade into the russet to rich mars brown of the forehead, ears, and nape. Ears with the almost evenly furred inner and outer sides uniformly mars brown, without any sign of light tipping. Undersurface a paler russet tone, slightly paler in the gular and inguinal regions, about ochraceous buff, but without trace of a sharply contrasting pale median area. Limbs without contrasted markings, the body coloration continuing on to the paws but warmed with a grizzling of ochraceous buff to tawny. There is an edging of tawny yellow at the inner angles of limbs and sides of tail-base. General colour of tail mars to chestnut-brown, with occasional irregular flecks of rich ochraceous-buff, and a similar light streak above the tail-base. Coloration of half grown animal entirely agreeing except for more youthful darker tone, most noticeable on the darker tail, which has similar light flecks of colour as in the adult.

General Characters.—Fur of adult male holotype unusually short, sparse, and somewhat harsh, suggestive of a rather lower habitat than usual for the genus; pelage of young animal naturally longer and richer but of similar texture. Single distinct whorl in middle of back. Rhinarium sparsely but evenly haired to a line above the nostrils. In the holotype flat-skin the tail slightly exceeds the length of the head and body. Ear rather short. Adult cranial features not available, but the skull of young animal with a basal length of 83.8 mm. shows no trace of the interorbital inflation characteristic of some species.

Dimensions of Holotype.—Flat skin of adult male much reduced by drying; head and body about 630; tail about 670; ear about 43 from inner base.

Typical Specimens.—Holotype skin of adult male, Austr. Mus., No. M.4561, collected by the late Captain G. F. W. Zimmer between the Upper Awarra and Strickland Rivers, Western Division of Papua, and presented by A. S. Le Souef; sub-adult skin and skull from the Bamu River district of the Western Division, Austr. Mus., No. M.5978, received through the Department of the Government Secretary of Papua.

Remarks.—In forwarding the adult skin, Captain Zimmer wrote: "I have just come back from a trip through entirely unknown and uninhabited country between the Upper Awarra and the Strickland Rivers, through which we had to cut our way on a compass course. One of my police shot what I take to be a tree climbing kangaroo, and, as it is entirely different to the animals shown in the Sydney Zoo as such, I have sent you the skin.

"It rained very hard for a number of days and the only means of drying it was over the fire. The skin was that of a large male, nearly six feet from nose to tip of tail *before being dried.* It was shot in a tree and, according to the boys, would live on the ground in fine weather and go into the trees when it rained, but one doesn't take much notice of that."

Dendrolagus deltae sp. nov.

Diagnosis.—Allied to *D. goodfellowi* by the marked inflation of the interorbital region, but apparently a smaller animal with a comparatively shorter tail, contrasted with a larger skull and dentition, greater interorbital inflation, and relatively longer nasals. Coloration generally similar, but the dorsal fur not definitely tri-coloured, and lacking light loin stripes, the muzzle paler than crown, and the ears light tipped. Distinguished from *D. matschiei* by the interorbital inflation, dimensions, and minor features of coloration. Habitat: Region of Mount Pratt, in the north-east of the Delta Division of Papua.

Colour.—Basal fur of back cinnamon-buff, shading imperceptibly into cinnamon, then into chestnut brown tips on the centre of back, the general colour much darker on the sides. A marked narrow dark spinal line extends from the forehead on to the base of the tail; not bordered by distinct loin stripes as in *goodfellowi.* Muzzle pale buffy, decidedly lighter than crown. Ears mainly dark russet brown, upper third of outer edge and tip light yellowish. Russet around neck and shoulders, this colour extending around throat and upper chest, separating the light gular and belly areas. Centre of chest and belly strongly contrasted with the mars-brown sides, the fur warm buff washed with ochraceous, becoming a much richer tawny around vent and base of tail. Dark body colour extending down front of limbs rather irregularly, to a point near the wrist, and to the heels. Manus of male shining warm buff, pes similar but washed with ochraceous tawny; manus of female darker warm buff tinged with ochraceous. Tail lighter than body, but darker than in *matschiei,* about shining or golden buckthorn brown, without the mottling described for *goodfellowi.*

External Characters.—Reversal of fur indicated by a definite double whorl in the male, the whorls less distinct and several inches lower in the female. Tail barely equal to the head and body length in the female, definitely shorter in the male, instead of being longer than the head and body as in *goodfellowi,* according to dimensions given for the type.

Skull and Dentition.—Skull and teeth proportionately larger than in *goodfellowi,* the greater breadth of the skull being emphasized by the zygomatic breadth of the allotype female being 8 mm. wider than that of

the male holotype skull of *goodfellowi* which is of similar length; the greater interorbital inflation, and nasal length is similarly emphasized.

Dimensions of Holotype Male.—Fresh specimen: Head and body 660; tail 620; pes 122; ear 59 mm.

Skull dimensions: Holotype male, allotype in brackets; basal length 114.5 (110); greatest breadth 72.2 (74); nasals, length 46 (45.1); interorbital 29 (31.2); palatal length 69.5 (67.6); length, premolar 11.1 (10.1); length three anterior molars 21.5 (19.9) mm.

Typical Specimens.—Holotype male No. M.5418, and allotype female M.5420, in the Australian Museum collection, presented by the Trustees of Taronga Park Zoological Gardens, Sydney.

Habitat.—Both specimens from the region of Mount Pratt, in the north-eastern area of the Delta Division of Papua.

Remarks.—Analysis of the external and cranial dimensions leaves little doubt of the specific distinction of this tree kangaroo, which exhibits the generally brilliant and contrasted coloration of the *matschiei-goodfellowi* group. It is clearly distinguished from the former by the marked inflation of the interorbital region, and from the latter more nearly allied form by the various characteristics detailed above.

Dendrolagus matschiei matschiei Foerster and Rothschild.

Dendrolagus matschiei Foerster and Rothschild, Novitates Zoologicae, xiv., 1907, p. 506, pl. iv.

Dendrolagus matschiei flavidior Matschie, Sitz. Ges. Nat. Freunde, Berlin, 1912, p. 572. Id., *loc. cit.*, 1915, 4, p. 94.

It is evident from a comparison of typical material in the Berlin, Tring, and British Museums that individual descriptions are misleading in various respects, both as to a reasonable interpretation of colours and the extent of markings, and authors' habits of describing single specimens when series are available, thus failing to allow for range of variation in certain forms of the brilliantly coloured *matschiei* group. Regarding dimensions also, it is evident that the proportional value of measurements is lessened or becomes worthless owing to the undue stretching, or mounting, of the skins.

Comparison of the type of Matschie's yellowish race with the plate of *matschiei,* and the typical Tring Museum series, makes it clear that Matschie made no allowance when describing his unique specimen of *flavidior,* for the existence of variation in the colour marking, or the fact that the description and figure of *matschiei* represented a single individual. In addition to a slightly more yellowish tone generally, the differences consisted in having the hair whorls situated somewhat higher on the back, and in the extent or delimitation of various colour-markings, all of which features are found to be subject to much variation in a series.

In reference to habitat, Matschie appears to have regarded the Sattelberg range area as faunally distinct from the Rawlinson and Saruwaged Mountains area, although both localities are situated on the Huon Peninsula. This view was based largely upon the slight and variable distinction shown by the single specimen of the subspecies *flavidior,* but as the habitat may be regarded as practically coincident with that of the typical race, it would seem evident that Matschie's yellowish form should be merged with the typical *matschiei,* in the coloration of which bright browns and yellows predominate.

Dendrolagus matschiei burgersi Matschie.

Dendrolagus burgersi Matschie, Sitz. Ges. Nat. Freunde, Berlin, 1912, 10, p. 571.

In the specific description of this form Matschie compared it superficially with the geographically more distant *goodfellowi,* and thereby overlooked the obviously closer affinity in cranial and other features with the geographically intermediate *matschiei.* His action may have been partly due to the extreme brevity of Foerster and Rothschild's description of *matschiei,* and the fact that Thomas, when describing the marked interorbital inflation in *goodfellowi,* did not state whether a similar degree of inflation was present in *matschiei,* although the typical skull was apparently available for comparison.

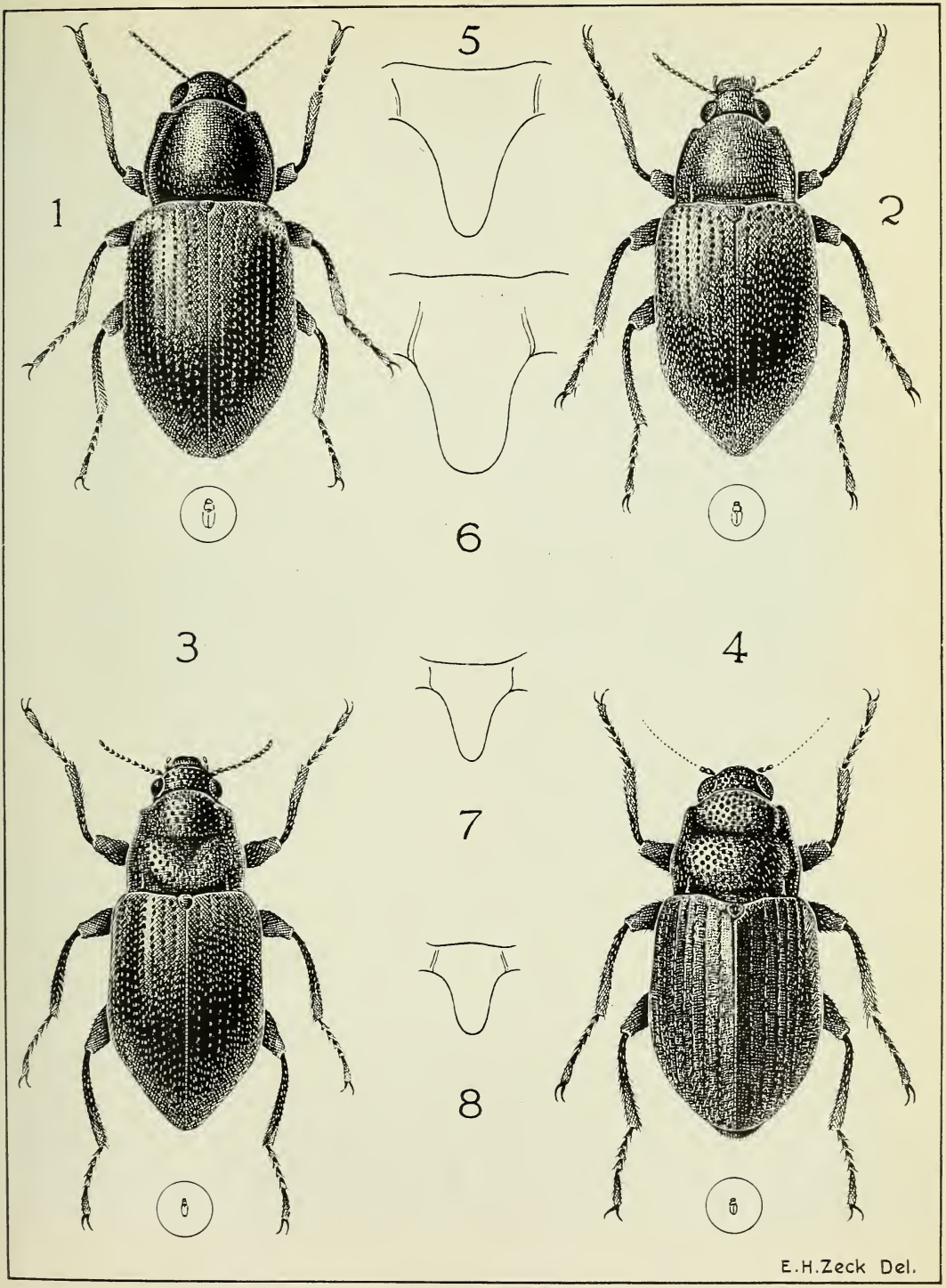
A series of topotypical crania of *matschiei* in the Australian Museum exhibit no trace of marked inflation, while Matschie's description of *burgersi* stated that the forehead is flat, with hardly any arch. It appears beyond doubt therefore that the two forms are linked together, and differentiated from *goodfellowi* and *deltae,* by their lack of the marked interorbital inflation present in the two latter.

The much shorter tail was stressed by Matschie as a distinction from *goodfellowi,* in which the tail is shown as about three inches longer than the head and body in the type, but such dimensions taken from the skin are subject to distortion, apart from natural variation, and in any event the tail-length of *burgersi* accords with the range of tail-length of *matschiei,* in which it is equal to or shorter than the length of the head and body.

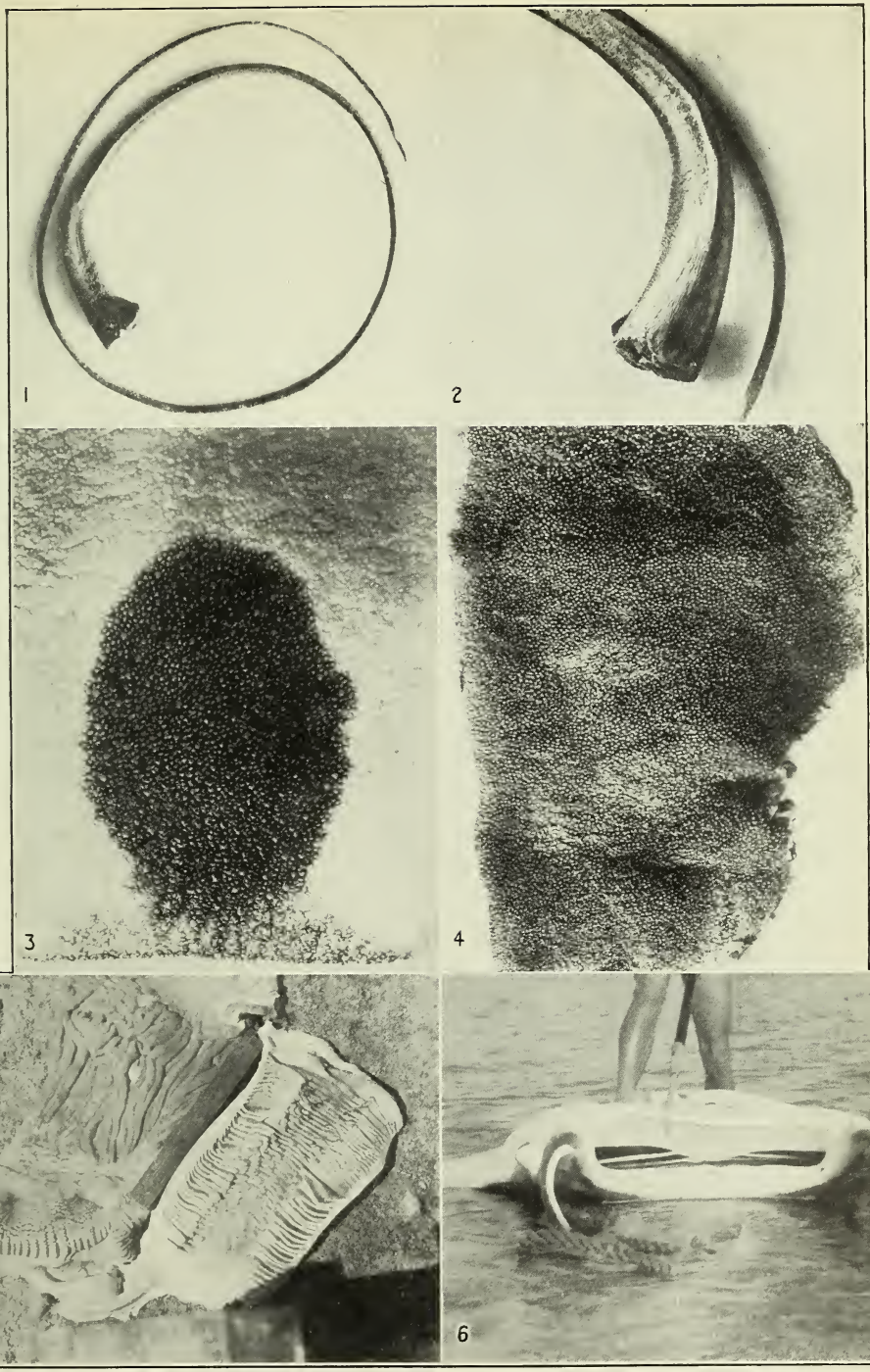
Coloration appears therefore to provide the main distinction and in this regard the only features of importance, beyond mere variation, appear to consist in *burgersi* having a somewhat darker face, and ears without light yellowish tips, and in the dorsal region having the light nape and loin stripes of *goodfellowi* which are lacking in *matschiei.*

In view of the above, it would seem that with the exception of the light ear-tips and stripes on the back, and some minor differences in cranial dimensions, such as the greater nasal width posteriorly, there are no features adequately supporting the specific distinction of *burgersi.* As the habitat of *burgersi,* however, is in the Hunstein Range in the mid Sepik Division, some three hundred miles north-west of the typical locality of *matschiei,* on the Huon Peninsula, subspecific distinction appears warranted.

THE BIRTH OF A WALLABY.



New Australian Dryopidae.



The Devil Ray.

(See explanation on p. 188.)

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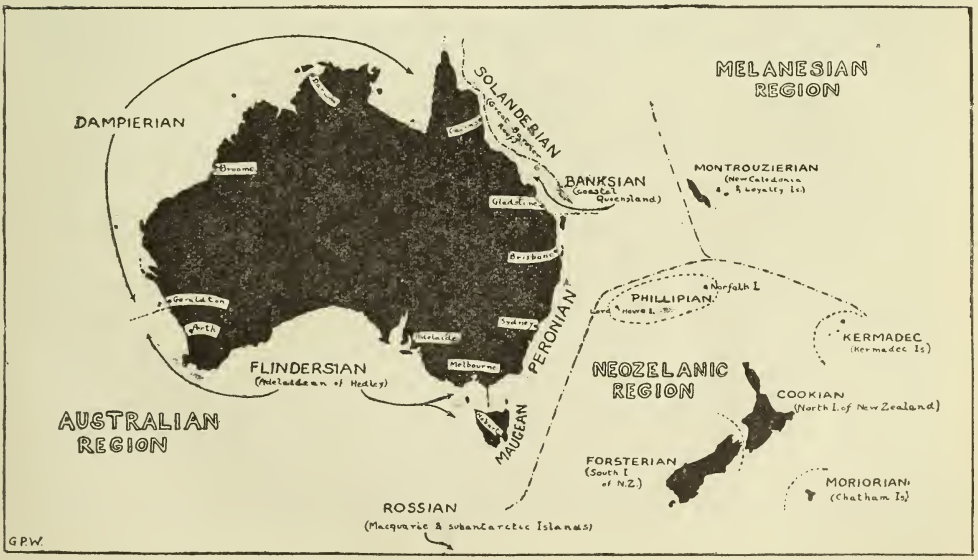
THE MIDDLETON AND ELIZABETH REEFS, SOUTH PACIFIC OCEAN.

By Gilbert P. Whitley, F.R.Z.S., R.A.O.U.,
Ichthyologist, The Australian Museum, Sydney.

(By Permission of the Trustees of The Australian Museum.)

Scheme of Contents:



The reefs lie in the Phillipian province, north of Lord Howe Island.

APR 15 1937

Situation of the Reefs and Historical Account.

Surrounded by unbroken leagues of open sea in a part of the Pacific some three of four hundred miles from the coast of New South Wales lie the Middleton and Elizabeth Reefs, the loneliest islets in the whole world. Even the term islets, implying land, is probably a misnomer, since the storm-lashed Tasman Sea may break entirely over the tiny sand or shingle-banks which rise from their coral ramparts, or wash the battered wrecks which alone afford footing for the rare visitors to these desolate atolls.

Not a tree or a shrub can here exist, for there is no soil and no fresh water, and the only inhabitants are the sea birds which rest awhile after long ocean flights.

Birds such as these suggested to La Perouse, as he proceeded from Samoa to Botany Bay in 1788, the idea that land or reefs might exist in the vicinity of Lord Howe Island and its satellite reefs and islets, whose existence it remained for the Englishmen of the First Fleet to prove later in the same year.

Middleton Reef was discovered by Lieutenant John Shortland (1736-1803), who, after a varied naval career, came to Australia with the First Fleet in the *Alexander*. On his way back to England he sighted many unknown islands and reefs and, in an account of his voyage is recorded the following,* under date July 20, 1788:—"About noon this day, the men at the masthead discovered a very extensive shoal on the larboard beam, bearing from north by west to west by south, distant between two and three leagues. It trended north by east and south by west, and was judged to be in length about three leagues and a half. The breadth could not be ascertained, for, while the ship ran along it, the sand bank was seen to extend as far as the eye could discern. It lies in latitude 29 deg. 20 min. south, and in longitude 158 deg. 48 min. east, and was named by Lieutenant Shortland, *Middleton Shoals*".

The next day, Shortland discerned what he thought was an island with a remarkable peak. This he named Sir Charles Middleton's Island, but later surveyors were unable to find land in the situation he indicated. Since Shortland's chart, published in Phillip's *Voyage,* shows that he was not very sure of his positions in those waters, it seems that Shortland must have drifted to within sight of Lord Howe Island. "Returning to London he strongly urged the Admiralty to have the eastern coast of Australia thoroughly surveyed and charted, and was thus partly responsible for the despatch of Matthew Flinders in 1799. He died at Lille in France in 1803" (W. Jeffery, *Austr. Encycl.,* ii., 1926, 461-462).

Sir Charles Middleton (1721-1813) was Comptroller of the Navy from 1778-1790, and thus during the time of the First Fleet. He became an Admiral in 1795, was elevated to the peerage as Lord Barham in 1805, and died 17 June, 1813. (Hist. Rec. N.S.W., v., 560 and 647.) Governor Hunter sent Middleton some specimens of Australian birds. (Hist. Rec. N.S.W., iii., 75.). He is apparently the Charles Theodore Middleton who compiled "A New and Complete System of Geography", published in London in 1779.

Soon after Lieutenant Shortland's discovery, the *Golden Grove* also encountered Middleton Reef, since a despatch sent by Governor Arthur Phillip to Secretary Stephens, dated Port Jackson, November 16, 1788, reads as follows:—(Hist. Rec. N.S.W., i., 2, 1783-92 (1892), 215.)

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*The Voyage of Governor Phillip to Botany Bay, 3rd ed., 1790, 259.

"The *Golden Grove* returned from Norfolk Island the 10th instant, having landed the provisions and people. In her return they fell in with a dangerous reef, on which the sea broke very high. The south end of the reef only was seen, which, by Mr. Blackburn's account (the master of the *Supply*), is in the latitude of 29 deg. 25 min. S., longitude 155 deg. 59 min. E. (Footnote: Middleton Reef named after Sir Charles Middleton, Comptroller of the Navy. The 'Directory of the South Pacific Ocean' gives the latitude of the 'west elbow' of the reef 29 deg. 27 min. 40 sec. S., and the longitude 159 deg. 3 min. 38 sec. E.) It extended from N.E. by N. to north, but the weather did not permit him to examine how far it extends to the northward. They were, when the bearings were taken, four leagues from it, with light airs of wind. It shall be examined in the course of the summer."

A later despatch from Governor Phillip to Lord Sydney was dated Sydney Cove, February 12, 1790. (Hist. Rec. N.S.W., i., 2, 1783-92 (1892), 295, and note.)

"The *Supply,* after landing the people and provisions, had orders to go in search of the reef seen by the *Golden Grove,* store-ship, and a shoal or island which Lieutenant Shortland informed me (by the *Sirius*) he had seen in the passage to the northward. The *Supply* cruised for several days in the latitude and longitude in which Lieutenant Shortland places the island, but returned without seeing it. There is some reason to think that a mistake has been made as to the latitudes in which the island and shoal are placed by Lieutenant Shortland. . . .

"The *Sirius* is now under repair; and, when ready for sea, I shall send that ship and the *Supply* to determine the situation and extent of the shoals and the island."

(A footnote speaks of the mythical island 28 deg. 10 min. S. by 159 deg. 50 min. E., and the Shoal 29 deg. 20 min. S. by 158 deg. 48 min. E. (Shortl.). Search was afterwards made for the islands, etc., in the schooner *Francis* and by Ball, but without success. Middleton Island was mentioned as late as 1840 in Polack's "New Zealanders.")

Elizabeth Reef.

This reef is some 30 miles to the southward of Middleton Shoals, is 95 miles from Lord Howe Island, and nearly 300 miles east of Cape Byron, New South Wales (Yule, The Australia Directory, 6th ed., 1907, 540). Its position is given as 29 deg. 55½ min. S. by 159 deg. 2 min. E., whereas that of Middleton is 29 deg. 28 min. S. by 159 deg. 4 min. E. Elizabeth Reef was named after a brig of that name which was wrecked there in 1831. Findlay's Directory of the South Pacific Ocean (ed. 5, 1884, 966) states that the Elizabeth Reef (also known as Seringapatam Reef, Clark Reef, or Eliza Reef) was discovered by the ships *Claudine* and *Marquis of Hastings* in 1820. However, this reef was evidently discovered even earlier, by the 300 ton whaler "Britannia" (Amiel Hussey), which was wrecked there in August, 1806, whilst on its way from California to Sydney with 200 tons of sperm oil. (Hist. Rec. N.S. Wales, vi., 1806-1808 (1898), 125 and 192.) The depositions of her officers, recorded on their arrival in Sydney, suggest that what is now known as Elizabeth Reef was the last resting place of their vessel. The Reef was referred to as Golden Grove Shoal in the "Sydney Morning Herald" of June 9 and 16, 1869.

Indeed, shipmasters steered well clear of the Elizabeth and Middleton Reefs, and yet they became known as graveyards of the Pacific, for wreck

after wreck was piled upon their coral, and derelict vessels from miles away were converged by currents upon these treacherous shoals.

Captain J. H. Watson, who was for many years identified with shipping interests in Australia, has compiled lists of the wrecks known to have occurred on Middleton and Elizabeth Reefs. In a series of articles on "Ships of Long Ago" in the "Scottish Australasian" (vii., October, 1916, 5048-5054), Captain Watson states:—

"In a long course of years Middleton Shoal is accountable for numerous wrecks, and is, in fact, an ocean cemetery. In 1859 the schooner *Shamrock,* Captain Punch, passed Middleton Reef, for such he says it is, with rocks standing from four to five feet out of the water at low tide, on which at all times the seas break heavily. There were then the remains of three vessels lying there, the schooner *Agnes Napier,* the ships *Defender* and *Constitution.* In 1866 the barque *Mary Lawson,* from Newcastle to Shanghai, was totally wrecked on June 10, when the captain, his wife, and nearly all the crew perished.

"Another wreck about this time was the barque *Ramsay,* from Brisbane to London. Coming to more recent times one of some prominence was that of the Greenock-owned barque *Annasona,* a vessel of 1,373 tons register, commanded by Captain G. H. Blackstock, which on a voyage from Newcastle to Callao in ballast, early in the morning of January 18, 1907, crashed right on top of the noted reef, there to stay as long as she will hold together, and, being built of steel, that will probably be for some years. She was formerly the *Margaret A. B. Carswell,* built at Glasgow in 1892. By latest accounts she was standing upright on the reef. The only satisfactory thing about the loss of the *Annasona* was that all the crew were saved.

"Not so fortunate was the Norwegian barque, *Errol,* that met her fate on the reef on June 18, 1909, at midnight. The *Errol,* originally the *Carisbrooke Castle,* was on a voyage from the South American coast to Newcastle, and the captain appears to have lost his reckoning, and as the weather was such as to prevent him taking the sun, all that could be done was to keep a good look out; but that did not prevent him from seeing his ship crash on to the reef, and, as a heavy sea was breaking on it, in a couple of hours she broke in two. What followed is one of those incidents which every now and then send a thrill of horror through the community. On the ship at the time of the disaster was the captain, his wife, and four young children, and sixteen others, officers and crew. The chief officer and two seamen were washed over the side and drowned when she broke up. In the attempt to launch a raft a few days later the captain and second mate were drowned. Days wore on, and, as starvation stared them in the face, the poor mother thought hungry eyes were cast on her children, and these disappeared at night. Then the distracted mother died. One by one others succumbed, and when the wreck was seen by the captain of the s.s. *Tofua* there were but five of the crew alive, and these were on a roughly-constructed punt or raft inside the lagoon of the reef. Three months later, and not a vestige of this 1,500 ton barque was to be seen.

"But the Middleton Reef does not stand alone as a menace to shipping in this locality, for the Elizabeth Reef is perhaps responsible for more shipping casualties, and the two were in the early days often regarded as one and the same. This reef, which is situated only thirty miles south of the Middleton Reef, has been known at various times as the Seringapatam Reef, Eliza Reef, and Clark Reef; and Findlay's Directory

of the South Pacific Ocean says it was discovered by the ships *Claudine* and *Marquis of Hastings* in 1820. It also states it is 350 miles from the Australian coast and has proved fatal to many vessels. There is no question about the latter statement being correct, but about the date of discovery there is room for doubt.

"In the Historical Records of New South Wales are the depositions of the officers of the whaler *Britannia,* which was totally lost on a reef on August 24, 1806. It is therein stated that by an observation taken that day at noon the latitude was 30 deg. 38 min. South, and the course steered by compass from noon was West until 8 p.m., at the rate of 4 knots an hour [sic]; and north-west at about the same rate, until 2 a.m., when breakers were discovered ahead. The longitude was by lunar observation at 3 p.m. 156 deg. 40 min. East; and by reckoning 157 deg. 40 min. East.

"Findlay gives this reef as 29 deg. 55 min. South and 159 deg. 6 min. East; this closely corresponds to the survey by H.M.S. *Fly* in 1850, of the Middleton Reef. On which, therefore, was the *Britannia* lost, the depositions do not say, but a footnote in the records infers it was on the Elizabeth Reef. . . . How many vessels have been lost on this reef no one can say, for no record has been kept, but there must have been many before the correct position was given it on the charts.

"In 1850 the Sydney-owned barque *Rosetta Joseph,* of 265 tons, under command of Captain Patrick, was returning to Sydney from San Francisco, when, on the night of December 1, she struck a reef 'known as Clark's or Elizabeth's Reef'. All hands embarked in the boats, and laid at anchor all the next night. On the 3rd three boats, with 47 persons, crew and passengers, set sail for Lord Howe Island, having a north-east wind. The unfortunate castaways experienced a most trying time, the weather being tempestuous, with mountainous seas, which threatened on several occasions to engulph them. Not being able to make Lord Howe Island, they bore away for the coast and made Port Macquarie on the 10th, having been seven days on the passage. Here they were received with lavish hospitality by the residents. The vessel was sold by auction in Sydney for £105 and the schooner *The Bride* was sent to the reef to recover what fittings and cargo could be brought away. The vessel was found entire, but three whalers had visited her before the salvor reached her, and freely helped themselves, so there was little left to bring away. She remained high and dry, on the higher part of this reef for some years, acting as a beacon, and place of refuge also, until in 1858, the captain of the barque *Elizabeth Swift,* landed his crew and burned her for the sake of the copper bolts, which was considered by mariners as a thoughtless act, depriving them of what she had acted as.

"The barque, *Tyrian,* 226 tons, a Scarborough-built vessel, was, in 1851, whilst commanded by Captain Robinson, on a voyage from Honolulu to Sydney, via Auckland, and, leaving there on November 6, did, without any warning, about 2 o'clock in the morning, strike heavily on the Elizabeth Reef and there remain fixed.

"At daylight it was found she was close to the *Rosetta Joseph.* As there was no possibility of getting her off, and there were not sufficient boats to carry the forty-seven people she had on board, it was decided to send the long-boat away for assistance.

"Eleven passengers, the chief officer, and two seamen, with Captain Birkenshaw (a passenger) in charge of the boat, left in her, and reached Newcastle in a week, encountering very bad weather. Thirty-three persons

were left on the ship, and to bring them away H.M.S. *Acheron* left Sydney on December 5. In the meantime, the ketch *Aeolus*, on her passage from Fiji, sighted the wreck on the 4th, and, sending a boat to her found eight seamen, four passengers and the captain on board. Of these, three seamen and four passengers accepted the offer to be taken to Sydney. From them he heard that the whaler *Jane* had taken off fifteen four days previously. The *Acheron* duly arrived and took off the captain and the remaining seamen. The barque shortly after slipping off the reef and disappearing. In 1857 the whaler *Packet* was lost on this reef, and, as usual, the crew had to take to the boats, and after trying experiences reached Brisbane.

"A small, obsolete steamer, which has been for many years a conspicuous object, moored to a buoy in Snails Bay, has a history which in one aspect associates her with the Elizabeth Reef. In this wise, on the morning of May 8, 1869, the barque *Douglas*, Captain Sayers, two days out from Newcastle, bound to China, was hurled by a heavy sea right on top of the reef. The captain, thinking she would soon break up, had a raft constructed, on which all the crew left her. Some days after they were picked up by the *Storm Bird*, a Sydney-owned schooner, and taken into Newcastle. The captain, on arrival, stated he had seen another vessel on a reef when drifting about on the raft. To verify this statement the Government steamer *Thetis*, which is the obsolete vessel alluded to before, was sent, having on board Lieutenant Gowlland, R.N., of the Admiralty Survey. This officer came to the conclusion that Captain Sayers saw his own vessel on the Elizabeth Reef and failed to identify her. The *Storm Bird* herself was lost during a heavy gale on the coast in May, 1870. In this year, also, the schooner *Colonist*, a trader to New Caledonia, found a last resting place on this reef, and the *Thetis* made another visit to it to bring off the crew. Captain J. M. Banks, that most ancient of "ancient mariners", was in charge. It was on his suggestion that a lifeboat fully provisioned was placed in the lagoon of the reef, and where for many years it was ready to succour distressed seamen, but its services were never called into use. It was eventually carried away or lost in some heavy gale.

"The *Alma* was long both a home and a landmark during the time she was a fixture there. Then the brig, *Naiad*, belonging to Nipper and See, got there to stop, although her crew came away in the schooner *Mary Ogilvie*. But the last wreck to bring this reef into prominence was that of the Norwegian ship *Askoy*. This ship, originally the British ship *Argus*, was built in 1878 by Barclay, Curle & Co., at Glasgow, was of iron, and 1,616 tons gross registered tonnage. She was in ballast from a South American port bound to Newcastle to load coal. On December 27, 1911, when between the Middleton Shoal and the reef the current took the ship right on to the rocks at high tide, and as the tide fell she bumped hard on the rocks, and soon had three or four feet of water in the hold. Seeing the impossibility of the ship ever being got off, the crew left her the next day in two boats, the captain and chief officer being in charge. The latter brought his boat to Yamba, at the entrance to the Clarence River, in five days, and its occupants were sent on to Sydney by the next steamer. The captain's boat was picked up by the French mail steamer, *Ville de la Ciotat* four days after the wreck, and those in it were landed at Noumea. Fortunately, no lives were lost. This reef, being now correctly charted and so well known to mariners, there is no reason why it should be such a source of danger in the future, as it has been in the past."

Captain Watson was also the anonymous author of the comprehensive list of Wrecks and Shipping Disasters, published in the *Australian Encyclopaedia* (ii., October, 1926), from which I have abstracted the following list of wrecks on the Middleton and Elizabeth Reefs because there are one or two discrepancies between this list and Captain Watson's earlier article. Beginning on page 684, and continued from pp. 713-731, in Captain Watson's own words, the list is:—

Britannia, ship, Nathaniel Goodspeed master, was wrecked, probably on Middleton or Elizabeth Reefs, in Tasman Sea, 25 August, 1806. Two boats reached Sydney; one boat was lost, and probably 8 lives.

Agnes Napier, schooner, was wrecked on Middleton Reef, Tasman Sea, about 1859. [The H.M.S. "Herald" saw her remains in 1854.—G.P.W.]

(*Alma,* wrecked on an Elizabeth Reef near New Zealand, yet mentioned in Captain Watson's 1916 article, p. 5053, as being on the Elizabeth Reef which concerns us here.—G.P.W.)

Annasona (1,436 tons), barque, formerly *Margaret A. B. Carswell,* was wrecked on Middleton Reef, January, 1907, during voyage from Callao to Newcastle; all the crew (22) were landed at Lord Howe Island, 25 January.

Askoy, ship, was wrecked on Elizabeth Reef, Tasman Sea, 27 December, 1911.

Colonist, for Noumea, was wrecked on Elizabeth Reef, Tasman Sea, 1 January, 1870.

Constitution, American ship, was wrecked on Middleton Reef, Tasman Sea, in 1859.

Defender (1300), ship, of Boston, U.S.A., from Puget Sound to Sydney with timber, was wrecked on Middleton Reef, Tasman Sea, 27 February, 1859. Two boats arrived at Macleay River, and one at Port Macquarie. There was no loss of life.

Douglas (380), barque, of Melbourne, was wrecked on Elizabeth Reef, Tasman Sea, 8 May, 1859.*

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*This is an error for 1869, since in the *Sydney Morning Herald* for June 9, 1869, p. 4, reprinted on June 16, pp. 10-11, we read of the total loss of the barque *Douglas* (380 tons). Her captain, Sayers, sailed from Newcastle on May 4 for Yokohama. "He experienced easterly winds from the time of leaving until the morning of the 8th of May, when, in longitude 160 deg. 30 min. E. and latitude 28 deg. 56 min. S., the vessel struck upon a coral reef known as the Golden Grove Shoal, but which was not laid down on any of his charts". An account of their raft-making and the subsequent picking up of the nine of them by the *Storm Bird* follows. "The reef" . . . "is in the shape of a circle, with a circumference of about five miles. All round this reef there was a very heavy surf, but in the centre the water was quite calm. For some time Captain Sayers was completely at a loss to get out of this curious harbour into the open sea". After more than a week they escaped on the raft. "On the following day, namely, the 13th of May, Captain Sayers reports having passed another reef, on which was a large ship of fully 700 tons burthen". Then comes the only natural history note:—The raft "was continually surrounded by sharks, and they appeared to follow them as though waiting for their prey".—G.P.W.

Elizabeth, ship, of London, was wrecked on Elizabeth Reef, Tasman Sea, in 1831. The cutter *Fanny* was sent out from Sydney to examine the wreck and reef.

Errol, barque, Norwegian, from Peru to Newcastle, was wrecked at midnight on Middleton Reef, Tasman Sea, 18 June, 1909. During the next weeks 17 lives were lost in horrible misery from starvation and thirst. S.S. *Jofua* [*Tofua*] saved 5 survivors, 12 July.

Maelgwyn (1,276), barque, on voyage from Peru to Sydney, was abandoned dismasted and sinking off Middleton Reef, Tasman Sea, 26 January, 1907. The crew were landed safely on Lord Howe Island. She was abandoned justifiably.

Mary Catherine, ship, was wrecked on Middleton Reef, Tasman Sea, in 1851.

Mary Lawson, barque, from Brisbane to China, was wrecked on Middleton Reef, Tasman Sea, June, 1866. The captain, his wife, and all the crew were lost, except three, who sailed in a boat to Clarence River, where one was drowned in the surf.

Naiad (297), brig, of Sydney, was wrecked on Elizabeth Reef, Tasman Sea, 9 July, 1885, through a N.W. current.

Packet, whaling brig, of Sydney, was wrecked on Elizabeth Reef, 24 February, 1857, at midnight, during a gale, and smashed up next day. The crew sailed away in 2 of her boats, were picked up 4 days later, and landed at Moreton Bay.

Ramsay, barque, from Brisbane to London with wool, was wrecked on Middleton Reef, Tasman Sea, about 1852. Eleven lives were lost and survivors in boats suffered hardships before being picked up.

Rosetta Joseph, ship, was wrecked on Elizabeth Reef, Tasman Sea, 1 December, 1850, while on voyage from San Francisco. The crew and passengers, 47 all told, left the wreck in 3 boats and arrived safely at Port Macquarie, New South Wales, 10 December.

Stuart Russell, was wrecked on Elizabeth Reef, Tasman Sea, about 1856.

Tyrian (220), barque, of London, from Honolulu to Auckland and Sydney, left Auckland and was wrecked at night on Elizabeth Reef, Tasman Sea, 25 November, 1851. One boat with people arrived at Newcastle, 2 December. The whaler *Jane,* of Sydney, took away 17 passengers, 30 November, and H.M.S. *Acheron* took the remainder, 9 December. No lives were lost.

The Hon. J. T. Bell wrote in Archibald Meston's "Report on Fraser Island", Queensland, in 1905, as follows:—"Fraser Island is named from Captain Fraser of the ship *Stirling Castle,* wrecked on Elizabeth Reef, 300 miles to the south-east on 21st May, 1836.

"Captain Fraser, Mrs. Fraser, the mate Brown, and some of the crew finally landed on Fraser Island, were received in a friendly manner by the blacks, and passed on in canoes to the mainland at Inskip Point, to be forwarded to the white people at the Brisbane Convict Settlement, which no one reached except Mrs. Fraser, the others, according to her three different and very contradictory stories, being killed by the blacks at or near the present Noosa River".

The most prominent wreck on Middleton Reef was (and still is) that of the *Annasona,* the barque of about 1,400 tons which, on a voyage

from Peru to Australia, crashed on top of the reef early in the morning of January 18, 1907. The master (Captain G. H. Blackstock) threatened to shoot anyone who tried to put over any boat until daylight came and they could review the damage done. His action enabled all his crew and himself to reach Lord Howe Island a few days afterwards, and some of the Islanders still recall his advent. Meanwhile the wreck of his steel ship remained, peopled only by huge rats which thrived for a while upon resting sea-birds. Eventually it was purchased by Mr. Stanley Spain, of Sydney, who sent his schooner the *Young Rock* (Captain Henderson) to obtain salvage from the *Annasona*. The *Young Rock* had earlier been named the *Evangel*.

Eventually an advertisement appeared in the Sydney press:—

"For Sale by Tender, Quantity Gear, salved from Barque ANNASONA, including 240 fathoms cable, anchors, steel hawsers, Windlass. Highest or any tender not necessarily accepted. On view at Messrs. Einersen Bros.' Yard.

"Tenders addressed to undersigned close Noon, 30th inst.

Stanley Spain, 1 Queen's Court."

By far the most terrible disaster in the doleful history of Middleton Reef was the wreck of the Norwegian barque *Errol* which was on her way from Chimbote, Peru, to Newcastle, New South Wales, when she struck the reef at midnight, 18th June, 1909. According to contemporary newspaper accounts, she broke into three sections and several of her crew were drowned, whilst others managed to get across to the *Annasona* where they suffered agonies of hunger and thirst. The master was drowned and eaten by sharks, only his legs, still in sea-boots, being recovered. His wife became mentally deranged and died, and there were dark whispers of cannibalism and murder concerning the disappearance of their four children. The *Tofua* eventually took five persons, the sole survivors, off Middleton Reef and brought them, aged and exhausted, to Sydney.

Apart from the wrecked ships and the vessels which came to their rescue, there were a few surveying trips made to the reef. The *Fly*, in the 1840's, had been instructed to examine "The position and dimensions of the several detached reefs and shoals which lie to the southward of the Great Barrier, and which appear, though with long intervals, to stretch towards Howe's Island". However, I find no mention of Middleton or Elizabeth Reefs in J. B. Juke's *Narrative* of that voyage, published in 1847, though Captain Watson stated that she was there.

The reefs were certainly visited by H.M.S. "Herald" in the 1850's. This vessel is well known to zoologists through the voyages she made in earlier years (1845-1851), but she continued in active service long afterwards, though no later zoological results were published except in the form of scattered references. Captain H. M. Denham was in command when Middleton Reef was surveyed in 1853. John Denis Macdonald was one of the naturalists aboard her and, though he contributed an excellent general account of the fauna of Lord Howe Island (printed in N.S. Wales Votes and Proceedings of the Legislative Council, ii., 1853, 719th page),, he says nothing about the reefs. The *Herald's* tender was the paddlewheel steamer *Torch*, aboard which was Captain F. Hixson. Abstracts from his log are given in the "Sydney Morning Herald" of March 22nd, 1924. Both the *Herald* and *Torch* made several cruises to Australian Pacific localities,

and in 1854 "They found the wreck of the schooner *Agnes Napier* on Middleton Reef, and also an old wreck on Elizabeth Reef". It would be worth while, if possible, to discover the routes of these vessels and the dates of their voyages, since only in that way will such problems as the type-locality of the Tiger Shark, *Galeocerdo rayneri,* and other species be revealed.

Elizabeth Reef was surveyed by Lieutenant G. E. Richards in the *Renard* in 1878, but there is no available published account of this trip. The charts made by Denham and Richards, with minor alterations, are still in use at the present time. Some years ago, a lifeboat was moored in the lagoon at Elizabeth Reef, with stores for shipwrecked mariners, but either it was stolen or it most probably disappeared in some storm.

In recent years, the reefs have naturally been spurned by shipping, but occasionally a vessel from New Caledonia or Fiji passed close enough to see if there were any persons in distress.

The well-known yachtsman, Ralph Stock, in his *Chequered Cruise,* 1916, published a photograph of Middleton Reef (so far as I know the first picture of the place ever reproduced), and wrote concerning it, as follows:—

"It was worth seeing. Anything more desolate and sinister than this gigantic horseshoe of coral out in the open sea, a menace to every storm-driven ship in a radius of a hundred miles, it would be difficult to imagine. Some day, perhaps, it will be an island, as fair as any in the South Pacific, but at present the . . . coral polyp has not finished its work and Middleton Reef constitutes a death-trap. A white circle of breakers, clear cut against the blue of deep waters outside, and the opalescent green of the lagoon within, and here and there perched on the reef's jagged teeth, like marine scarecrows, wrecks in every stage of dissolution. At the time of the Firm's passing there were five, and never a year goes by without adding to their number."

Again, in his *Cruise of the Dream Ship,* 1921, Ralph Stock reproduces the picture of the *Annasona,* but since he calls it "The Wreck of Tragedy", he had evidently mistaken this ship for the *Errol.*

Narrative of the "Wanderer" Expedition.

When travelling from Noumea to Sydney in a 20,000 ton liner some years ago, the present writer passed the vicinity of Middleton Reef, he little thought that he would some day be landing thereon from a yacht in the interests of the Australian Museum. Yet such was to be.

Early in 1936, Mr. Norman K. Wallis, owner of the yacht *Wanderer,* purchased the *Annasona* wreck (for five shillings!) and organized an expedition to visit the Middleton and Elizabeth Reefs, and the writer was deputed by the Trustees of the Museum to accompany the expedition as naturalist.

The schooner yacht *Wanderer* is nearly fifty feet long and fitted with an auxiliary engine. She was named after the *Wanderer* in Masefield's poems, but her name is also the same as that of Ben Boyd's famous yacht,*

*A "poem" was written about Ben Boyd's *Wanderer,* too, by T. Dibdin, and published in Boyd's "Reminiscences of Fifty Years", 1871, pp. 106 to 108, but it is of very poor quality. A painting of Ben Boyd's yacht by O. Brierley was reproduced in The Navy League Journal, February, 1924, p. 5 and fig.

whose moorings she now occupies. On this, the third of her trips to Lord Howe Island, the crew consisted of Messrs. Norman Wallis, H. Newton Scott (navigator), J. Forsyth, and the writer, who had had no previous yachting experience, as naturalist. We sailed from Neutral Bay, Sydney, at noon on Saturday, April 4, 1936, and struck a rough sea and strong south-east wind on leaving the Heads. That very afternoon, an accident occurred which might well have terminated the expedition: the main sheet parted, and Wallis and Scott were washed overboard. Fortunately, they both managed to grab ends of rope trailing in the water, and then a heavy wave swept Forsyth into the sea, leaving a very seasick naturalist for a short while in sole possession of the ship. Then the skipper hauled himself aboard, whilst Scott was aquaplaning below the end of the swinging 30 ft. boom and Forsyth had managed to grasp the counter. Finally, all were got safely aboard, and we hove to for the night. The next few days were marked by rough weather and dolphins and sea-birds were about the only creatures seen. The yacht was blown or drifted well off her course and suffered a good deal of damage, even the bowsprit being carried away one night during a cyclone. A flying fish (*Exocoetus volitans*) was washed up on deck and was the first specimen secured for the Museum. Two days after the storm, a gannet visited us, although we were over one hundred miles from Lord Howe Island, and we saw a large waterspout, which later disappeared. Very early on the morning of April 11th, the ship's course had to be altered to avoid striking two large whales, and later in the day we sighted the mountains of Lord Howe Island, and managed to reach an anchorage there the same night.

Here our little crew was augmented by three of the islanders, Messrs. Frank Payten, Tom Payten and Maurice Wilson, and we left for the main objective: the Elizabeth and Middleton Reefs.

After two days' sailing through a curious criss-cross sea,* we sighted Elizabeth Reef on the afternoon of the 14th, and, as we approached it, huge green waves were seen and heard crashing upon the ring of submerged coral which encircled the smooth lagoon, some five by four sea miles in extent. From the appearance of the surf, it appeared impossible to approach such a reef, but Wallis and a couple of others went off in the dinghy to test the anchorage in an opening marked on the chart, taking with them a compass, some food and drink, lights, etc., in case they became stranded. Those who remained on the yacht were relieved when the dinghy returned, reporting safe anchorage, and at sunset we moved slowly through the opening, and, for the first time in the whole voyage, kept an even keel. The water was alive with sharks and everybody caught at least one. They were whalers (*Galeolamnoides macrurus*), five to six feet long, but immature; their bodies were suspended around the yacht to form most unusual fenders.

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*This phenomenon seems characteristic of these waters. In an account of the wreck of the *Rosetta Joseph*, a 265 ton barque from the California goldfields ("Sydney Morning Herald", 13 December, 1850), we read of the survivors making out to sea:—"After running for some time, most favourably, about 11 a.m., encountered a remarkable cross sea, having much the appearance of the junction of two currents".

A sailor acquaintance of mine also observed this criss-cross sea in 1909 and ascribed it to the effect of submarine mountains upon the currents.

On Wednesday, April 15, we were all up early as the reefs were being uncovered by the ebb-tide and we landed upon parts of them. Since there is a permanently exposed sand cay here and the reef was not known to have been annexed, the Expedition took possession of Elizabeth Reef in the name of His Majesty, King Edward VIII.

In the short time available, I collected all I could whilst the tide allowed, and obtained a new species of clam, various shells and crabs, a new mollusc, and some marine worms. By fishing, we obtained several different species, all identical with Lord Howe Island forms, except a Red Bass (*Lutjanus coatesi*) which was the same as a Queensland fish which has the reputation of being poisonous as food. The fishes and sharks here had never known the presence of anglers and took baits eagerly, so that we had enough for both scientific and gastronomic purposes. Our navigator, trolling for sporting fish, caught a Lizard Fish (*Synodus*) which was only slightly larger than the automatic striking lure which it had so gamely taken. We also caught a new species of Trevally. Gannets and Noddies were the only avian inhabitants of the sand cay, where Frank Payten distinguished himself by catching a shark by the tail as it came into shallow water after bluefish.

We rose at dawn the next day and prepared to leave Elizabeth Reef. There was some anxiety when getting the anchors up, as we were very near coral, but we finally got away and plunged into a terrific sea. The trip to Middleton Reef was very rough, the yacht rolling considerably and often shooting breakers. Mutton birds, gannets, and a Fluttering Petrel were the only living things in view.

At about noon, the wreck of the *Annasona* was espied, her bowsprit raised to the squally heavens like some titanic forefinger uplifted in admonition. Here, then, was Middleton Reef, quite invisible from a distance and only indicated by this tragic relic. We approached the reef from the lee shore, and saw numerous small niggerheads on the coral. The surf was not so strong as that at Elizabeth Reef, although the lagoon was of about the same area, and in the afternoon we made our way into Herald Haven, where we anchored. Tom Payten immediately caught a Tiger Shark, and the water around the yacht was soon thick with Whalers, and an occasional Kingfish or Tiger Shark. One or two turtles were also seen.

The next day, April 17th, we all visited the wreck of the *Annasona* crossing the lagoon whose floor consisted of coral sand, with sparse coral patches, until the inner rampart of the reef-crest was reached. This reef-crest, upon the outer rampart of which the *Annasona* lay, was peculiar in having a moat of impounded water whose level was higher than that of the water in the lagoon. There was a rich variety of corals in this moat, also small clams and Turban shells (*Turbo cepoides*), the like of which must have sustained the victims of shipwreck in other days. The *Annasona* yielded much fine timber—teak, mahogany, and lignum vitae—and other relics to our crew, but I was surprised to find no coral growth or animal life whatever attached to her hull, with the exception of three Black Periwinkles (*Melanerita melanotragus*); possibly rust had fouled the water. Fishes in the vicinity of the wreck all belonged to Lord Howe Island species: Bluefish, Double-heads, Parrot fishes, Demoiselles, and others. Some ballast stones, probably brought from Callao, had formed a bank occupied by swiftly running crabs, but the only bird inhabitants were

Noddies (*Anous stolidus*). In the lagoon, beche de mer were common browsing over the bottom. We took possession of the reef in the name of the King, thus having made the first additions (inconspicuous though they be) to the Empire during his reign.

We also visited a smaller wreck, thought to be the remains of the ill-fated *Errol,* but were unable to land and join the few moulting Noddies which perched thereon.

The next day, we paid another visit to the *Annasona,* whence my friends removed the figurehead and some miscellaneous gear. We left some provisions, fishing lines, rockets and other things aboard her, also a plate (a la Dirk Hartog) inscribed with a note of our visit for future visitors or shipwrecked sailors. The wreck itself had small pools along her ribs and keel, and from these I obtained small Bluefish, Scorpion Fish, some sea-slugs and Palolo worms, and other specimens. The outer edge of the reef-crest was encrusted with *Lithothamnion,* which was largely burrowed into by Sea Urchins, as at Lord Howe Island. Indeed, the similarity of the fauna of Middleton and Elizabeth Reefs to that of the southernmost coral reef in the world at Lord Howe Island is very striking and demonstrates that these places are more closely connected with one another than with New Caledonia or the Great Barrier Reef.

Very early in the morning on the 19th a gale sprang up, so that it was difficult to stand on deck, and we dragged our anchors and looked, for a while, like being blown on to the reefs. However, the anchors were got aboard, polished by grating along the coral sand, and, forced to postpone all shore activities, we made out to sea. After beating through rough seas all day, we hove to, and, being short of petrol, which was being conserved for emergencies, drifted helplessly in the treacherous currents around Elizabeth Reef. More by good luck than anything else, we missed the reef and proceeded laboriously, through lack of wind this time, in the direction of Lord Howe Island. On the afternoon of the 20th a good wind sprang up and we sped forth through seas still rough, but helped by a southerly drift. The bilge water, always unpopular, now slopped up through bunks and lockers spoiling note-books, cameras, clothes and gear, but finally that evening we reached Lord Howe Island, exhausted and bearded. The hillsides were swarming with anxious islanders, who gave us a wonderful welcome, for we were several days overdue. Here we stayed for about a week, mending sails, refitting, and recuperating, and I secured some more specimens for comparison with those from the reefs we had left behind. The weather was very unsettled on the 29th, but we decided to sail for the mainland, and a convoy of gannets accompanied us for the first part of our homeward journey. Land was sighted on May 2nd and proved to be the North Brother Mountain, northern New South Wales. A Horse Mackerel and a new species of Little Tunny were caught by trolling and, the next day, we witnessed a grand display of sporting and leaping by innumerable dolphins, pairs of which would sometimes leap twelve feet into the air. Slowly and pleasantly we sailed down the coast in calm water at last, after our 25 stormy days out of 29, and a total of 117 hours hove to in rough seas; passing Newcastle, Norah Head, and then Barrenjoey lighthouse as darkness fell; past the jewelled lights of Manly to enter the Heads at 11 p.m. At eight bells, exactly midnight, the *Wanderer* had returned to Ben Boyd's old moorings at Neutral Bay.

ZOOLOGICAL RESULTS.

Birds.

Throughout the trip I kept a constant watch for birds, and the monotony of many a trick at the wheel was not a little broken by this practice. The following notes on birds are taken from my diary, with annotations where necessary. No specimens were collected.

1. *Between Sydney and Lord Howe Island.*

April 4. After the accident, when three men were washed overboard, and I lost a boathook when trying to fish one of them aboard, I noted, "Last impression: handle of a boathook protruding from the water and a mutton bird inspecting same as if to assess its value as a nesting site". Birds are often curious about floating objects and more than one yachtsman, washed overboard, has owed his subsequent rescue to this fact.

April 5. Birds of Providence* quite common, often flying at steep angles, so as to appear about to topple over. The greyish facial feathers are much lighter in colour than in (beach-stranded) Sydney specimens. Fluttering Petrels seen with very white nape and rump and flying rather like swallows at times. One Mollymawk.

April 10. A school of mutton birds, sitting on the water, was disturbed at our approach. Estimated distance from Lord Howe Island is 120 miles, yet a Gannet paid us a visit at 12.30. La Perouse deduced the existence of land in the vicinity of Lord Howe Island from the presence of birds. An English translation of his remarks (Voy. La Perouse, ed. 3, iii., 1807, 139-140) states, under date 17 January, 1788:—

"On the 17th, being in the latitude of 31 deg. 28 min. south, longitude 159 deg. 15 min. east, we were surrounded with an innumerable quantity of gulls (*goëlettes*), [probably mutton birds—G.P.W.] which led us to suspect, that we were passing near some island or rock; and many wagers were laid that we should discover some new land before we reached Botany Bay, though we were not above a hundred and eighty leagues from it. These birds accompanied us till we were within fourscore leagues of New Holland; and it is very probable, that we left behind us some islet or rock, which serves as an asylum for these birds, for they are much less numerous near an inhabited land."

(As a matter of fact, however, the presence of flocks of birds at sea is not always an indication of the proximity of land. I have myself seen birds in numbers hundreds of miles at least from any land when travelling between Norfolk Island and Tonga.)

April 11. Scott sighted Lord Howe Island† (Mount Gower) at 9.55

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*The Bird of Providence has been dealt with recently in the Australian Zoologist, viii., May, 1934, 42-49, pl. i.

†The early history of the birds of Lord Howe Island has yet to be written. The Mitchell Library, Sydney, houses priceless old diaries and drawings, some of which deal with birds now extinct there. Hindwood has brought to light Bowes MS. Journal, but there are other MSS. by Ralph Clark, William Bradley, George Raper and others. Some interesting notes by David Blackburn were published in the *Journ. Roy. Austr. Hist. Soc.*, xx., 1934, 327-328. The first published account is in Thomas Gilbert's *Voyage from New South Wales to Canton* in 1788 (published 1789). Other old books of importance are those of Phillip, Hunter, Tench, Collins, and Forster's *Neuesten Reisen nach der Botany Bay.*

a.m., and estimated its distance as about 45 miles. It was then obscured by haze and I did not see it until about 11 a.m. Two Gannets visited us this morning, one with much "immature" plumage, and the other with a black mark on one foot. Mutton Birds round about as usual.

2. *Lord Howe Island to the Reefs and Back.*

April 12. We cast off from Lord Howe Island at 5.45 and sailed past the Admiralties into open water, when the engine was started and we steered N. by E. Saw a few Noddies and Gannets but no Bosun Birds, and altogether the bird season seems almost over here. Islanders report fluffy baby mutton birds as being present on Lord Howe Island at present.

April 13. Very few mutton birds to-day. Some Gannets with "immature" plumage.

April 14. A Bosun Bird with red beak and tail-feathers soared aloft. Otherwise only an occasional mutton bird or creature like a black sea swallow. No Birds of Providence.

At 12.20 p.m. ship's (Sydney) time, Forsyth, at the cross-trees, sighted the Elizabeth reef. . . . Fluttering and ordinary petrels were in evidence.

April 15. Some of the men visited a distant coral cay. They reported that it was 10 feet high and that Gannets flew from it as they approached and Noddies fluttered in the vicinity, all these birds utilising the cay as a place for rest. (These are apparently the only records of birds from Elizabeth Reef, and show that there is apparently no resident avian population, but that the exposed parts are merely used for rest by Lord Howe Island birds.)

April 16. Very rough trip towards Middleton Reef, the yacht often shooting breakers and rolling considerably. Saw Mutton Birds, Gannets, and a fluttering Petrel.

April 17. Noddies rested on the supine masts and on parts of the wreck of the *Annasona* on the Middleton Reef and were the only birds. In the afternoon, we visited a wreck identified as that of the *Errol*. Noddies perched all over this wreck and were very tame (see figure in Australian Museum Magazine, vi., 1936, 102). Most of them were moulting their wing feathers, and some had feathers off the breast.

April 18. Re-visited the wreck of the *Annasona* and noticed the Noddies (*Anous stolidus*) perching, some of them looking down at their toes as I have seen them acting at Michaelmas Cay, Queensland (see Australian Museum Magazine, iii., 1928, p. 248, fig.). As their name signifies, they were very tame. Some bones, and much guano and feathers, were found in different parts of the wreck.

A Gannet and a fluttering Petrel were seen seawards.

April 20. Frank Payten saw a Bosun Bird.

April 21. Arrived back at Lord Howe Island. Gannets here often attack the lead sinkers used by the fishermen and make dents in the lead with their beaks. Sometimes they daze themselves by the blow. One Gannet even attacked the *Wanderer's* log.

3. *Lord Howe Island to New South Wales.*

April 29. Leaving Lord Howe Island, a convoy of Gannets accompanied our craft, probably thinking that we were fishermen and that they would get some scraps. A few Noddies around.

April 30. Westward of Lord Howe Island, but out of sight of it. An Albatross seen this morning had a pale horn yellow bill and a good deal

of dark and light plumage above the wings. Tail white with a dark edging. It appeared near the ship for two days and may have been a colour phase of the Mollymawk.

A number of Mutton Birds and fluttering Petrels over a confused sea.

May 1. A white bird (Tern?) and a Mollymawk seen.

May 2. A Tern with black head seen and then a few others. Some occasional Mutton Birds and several Mollymawks. No Birds of Providence, Bosun Birds or Noddies. Northern coastline of New South Wales sighted.

May 3. Pelicans, Gannets, Mutton Birds, fluttering Petrels and Terns seen in Newcastle Bight.

Then Sydney.

FISHES.

Family Galeidae.

Genus Galeolamnoides Whitley, 1934.

Galeolamnoides Whitley, Mem. Qld. Mus., x., 4, June 30, 1934, 191. Orthotype, *Carcharias macrurus* Ramsay and Ogilby.

Galeolamnoides macrurus (Ramsay and Ogilby).

(Plate xiii., Fig. 1.)

Carcharias macrurus Ramsay and Ogilby, Proc. Linn. Soc. N.S. Wales (2), ii., 1, 1887, 163 and 1024. Port Jackson, N.S.W. Type in Austr. Mus.

Carcharinus brachyurus Waite, Rec. S. Austr. Mus., ii., 1, 1921, 14, fig. 8. Not *Carcharias brachyurus* Günther, 1870.

Carcharhinus macrurus McCulloch, Proc. Linn. Soc. N.S. Wales, xlvi., 4, 1921, 457, pl. xxxvii., fig. 4.

Id. Waite, Rec. S. Austr. Mus., iii., 1927, 224.

Id. Roughley, Austr. Mus. Mag., iii., 1927, 152 and frontispiece.

Id. Whitley, Austr. Zool., v., 1929, 354.

Id. Coppleson, Med. Journ. Austr., April 15, 1933, 450-458, figs. i., ii. and vi.

Id. Young and Mazet, Shark! Shark! 1933, 272.

Galeolamnoides macrurus Whitley, Mem. Qld. Mus., x., 1934, 191 and 198.

Whaler sharks were very common in the lagoons of both Middleton and Elizabeth Reefs. A male from the latter place had the following measurements and characters:—

Head nearly 12 inches to first gill-slit or 14½ to last. Fifth gill-slit smallest; fourth and fifth lie over pectoral base. Snout 4½. Snout to dorsal origin 20. Standard length 45. Upper caudal lobe 15 from middle of caudal peduncle; lower lobe 8½. Depth of body below first dorsal nearly 9. Distance from snout to pectoral origin 15. Ventral origin to pectoral origin 17. Caudal peduncle to dorsal origin 26. Origin of first dorsal fin to vent 14. Snout to vent 31½. Vent to tip of tail 27½. Width of mouth over 6 inches. Eye 1 by ¾. Nostril 1. Interorbital (above) 7¼. Internarial space 3¾. Nostril to eye about 2½; to tip of snout 3. 14 + 14 teeth in each jaw; no symphysial tooth. Tongue broadly rounded. A broad velum maxillare.

Base of first dorsal fin 5½ inches, its height 6¼ and last ray 2. Base of second dorsal 2, its height 1½, and last ray 2¼. Base of anal 2¼, height 3, and last ray 2. Base of ventral fin 3, its height 3½, and last ray 2. First dorsal origin nearer pectoral than ventral origin. Interdorsal space 14. Origin of second dorsal very slightly in advance of that of anal, though

latter fin is larger. Length of pectoral fin 12½, its base 3 and posterior lobe 3½.

Rows of prominent mucus pores on head. Nasal flaps broad and not lobed. Eye with a well developed nictitating membrane. Labial folds small. Lateral line obsolete. No spiracles. A pit above and below the caudal peduncle, which is transversely oval, there being no caudal keel. Caudal fin notched. A low keel along middle of back between the dorsal fins.

General colour, light ashy grey above, and pale yellowish white below. No black tips to fins. Pupil of eye dark green surrounded by a black line. Iris bronze, surrounded by a grey ring. Remainder of eye whitish.

Some teeth and portion of integument preserved from the above specimen, which was 59 inches in total length.

Austr. Mus., Regd. No. IA 6856.

Elizabeth Reef, 14 April, 1936.

Several other specimens were caught very easily by being hooked and pulled aboard, being despatched by bullets. Males and females, all immature, were represented, and nothing identifiable was found in their stomachs.

At Middleton Reef, on 17th April, larger examples (6 feet or so long), were caught on kingfish bait; these were darker grey than the Elizabeth Reef ones. One of the largest examples was so dark as to appear almost blackish in the water, with fins dusky, particularly towards the edges. The Whaler shark apparently becomes darker with age, and old specimens are known as Black Whalers or Shovelnose Sharks to the fishermen in New South Wales, who say that this shark is the only one that "bleeds through the skin" when caught. Large blood vessels certainly occur just below the skin and drops of blood are said to percolate through the integument of captured specimens; this did not, however, occur in the case of my reef examples.*

This species is known to attack man in Australia, and is evidently just as dangerous on the reefs, as in the newspaper accounts of the "Errol" shipwreck on Middleton Reef it is recorded that the captain was eaten by sharks, and only his legs and boots were recovered.

When working in the lagoons we kept a good lookout for sharks, therefore, but they did not invade the impounded water on the reef crest at Middleton Reef, where most of my collecting was done.

The species is also common at Ball's Pyramid and at Lord Howe Island, where necklaces are made from the vertebrae. Sometimes specimens are found with numbers of vertebrae coalesced.

The type of *macrurus* in the Australian Museum is an old stuffed specimen, but the species was redescribed from fresh material by McCulloch in 1921. A comparison of my measurements and proportions with his shows close agreement, the only noteworthy discrepancies being that in my Elizabeth Reef example the width of the mouth (at least 6 inches) rather exceeds the length of the snout before it (4¾) and the nostrils are about midway between tip of snout and mouth, but there may be some variation in the elongation of the snout with age. The mouth is wider than long. The first dorsal fin rises nearer the snout than the tail. The caudal fin is shorter than the distance between the posterior angles of the bases of the two dorsals.

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*Compare the paper on the Subcutaneous Venous System of *Scyliorhinus* by Marples, *Proc. Zool. Soc.*, London, 1936, 317, pl. i. and figs. 1-7. Also Daniel, Elasm. Fishes, ed. 3, 1934, 202, figs.

Subfamily Galeocerdinae.

Genus Galeocerdo Müller and Henle, 1837.

Galeocerdo rayneri Macdonald and Barron.

Galeocerdo rayneri Macdonald and Barron, Proc. Zool. Soc., London, September 15, 1868, 369, pl. xxxii. Australian coasts (type) and Lord Howe Island.

A small male, about 44 inches to the upper caudal pit, was hooked on kingfish bait at Middleton Reef on the night of April 16. It had about thirty-four dark spots along the sides, and some more along the tail; they were in about three longitudinal rows anteriorly. First dorsal fin pale grey; almost whitish in life. It vomited all its food before being hauled aboard.

Some teeth preserved as Austr. Mus. Regd. No. IA 6860.

A larger specimen had the body more conspicuously banded, but the species was not as common as the whaler at Middleton Reef.

Family Exocoetidae.

My friend Anton Brunn has recently issued a comprehensive report on the Flying-fishes (*Exocoetidae*) of the Atlantic (Dana Report, No. 6, 1935) which is easily the most thorough and up-to-date account of the group and has been utilised in identifying the Tasman Sea species which were washed aboard the "Wanderer" in heavy weather between Sydney and Lord Howe Island.

Flying fishes are common in the open ocean off the warmer parts of Australia, but the species have not all been captured and classified. Often I have watched them from various ships between Australia and Lord Howe Island, the Solomons, Fiji, New Caledonia, the New Hebrides, Cook Islands and elsewhere, and noticed from the "wing" coloration that there were more species to be seen than were currently listed. The first fish recorded from anywhere near the eastern coast of Australia was a flying-fish with black body and red wings noted by Bougainville (Hist. Acc. Voy., iv., 1773, 307-308) in the open sea eastward of the Great Barrier Reef, and, earlier still, Dampier figured "a flying fish taken: in ye open sea", which is recognisable as an *Exocoetus*.

Genus Exocoetus Linné, 1758.

Exocoetus Linné, Syst. Nat., ed. 10, 1758, 316; ed. 12, 1766, 520. *Ex.* Artedi, 1738. Haplotype, *E. volitans* Linné.

Exocoetus volitans vagabundus, *subsp. nov.*

Exocoetus volitans Linné, Syst. Nat., ed. 10, 1758, 316. Europe and America. *Id.* White, Voy. N.S.W., 1790, 295, and plate, fig. 2 (N.S.W.). *Id.* Richardson, Rept., 12th meet. Brit. Assn. Adv. Sci., 1842 (1843), 25. *Id.* Griffith, Anim. Kingd. (Cuvier), x., 1834, 396 and footnote. *Id.* Fowler, Proc. Acad. Nat. Sci. Philad., 1907 (1908), 424 (Victoria). *Id.* McCulloch and Whitley, Mem. Qld. Mus., viii., 1925, 139 (Queensland). *Id.* McCulloch, Austr. Mus. Mem., v., 1929, 104.

Exocoetus evolans, Cuvier and Valenciennes, Hist. Nat. Poiss., xix., 1846, ed. 2, 101 (New Holland). *Id.* Günther, Cat. Fish. Brit. Mus., vi., 1866, 282 (N. Australia). *Id.* Steindachner, Sitzb. Akad. Wiss. Wien., liii., 1866, 470 (Port Jackson). *Id.* Waite, Austr. Mus. Mem., iv., 1899, 57 (N.S.W.). *Id.* Zietz, Trans. Roy. Soc. S. Austr., xxxiii., 1909, 263 (S.

Austr.). *Id.* McCulloch, Austr. Zool., ii., 2, 1921, 30, pl. x., fig. 106; Austr. Zool. Handb., i., 1922, 30.

Exoccetus volans Saville-Kent, Great Barrier Reef, 1893, 299 and 370 (Queensland).

D. 13; A. 13; P. 2 + 14; V. 1 + 5; C. 15.

Sc. 42, L. tr. 6½ (Dorsal origin to L. lat.). L. lat. 36, ceasing by caudal peduncle. There appear to be 17 or 18 predorsal scales, but some are missing.

Following Bruun's methods of investigation, the specimen of two-winged flying-fish may be described as follows:—

Head, 25 mm. Snout, 5. Diameter of eye, 7. Interorbital, 9. Length of pectoral, 67. Ventral, 12. Upper lobe of tail, 18.5. Lower lobe of tail, 26.5. Predorsal length, 62. Breadth of body, 14. Depth, 17. Height of dorsal, 10. Preventral length, 40.5. Preanal length, 63. Standard length, 94. Total length, 119 mm.

Bruun has discarded the more commonly used method of expressing the measurements in fractions of either head or standard length, but reduces his measurements to percentages of the standard length. The above measurements thus reduced are as follows:—

Head, 26.6%. Snout, 5.3%. Eye, 7.4%. Interorbital, 9.5%. Pectoral, 71.2%. Ventral, 12.7%. Upper lobe of tail, 19.6%. Lower lobe of tail, 28.2%. Predorsal length, 66%. Breadth of body, 14.9%. Depth, 18%. Height of dorsal, 10.6%. Preventral length, 43%. Preanal length, 67%.

The present specimen works down to *Exocoetus volitans* in Bruun's key to adults of Atlantic species. He found that juvenile characters disappeared before a length of 100 mm. is achieved, and my specimen just enters this category. On comparing it with his tables, the following differences are revealed:—

Diameter of eye, 7.4, instead of 6.2 to 6.7% of standard length.

Interorbital, 9.5, instead of 7.9 to 8.6% of standard length.

Pectoral, 71.2, instead of 73.2 to 77.1% of standard length.

Ventral, 12.7, instead of 13.3 to 14.5% of standard length.

Otherwise my specimen comes within the limits of variation of his Table 9. However, my Tasman Sea specimen differs more in cephalic characters, especially as regards the interorbital, which is 9.5% of the standard length, a value much higher than any of Bruun's and apparently not due to immaturity. In the position of the fins my specimen shows no marked abnormality, but the pectoral and ventral percentages show notably lower values, only approached by some figures in Bruun's Table 13, also the fin-counts approach those of Table 16 rather than the earlier ones.

Mouth toothless.

Colour, in spirit, brownish to greyish above, brilliant silvery, with a slight bluish tinge on sides and white tinged with yellowish below. Anal and ventral fins practically hyaline. Dorsal with a few smoky marks. Caudal infuscated. Pectorals uniform, greyish for the most part, but with a margin of white and the lowermost rays also white.

Described from a specimen 94 mm. in standard length or nearly 4¾ inches overall.

Locality: Tasman Sea, about half-way between Sydney and Lord Howe Island. Washed aboard the yacht "Wanderer" at night, 8th April, 1936. Coll. G. P. Whitley, Austr. Mus., Regd. No. IA 6854.

In view of the differences observed between this specimen and the Atlantic *Exocoetus volitans,* and considering their wide geographical separation, I provide a new subspecific name *vagabundus* for the Australian form in reference to its distribution and after the yacht "Wanderer".

The Australian Museum has a few specimens of the two-winged *Exocoetus,* but it appears as if the four-winged flying fishes are commoner in Australian seas, as they are better represented in the collections. In the Atlantic, on the other hand, by far the largest quantity of adult flying-fishes examined by Bruun belonged to *Exocoetus volitans.*

Two specimens labelled "Australian Seas" probably came from the Tasman Sea.

The specimens labelled "South Pacific Ocean" came aboard a ship at 8.30 p.m. one evening in August, 1930, and were secured by Mr. Melbourne Ward when east of the Friendly Islands and south of Niue in 22 deg. 08 min. S. lat. and 169 deg. 02 min. W. long. Previous records from Oceania have been given by Fowler (Mem. Bishop Mus., x., 1928, 80, fig. 16; xi., 1931, 319 and xi., 1934, 393), most of whose specimens were from the Hawaiian Islands.

No unlocalised specimens have been utilised, although there are some interesting flying fishes, unfortunately without data, in the Australian Museum. One of these has two long barbels, D. 12, A. 10, and pectoral fins not reaching base of caudal; it is 6 inches long and is apparently the young of a four-winged species.

Fowler includes in the synonymy of *Exocoetus volitans* a fish named *Exocaetus longibarba* by De Vis (Proc. Linn. Soc. N.S. Wales, viii., 1884, 454) from New Britain, notwithstanding the fact that the young phase of *volitans,* as figured by Fowler, has no barbels. I have seen no specimen corresponding to De Vis' description.

Genus Hirundichthys Breder, 1928.

Hirundichthys speculiger praecox, *subsp. nov.*

? *Exocoetus speculiger* Cuvier and Valenciennes, Hist. Nat. Poiss., xix., "1846" = May, 1847, 94; ed. 2, 69. Mers des Indes (type), Pacific locs., Mauritius, and King George's Sound, W. Australia. *Id.* Günther, Cat. Fish. Brit. Mus., vi., 1866, 287 (Australia, etc.).

Cypsilurus speculiger Jordan and Seale, Bull. U.S. Bur. Fish, xxv., 1905 (1906), 209, fig. 13. Between Auckland and Sydney. *Id.* McCulloch, Austr. Zoologist, ii., 2, 1921, 30 (N.S.W.).

Exonautes speculiger Waite, Rec. Canterb. Mus., i., 1907, 15 (New Zealand). *Id.* McCulloch, Zool. Res. Endeavour, i., 1, 1911, 30 (between Port Stephens and Newcastle, N.S.W.). *Id.* McCulloch, Austr. Mus. Mem., v., 1929, 106.

On the morning of April 10, a four-winged flying-fish was found on the "Wanderer's" deck; it was somewhat sun-dried, so that the following measurements may be regarded as approximate. The fins were dusky, the pectorals having ill-defined oval white spots. It belongs to the species listed as *Cypselurus speculiger* from New South Wales, and well figured by Jordan and Seale from a specimen about 11 inches in total length.

All the Australian Museum specimens are juvenile, the largest being only a little over 3½ inches in length.

These specimens do not agree with Cuvier and Valenciennes' original description of *speculiger* in their proportions and the coloration of the

paired fins is also different. It was only with considerable doubt that those authors identified a Western Australian specimen as their species and Günther, in his Catalogue, followed by recording another Australian specimen as *Exocoetus speculiger?* Later authors, such as Bleeker, Jordan and Seale, and others, have regarded any four-winged flying-fish with mirrored pectorals and having the dorsal and anal origins opposite one another as *speculiger*. Since, however, my Tasman Sea specimens are not typical *speculiger,* I provide the new subspecific name *praecox* for the eastern Australian form, the holotype being registered No. IA 4050 in the Australian Museum, from Port Jackson, New South Wales.

Family Synodontidae.

Genus Synodus Scopoli, 1777.

Synodus Scopoli, Introd. Hist. Nat., 1777, 449. Haplotype, *Esox synodus* Linné. *Id.* Norman, Proc. Zool. Soc. Lond., 1925, 102 (refs. and synon.).

The generic name *Synodus* is at present employed for a number of species which would be better separated into subgenera to facilitate classification. In his recent invaluable revision of these lizard-fishes, Norman was not certain as to the identity of the genotype, *Esox synodus* Linné, an American species, but I see no reason for doubting the correctness of his determinations. Another Linnean species, *Salmo saurus,* is evidently the type of an allied genus to be known as *Tirus* Rafinesque, with *Saurus* Cuvier, *Alpismaris* Risso, and *Laurida* Swainson as its synonyms. No other generic names call for consideration here, so that the way is clear for new nominations.

The following new names are therefore proposed, the key-characters given by Norman being sufficiently diagnostic for their definition.

Negotirus, nov. Orthotype *Synodus evermanni* Jordan and Bollman, and including *S. intermedius* (Spix), and *S. poeyi* Jordan.

Newtonscottia, subg. nov. of *Synodus.* Named in honour of Mr. H. Newton Scott, navigator of the "Wanderer". Orthotype, *Synodus houlti* McCulloch, and including *S. variegatus* (Lacépède) with its synonyms and *S. lacertinus* Gilbert. This leaves *S. synodus* and *S. meleagrides* in the typical subgenus *Synodus.*

Austrotirus, nov. Orthotype, *S. similis* McCulloch. Also includes *S. kaianus* (Günther), and *S. indicus* (Day).

The species called *Salmo saurus* Linné stands alone as the representative of the genus *Tirus* of Rafinesque.

Allouarnia nov. Orthotype, *Synodus sageneus* Waite, a well-known Western Australian form = *Allouarnia sagenea.* Named after Francois de St. Allouarn, an early explorer, who claimed Western Australia for France in 1772.

Exotirichthys nov. Orthotype, *Synodus altipinnis* (Günther), as described and figured by Norman. Tentatively includes *S. foetens* (Linné) and *S. scituliceps* Jordan and Gilbert.

Esosynodus, nov. Orthotype, *Saurus lucioceps* Ayres.

Synodus (Newtonscottia) houlti McCulloch.

Synodus japonicus McCulloch, Mem. Qld. Mus., vii., November 4, 1921, 165 (Murray Island and Lord Howe Island). Not *Cobitis japonica* Houttuyn, 1782, from Nagasaki. *Id.* McCulloch, Austr. Mus. Mem., v., 1929, 78.

Synodus houlti McCulloch, Mem. Qld. Mus., vii., November 4, 1921, 165, pl. viii., fig. 1. Near the Capricorn Group, Queensland. Holotype in Queensland Museum. *Id.* McCulloch, Austr. Mus. Mem., v., 1929, 79.

D. 12; A. 9; P. 14; V. 8; C. 17. L. lat., 61. L. tr., 5½/1/8.

Head (45 mm.), 3.4; depth (23), 6.7 in standard length (155). Eye (6), 7.5. Snout (10), 4.5. Interocular (6), 7.5. Interorbital (4), 11.2. Pectoral (16), 2.8 in head. Upper surface of head rugose above and behind eyes. Snout broader than long. Upper lip projecting very slightly beyond lower, not ending in a fleshy knob. Two or three rows of palatine teeth anteriorly. Mouth extending well beyond eye. Postoral portion of cheek naked.

5½ scale-rows between lateral line and middle of dorsal fin. 19 scales between occiput and origin of dorsal fin, which is nearer the adipose fin than the snout. Longest ray of dorsal less than half length of head and, when laid back, not reaching the tips of succeeding rays. Base of anal fin shorter than that of dorsal. Origin of anal fin about four times as distant from head as from base of caudal. Pectorals short and rounded, extending slightly beyond vertical of ventral origin. Ventrals about as long as postocular portion of head. Caudal peduncle depressed.

Colour in spirits brownish above and whitish below. A series of dark grey blotches along the median line of the back, double just before the dorsal fin. A similar series along the upper part of the sides. About eight large indistinct greyish blotches along lateral line. Numerous smoky marks and lighter marbling on head. Most of the scales with tan borders. Fins plain brownish-yellow. Eye pinkish and silvery.

No dark mark above gill-opening.

Described from a specimen 155 mm. in standard length or about 6½ inches over all.

Locality: Elizabeth Reef, April 15, 1936. Caught on a spinner by Mr. H. Newton Scott, a surprising capture, since the spinner was almost as large as the fish itself, which must be very voracious as the strong teeth and expansive mouth suggest. Mr. Scott's navigation meant everything to the expedition, and he also kindly assisted me to get specimens from the reefs. I have much pleasure in naming the new subgenus in his honour.

This fish enters Norman's section relating to *Synodus variegatus* (Lacépède). However, it disagrees in several respects from his description —in the insertion of dorsal and anal fins in relation to other parts, length of ventral fins, and in colour—and it is probable that more than one species is included in Norman's synonymy of *S. variegatus*.

A queried synonym of Norman's is *Synodus houlti* McCulloch (Mem. Qld. Mus., vii., 1921, 165, pl. viii., fig. 1) from the Capricorn Group, Queensland, but this appears to be a good species, agreeing better with my Elizabeth Reef specimen than Lacépède's *variegatus*.

McCulloch's type is not in the Australian Museum, but Lord Howe Island specimens labelled *Synodus variegatus* agree with the Elizabeth Reef example and Australian and Lord Howe Island records of *"Synodus japonicus"* may be referred to *houlti*. The coloration and relative proportions of the head appear to be rather variable.

Family Muraenidae.

Genus Gymnothorax Bloch, 1795.

Gymnothorax flavimarginatus annasona, *subsp. nov.*

Muraena flavimarginata Rüppell, Atlas zu Rüppell, Reise (Senckenb. Nat. Ges.), Fische, 1831, 119, pl. xxx., fig. 3. Red Sea.

Muraena flavomarginata Günther, Cat. Fish. Brit. Mus., viii., 1870, 119 (Norfolk Island specimen).

Gymnothorax flavimarginatus Waite, Rec. Austr. Mus., v., 3, March 11, 1904, 145 (Lord Howe Island), and Trans. Roy. Soc. S. Austr., xl., 1916, 453.

A small moray or reef eel was obtained on Middleton Reef. It was rather damaged, but the following characters can be made out.

Head (2½ inches), 7.6; distace from snout to vent (9), 2.1; tail (10), 1.9 in total length (19). Eye, 5 mm. Snout, 14. Interorbital, 8. Upper jaw, 30. Depth of body about 25. Head about one-third of trunk and mouth-opening about half of head. Head long, with rather a long snout and having a few small mucus pores.

Anterior nostrils tubular, posterior ones without tube. Eye over middle of mouth-opening. Lips entire. A single series of teeth, rather like those of a shark, but with entire edges, in each jaw, less than 20 on each side of mandibles; no inner series of teeth. At least two long, trenchant, depressible fangs on the vomer. Mesial teeth on intermaxillary fang-like.

Form of body elongate, somewhat compressed.

Dorsal fin high, originating in advance of the level of the gill-openings; anal lower and arising just behind the vent; the two join the caudal which is truncated in this specimen, perhaps due to injury.

When alive I noted the colours as "brown and white. White edges to fins. Pupil dark blue. Iris coppery orange", but since death and preservation in alcohol the coloration has altered slightly, thus:—Ground colour creamy yellowish to brownish, densely overlain by small irregular dark brown blotches which are nearly all smaller than the eye. Anal, caudal and posterior margin of dorsal edged with cream. Eye blue. No dark mark at gill-slit or at corner of mouth. No crossbands.

Described (and figured) from the holotype of the subspecies, a specimen 19 inches long. Austr. Mus., Regd. No. IA 6867.

Locality: Middleton Reef. Speared by Mr. Tom Payten near the wreck of the "Annasona", April 18, 1936. Other specimens of this species are preserved in the Australian Museum collection from Lord Howe Island, labelled as *Gymnothorax flavimarginatus* (Rüppell).

The original figure of *Muraena flavimarginata* Rüppell, shows an eel with uniform dusky head, gill-opening in a small black patch, smaller mottlings on the body and yellow margins to fins. Weber and Beaufort (Fish. Indo-Austr. Archip., iii., 1916, 374) give an array of synonyms of *flavimarginata,* which they describe as having the head more than 3-3.5 in trunk, and Bleeker's figure in the "Atlas Ichthyologique" illustrates this feature.

Gymnothorax flavimarginatus has been recorded from Darnley Island, Queensland, by Richardson (Zool. Voy. Erebus and Terror, Fish, 1848, 84) as *Muraena pratbernon* Quoy and Gaimard, and is included in McCulloch's Check-list as *Gymnothorax javanicus* Bleeker, a species which Jordan and Seale, writing of Samoan specimens, regarded as distinct from *flavimarginatus.* In view of the differences in colour and proportions, I consider that the Phillipian form of this species (*i.e.*, specimens from Middleton Reef, Lord Howe Island, and Norfolk Island) would be better distinguished by a subspecific name and I propose *annasona* for them with Middleton Reef as type-locality.

An unidentifiable eel was obtained from the stomach of a Red Bass.

Family Epinephelidae.

Genus Epinephelus Bloch, 1793.

Epinephelus forsythi, *sp. nov.*

(Plate xiii., fig. 4.)

The Black Rock Cod was a common fish at both Elizabeth and Middleton Reef. It is a savage species and several of us were rushed by them as we waded on Middleton Reef, and we had to beat them off. Larger specimens were hooked from the yacht and were welcome as food. This species is recorded from Australia in literature as *Epinephelus fuscoguttatus* (Forskal), but this name is not acceptable as the Phillipian specimens are atypical.

Forskal's original description under *Perca summana* var. *fusco-guttata* (Desc. Anim., 1775, pp. xi. and 42) mentions "Corpus caerulescens. Dentes multi, setacei. Macula nigra in dorso caudae. Guttae circulares fusco-ferrugineae. Caput, maxillae and M.Br. pariter guttatae. Oculi remotiusculi. Vertex inter oculos planus, subcavus. Squamae parvae, vix dentatae. Cauda altior. Rad. P. 18. C. 18 . . ." Whilst the colouring of species of *Epinephelus* is variable within limits, the colours given by Forskal cannot apply to the Phillipian species, and neither can some of his other characters. As there is no synonym from the Australasian region, I propose *Epinephelus forsythi,* sp. nov.; named in honour of Mr. J. Forsyth, a member of the expedition. Since specimens were not preserved from the reefs, being too large, the type locality is designated Lord Howe Island, and Austr. Mus., Regd. No. I 1793, may be taken as the holotype.

Notes on a specimen from Elizabeth Reef:—

D. xi/14 (15); A. iii/8 (9). L. lat., *circa* 96, the tubules small, apparently not branched. Head (10¾ inches), 2.5; depth of body (8) 3.4 in standard length (27¼). Eye (1⅜), 7.8 in head. Total length, 30½ inches.

Preoperculum with obsolescent serrae. Three opercular spines, the lowermost entirely covered by integument and its tip situated behind the tips of the others. Caniniform teeth on all mouth-bones.

Pectorals, soft dorsal and anal fins, and caudal rounded. Colour very dark brownish grey with black blotches on posterior parts of median fins and an obscure ephippium on caudal peduncle. No cross-bands.

The stomach contained one much digested fish. No gonads apparent.

Middleton Reef specimen:—

D. i. + xi/14 (15); A. iii/9; P. i/18.

Head (10), 2.6; depth (9), 2.7 in standard length (26).

Total length, 29 inches.

Preoperculum rough. Lowermost opercular spine hidden by integument, its tip midway between the levels of the tips of the others.

Dorsal spines increasing in length backwards. All fins rounded.

Body lighter brown than Elizabeth Reef example and marbled with greyish. The margins of the ventrals and the unpaired fins are kid white. Sides of head, body, and parts of fins with blackish spots. A dark ephippium over caudal peduncle.

The accompanying figure shows a living specimen photographed at Lord Howe Island by the late Allan R. McCulloch.

Family Arripididae.

Genus Arripis Jenyns, 1840.

Arripis trutta (Bloch & Schneider).

Sciaena trutta Bloch & Schneider, Syst. Ichth., 1801, 542. *Ex* Forster MS. Queen Charlotte Sound, New Zealand.

Arripis trutta McCulloch, Austr. Mus. Mem., v., 1929, 200 (synon.).

The "Salmon" or Kahawai was seen, but not collected, at Elizabeth and Middleton Reefs.

Family Carangidae.

Genus Usacaranx Whitley, 1931.

Usacaranx Whitley, Austr. Zool., vi., 4, February 13, 1931, 316. Orthotype, *Caranx nobilis* Macleay, Proc. Linn. Soc. N.S. Wales, v., 4, May 20, 1881, 532, from Port Jackson, N.S. Wales.

The following new species is named *insulanorum* in honour of the three Lord Howe Islanders who joined the "Wanderer" Expedition and performed yeoman services on the reefs; Messrs. Tom Payten, Frank Payten, and Maurice Wilson, all of whom helped me to collect specimens.

Usacaranx insulanorum, *sp. nov.*

(Plate xiii., fig. 2.)

D. viii/26; A. ii/23; P. i/20.

Length of head a little more than length of body and nearly one-quarter of the total length (27½ inches). Eye (25 mm.) 7.4 in head (185). Snout (80), subequal to postorbital portion of head (80), and longer than maxillary (71). Pectoral fin (168), shorter than head. The curved portion of the lateral line (200) is equal to the straight portion in length.

Snout somewhat produced, rather overhanging. Maxillary not reaching to below eye. A single row of short, peg-like teeth in both jaws, though partly hidden by the coriaceous lips. No villiform teeth. No teeth whatever on vomer or palatines. A broad series of spaced conic or molariform pharyngeal teeth. Fourteen plus twenty-five long gill-rakers on first branchial arch.

Thorax entirely scaly except for a small median patch where scales appear to be obsolete. About 24 scutes, mostly on the posterior half of the straight portion of the lateral line, the largest occupying only about one-third of the depth of the caudal peduncle.

Colour grey above and silvery with iridescence. White below. Pupil of eye black. Fins all dirty yellowish.

Described and figured from a female specimen having minute yellow ova and numerous pyloric caeca.

Locality: Elizabeth Reef, 15th April, 1936.

This species belongs to the *Caranx georgianus* group, embraced by my genus *Usacaranx*, but differs from its congeners in the form of the snout, the small number of dorsal rays, etc.

Family Seriolidae.

Genus Regificola Whitley, 1931.

Regificola Whitley, Austr. Zool., vi., 1931, 316. Orthotype, *Seriola grandis* Castelnau.

REGIFICOLA GRANDIS (Castelnau).

Seriola grandis Castelnau, Proc. Zool. Acclim. Soc. Victoria, i., July 15, 1872, 115. Melbourne Markets. *Id.* McCulloch, Biol. Res. Endeavour, iii., 3, 1915, 121, pl. xxxv., fig. 1 (refs. and synon.).

Kingfish were very common at Elizabeth and Middleton Reefs and were often hooked from the yacht. A specimen nearly two feet over all had D.vi/34; A.i/21; head 5; depth 4½; fins yellowish.

Family LUTJANIDAE.

Genus LUTJANUS Bloch, 1790.

LUTJANUS COATESI Whitley.

Lutjanus coatesi Whitley, Mem. Qld. Mus., x., 4, June 30, 1934, 176, pl. xxvi., fig. 2 and text fig. Off Townsville, Queensland. Holotype (No. I.4977) in Queensland Museum.

At Elizabeth Reef, April 15, 1936, Mr. T. Payten caught a couple of specimens of this species. I had on board a copy of the original description and was able to make some comparative notes, since the species was hitherto known only from the holotype.

Specimen A.—Total length, 20½ inches. Head, 158 mm. Depth of body, 166. Length to hypural joint, 446. Eye, 27. Snout, 55. Maxillary, 72. Preorbital, 35. Interorbital, 48. Pectoral, 115. Depth of caudal peduncle, 54. Longest (fourth) dorsal spine measures 50 mm., the fifth and sixth spines are little shorter. Gill-rakers 8 + 16 on first branchial arch. The first (upper) seven are stumpy and rugose, the main ones (eighth to eighteenth) slender and strongly denticulate until towards the last ones which again become stunted and rugose. The longest (ninth) gill-raker is at the angle and measures 16 mm. Behind this anterior series is a row of small, very rugose gill-rakers, corresponding to the front ones.

Preoperculum finely serrated. Interopercular frill not developed. Eight rows of scales on preoperculum and five or six on operculum. Seventeen predorsal scales. Suprascapula bluntly serrate. Pectoral fins reaching to beyond the vertical of the vent but not quite to level of anal fin.

In life, the eye was golden peach-colour, and the dorsal fins dark burgundy. No wavy lines on head. The dark portions of the body-scales tend to form stripes along the sides as in my figure.

The stomach contained small lumps of digested animal remains which may have been fish or perhaps cephalopod. Five pyloric caeca. Testes about 2¼ inches in length, banana-shaped.

Austr. Mus., Regd. No. IA.6857.

Specimen B.—Nearly 31 inches over all. It has the preopercular denticulations obsolete, the interopercular frill present, and about fifteen predorsal scales. It was yellower about the face than Specimen A, and had a dark red spinous dorsal fin. It was another male with gonads of irregular leaf-shape, 4½ inches long. The stomach contained an organic mass resembling a sea-slug (*Dolabella*) and pieces of crab, also a partly digested snake-eel, over 14 inches long.

In view of the fact that this species is reputed to be poisonous in Queensland, we did not eat any of these fish. It was interesting to find it occurring on Elizabeth Reef, as it is quite unknown to the fishermen of Lord Howe Island.

Family Girellidae.

Genus Iredalella Whitley, 1931.

Iredalella Whitley, Austr. Zool., vi., 1921, 320. Orthotype, *Girella cyanea* Macleay.

Iredalella cyanea (Macleay).

(Plate xiv., fig. 2.)

Girella cyanea Macleay, Proc. Linn. Soc. N.S. Wales, v., 3, February, 1881, 409. No locality (probably coast near Sydney).

This is the Bluefish or Panfish of the Lord Howe Islanders. It was very common at Elizabeth and Middleton Reefs and a few small specimens (IA.6861-3) were even obtained by Mr. Forsyth by firing rifle shots into the pools in the hull of the "Annasona" wreck.

Weed-eaters, with peritoneum black. This species is still fairly common at Lord Howe Island, and Ball's Pyramid, though not so plentiful as formerly, obviously owing to overfishing; even during my brief stay at Lord Howe Island on this occasion, several two-feet long females with ripe ovaries were killed at Ball's Pyramid. The Bluefish used to be caught in New South Wales and Bluefish Point, Manly, is named from them, but it is rarely, if ever, caught near Sydney now.

Family Labridae.

Genus Thalassoma Swainson, 1839.

Thalassoma lunare (Linné).

Labrus lunaris Linné, Syst. Nat., ed. 10, 1758, 283; ed. 12, 1766, 474. In Indiis.

Thalassoma lunare Fowler & Bean, Bull. U.S. Nat. Mus., 100, vii., April 17, 1928, 321 (refs. and synon.).

Specimens identified as this species were seen swimming near the wreck of the "Annasona" at Middleton Reef on 17th April, 1936. This fish is common at Lord Howe Island.

Thalassoma quadricolor (Lesson).

(Plate xiv., fig. 1.)

?? *Labrus trilobatus* Lacépède, Hist. Nat. Poiss., iii., 1802, 454 and 526. Le Grand Ocean équatoriale.

? *Scarus purpureus* Bonnaterre, Tabl. Encycl. Meth., Ichth., 1788, 94. Based on *"Scarus purpureus"* Forskal, Descr. Anim., 1775, x. and 27, from Djedda, Red Sea. Not the *Julis purpurea* of Rüppell or Gunther = *Julis ruppellii* Klunzinger, Verh. Zool. Bot. Ges. Wien., xxi., 1871, 536.

Labrus purpureus Gmelin, Syst. Nat. (Linné), ed. 13, 1789, 1284. *Ex* Forskal.

Grammistes purpureus Bloch & Schneider, Syst. Ichth, 1801, 190. *Ex* Forskal.

Scarus purpuratus Shaw, Gen. Zool. (Pisces), iv., 2, 1803, 397. *Ex* Forskal.

Julis quadricolor Lesson, Dict. Class. Hist. Nat., xiii., January, 1828, 27. Tahiti. Name only, with reference to a plate then unpublished. *Id.* Lesson, Mem. Soc. Hist. Nat. Paris, iv., September, 1828, 400 and Voy. Coquille, ii., 1831, 139, pl. xxxv., fig. 1 (Tahiti and Bora Bora). *Id.* Bleeker, Atlas Ichth., i., 1862, 93, pl. xxxiv., fig. 3.

Scarus georgii Bennett, Fish. Ceylon (5), 1830, No. 24, pl. xxiv. Ceylon.

? *Julis bicatenatus* Bennett, Proc. Comm. Sci. Zool. Soc., London (14), March, 1832, 167. Mauritius.

Julis semicoeruleus Rüppell, Neue Wirbelth. Abyssin., Fische (4), 1835, 10, pl. iii., fig. 1. Red Sea.

Julis umbrostygma Rüppell, *id. ib.*, fig. 11, pl. iii., fig. 2. Red Sea.

?? *Julis aeruginosus* Cuvier & Valenciennes, Hist. Nat. Poiss., xiii., early 1839, 441. Mauritius.

Julis cyanogaster Cuvier & Valenciennes, Hist. Nat. Poiss., xiii., early 1839, 444. Tahiti. Ex *Labrus cyanogaster* Solander MS.

Labrus vittatus Cuvier & Valenciennes, Hist. Nat. Poiss., xiii., 1839, 445. *Ex* Forster MS. Tahiti. Not *"Labrus vittatus"* Walbaum, 1792.

Julis erythrogaster Cuvier & Valenciennes, Hist. Nat. Poiss., xiii., 1839, 447. Tahiti (type) and Ulea.

Labrus erythrogaster Cuvier & Valenciennes, Hist. Nat. Poiss., xiii., 1839, 447. *Ex* Solander MS. Tahiti

Labrus formosus Cuvier & Valenciennes, Hist. Nat. Poiss., xiii., 1839, 447. *Ex* Forster MS. Tahiti. Not *Julis formosus* Cuv. & Val., *ibid.*, 439. Preoccupied by *Labrus formosus* Bennett, 1830.

? *Scarus quinquevittatus* Lay & Bennett, Zool. Blossom, 1839, 66, pl. xix., fig. 1. Loo-Choo.

Scarus georgii quarti Bennett, Fish. Ceylon, ed. 3, 1841, No. 24, pl. xxiv. Ceylon—*fide* Sherborn, Index Animalium.

? *Julis guntheri* Bleeker, Versl. Kon. Akad. Wet., xiii., 1862, 279 and Atlas Ichth., i., 1862, 94, pl. xxxiv., fig. 1. Celebes.

Thalassoma immanis Fowler, Proc. Acad. Nat. Sci. Philad., 1899 (January, 1900), 488, pl. xviii., fig. 2. Thornton Is., Carolines.

Thalassoma berendti Seale, Occas. Pap. Bish. Mus., i., 4, 1901, 15, fig. 7. Honolulu. Name emended to *T. berndti* by Jordan & Seale, 1905.

Julis trilobata Ogilby, Austr. Mus. Mem., ii., 1889, 68 (Lord Howe Island). Not *Labrus trilobatus* Lacépède.

Thalassoma trilobatum Waite, Rec. Austr. Mus., v., 1904, 209. Not *Labrus trilobatus* Lacépède.

Thalassoma purpureum Jordan & Seale, Bull. U.S. Bur. Fish., xxv., 1906, 305. *Id.* McCulloch & Waite, Trans. Roy. Soc. S. Austr., xl., 1916, 445 and 454 (Lord Howe and Norfolk Islands). Not *Scarus purpureus* Bonnaterre.

Julis purpurea Günther, Journ. Mus. Godeff., vi., 16 (Fische der Sudsee, viii.), 1909, 292, pl. cxlix., fig. A (Friendly Islands, etc.). Not *Scarus purpureus* Bonnaterre.

A gorgeously coloured parrot fish was seen swimming near the wreck of the "Annasona" on Middleton Reef on April 17th, 1936. Unfortunately it evaded capture, but was easily recognisable as a well known Lord Howe and Norfolk Island species which has been recorded from those places as *Julis trilobata* or *Thalassoma trilobatum* and *purpureum*. It is doubtful, however, whether these specific names are applicable, since the typical *Labrus trilobatus* was very briefly described by Lacépède and seems to be a different fish, and Forskal's *"Scarus purpureus"* from the Red Sea is also regarded as distinct by some authors. Under the circumstances, I am using Lesson's name *quadricolor* as his figure agrees quite well with the Phillipian

form, but I have included a number of nominal synonyms in the references given above.

Amongst the Phillip Gidley King papers in the Mitchell Library, Sydney, I have seen a painting of this species of parrot fish labelled "Norfolk Island. Painter unknown. 1793/4". This drawing may have been the work of Thomas Watling (I do not think it is by George Raper), and is probably the first illustration ever made of this parrot fish. It is reproduced here in monochrome, with grateful acknowledgments to the Mitchell Library.

Whilst this species has been recorded from localities as far apart as the Red Sea and Hawaii, Mauritius and Easter Island, it seems likely, so far as I can determine from published figures, that more than one species has been confused and caused the still tangled synonymy.

Family Coridae.

Genus Coris Lacépède, 1802.

Coris cyanea Macleay.

(Plate xiii., fig. 3.)

? *Coris aygula* Lacépède, Hist. Nat. Poiss., iii., 1802, 96, pl. iv., fig. 1. No locality (Commerson) = Mauritius.

Coris cyanea Macleay, Proc. Linn. Soc. N.S. Wales, vii., April, 1883, 588. New Guinea. Type in Australian Museum seen.

This is the Double Head of the Lord Howe Islanders, a large blue fish which browses over the coral reefs at half-tide, often exposing the back out of water. It was found on Middleton Reef, 17/4/36, and we speared several for food. They lack the lengthened dorsal spine from which the species derived its specific name (*aygula,* an aigrette), bestowed by Lacépède, and since it seems unlikely that our fish is identical with the Mauritius one, I am employing Macleay's name for it, since *cyanea,* so far as I know, is not preoccupied.

D. 9/12; A. 3/12; L. lat. 50 + 12 = 62; L. tr. 9/1/31.

Head (7 inches), 3.7; depth of body (7½), 3.4; base of dorsals (13¼), 1.9; depth of caudal peduncle (3½), 7.4 in total length (26).

Family Pomacentridae.

Subfamily Glyphisodontinae.

Genus Glyphisodon Lacépède, 1802.

Glyphisodon sexfasciatus (Lacépède).

Labrus sexfasciatus Lacépède, Hist. Nat. Poiss., iii., 1802, 430 and 477, pl. xix., fig. 2. [Indo-Pacific.]

Several specimens were seen swimming near the wreck of the "Annasona" at Middleton Reef, but I was unable to catch any, though I could see the characteristic markings of the caudal fin.

Family Eleotridae.

Genus Eviota Jenkins, 1903.

Eviota viridis (Waite).

Allogobius viridis Waite, Rec. Austr. Mus., v., March 11, 1904, 177, pl. xxiii., fig. 3. Lord Howe Island. Types in Austr. Mus., Sydney.

Eviota viridis Whitley, Sci. Rept. Great Barrier Reef Exped., iv., 9, 1932, **301**, *q.v.* for references to literature.

Several specimens (Austr. Mus., Regd. No. IA.6858) from Elizabeth Reef, 15th April, 1936, amongst coral crevices, and others (IA.6864) from similar situations and from pools in the wreck on Middleton Reef, April 17, 1936.

Family Scorpaenidae.

Genus Scorpaenodes Bleeker, 1857.

? *Scorpaenopsis* Heckel, Ann. Wiener. Mus., ii. (1), 1839, 158. Two species: *S. neglecta* Heckel and *S. nesogallica* Cuvier & Valenciennes—*fide* Sherborn, Index Animalium. Logotype, *Scorpaena nesogallica* Cuv. & Val., Hist. Nat. Poiss., iv., November, 1829, 315, from Mauritius—*fide* Jordan, Gen. Fish.

Scorpaenichthys Bleeker, Nat. Tijdschr. Ned. Ind., xi., 1856, 385, 388 and 402, *et ibid.* xii., 1856, 213. Virtual haplotype, *Scorpaena polylepis* Bleeker. Name preoccupied by *Scorpaenichthys* Girard, Proc. Acad. Nat. Sci. Philad., vii., 1854, 131, another genus of fishes.

Scorpaenodes Bleeker, Nat. Tijdschr. Ned. Ind., xiii., 1857, 56, 60 and 371. Haplotype, *Scorpaena polylepis* Bleeker, Nat. Tijdschr. Ned. Ind., ii., 1851, 173, from western Sumatra; figured in Atlas Ichth., ix., 1878, pl. ccccxv., fig. 1.

Sebastopsis Gill, Proc. Acad. Nat. Sci. Philad., August, 1862, 278, footnote. Orthotype, *Scorpaena polylepis* Bleeker.

Scorpaena polylepis Bleeker, the genotype of *Scorpaenodes,* was described as having, amongst others, the following characters:—

> "altitudine 4 circiter in ejus longitudine . . . spinis suborbitalibus 2 . . . squamis lateribus 35 p.m. in serie longitudinali," etc., which do not agree with the species described hereunder as *scaber.*

Bleeker's species is commonly regarded as a synonym of *Scorpaena guamensis* Quoy & Gaimard, an identification which is open to doubt. The species called *S. guamensis* from Oceania by most authors is, however, allied to *Sebastes scaber* Ramsay & Ogilby, and records of *scaber* from Samoa, Pelew Island, Philippines, New Hebrides, Fiji and the Society Islands are almost certainly referable to *guamensis,* auctorum, rather than to the true southern *scaber.*

Scorpaenodes scaber (Ramsay & Ogilby).

Sebastes scaber Ramsay & Ogilby, Proc. Linn. Soc. N.S. Wales, x., 4, April 3, 1886, 577. Shark Reef, Port Jackson, New South Wales. Types (B.8450-51) in Austr. Mus. examined. *Id.* Ogilby, Cat. Fish, N.S. Wales, about August, 1886, 21.

Scorpaena scabra Ogilby, Mem. Austr. Mus., ii., 1889, 60 (Lord Howe Is.).

Sebastopsis scaber Waite, Mem. N.S. Wales Nat. Club, ii., 1904, 47 (N.S. Wales) and Rec. Austr. Mus., v., 1904, 220 (Lord Howe Island). *Id.* McCulloch, Rec. Austr. Mus., ix., 3, May 31, 1913, 387, pl. xiii., fig. 2.

Scorpaenodes scaber McCulloch, Austr. Zool., ii., 3, 1922, 117 and Austr. Mus. Mem., v., 1929, 387.

Br. 7. D. xii., i., 8, the last divided. A. iii/5 (last divided). P. 19. V. i/5. C. 9. 23 to 25 small spines along the course of the lateral line. L. tr. 8/1/16. About five large predorsal scales in largest specimen. 5 + 9 short spiny gill-rakers on first branchial arch.

Head (28 mm.), 2.3; depth (23) 2.8 in standard length (65). Eye, 8 mm. Snout, 7. Interorbital, 3. Fifth dorsal spine, 9. Second anal spine, 12. Pectoral, 20. Depth of caudal peduncle, 7.

Head almost entirely covered with small scales which degenerate anteriorly to be replaced by upstanding papillae which even extend over the eye. Maxillary very broadly rounded, without ridges. Broad bands of villiform teeth on jaws and vomer. No teeth on palatines. Anterior nostril with a bifid flap; posterior with a circular rim. A spine near each pair of nostrils. Preorbital with incipient spines only. Three supraorbital spines followed by a large and a small spine just behind. Three spines between orbital series and lateral line. Two on each side of the nape. Three or four suborbital and three or four preopercular spines. Two opercular and one scapular spines. Interorbital sunken. Nuchal region not excavated. Gill openings wide. Some large mucus pores around chin.

Mandible with a symphysial knob fitting into a gap in the upper jaw. Tongue well developed, its tip rounded. Velum maxillare present.

Body covered with large ctenoid scales, which ascend in oblique series above the lateral line and in horizontal series below it. Some of the spines on the head have a produced membrane, but there are no prominent leaf-like dermal appendages on the body. There is a minute orbital tentacle.

Dorsal fin with thirteen spines, bearing prickles on their anterior surfaces, the fifth to ninth longest.

Second anal spine longer and stronger than the third. Lower pectoral rays simple but not free. Caudal rounded.

General colour in alcohol dark brown with irregular blackish mottling, most dusky on opercles and tending to form crossbands on body posteriorly. Fins whitish, but densely overlain by the dark spots or mottling. Pectoral axil with a few large irregular brown blotches.

Described from a specimen, 65 mm. in standard length or 3¼ inches over all.

Two specimens of this species were collected on Middleton Reef by poisoning the pools in the hull of the "Annasona" wreck with chloride of lime, April 17, 1936. Austr. Mus., Regd. Nos. IA.6865 and 6866. The smaller one has 9 dorsal rays and 18 pectoral rays. In life it was largely reddish in colour.

This species was well figured by McCulloch in 1913.

The Australian Museum has specimens from Lord Howe Island and the coast of New South Wales from Newcastle southward to Bermagui.

Family Sardidae.

Wanderer, *gen. nov.*

Orthotype, *W. wallisi, nov.*

Thynnichthys Giglioli, Espos. Int. Pesca, Berlin, 1880, Elenco, 25. Orthotype, *Thynnus thunnina* Cuvier & Valenciennes—*fide* Jordan, Gen. Fish., iii., 1919, 402. Name preoccupied by *Thynnichthys* Bleeker, Nat. Tijdschr. Ned. Ind., xx., 1859, 433, a genus of Cyprinid fishes.

The Little Tunny, generally known as *Euthynnus alletteratus* (sic) (Rafinesque) deserves a generic name to distinguish it from the Bonito or true *Euthynnus* (*pelamis*), of which *Katsuwonus* is a synonym. Giglioli provided *Thynnichthys* for this purpose, but unfortunately his name is preoccupied, hence the new nomination proposed here. *Wanderer* is of course named after the schooner which took members of the expedition to the Middleton and Elizabeth Reefs, but it is doubly appropriate for this fish which is essentially a nomadic species.

Since the European species, *Wanderer allitteratus* (Rafinesque), differs at sight from its Australian representative, I name the latter as a new species and designate it as the orthotype of my new genus. For references

to literature dealing with extralimital specimens, consult Miss Corwin's "Bibliography of the Tunas", Fish Bulletin 22, of the Division of Fish and Game, California, published in 1930. Australian citations are tabulated hereunder.

WANDERER WALLISI, *sp. nov.*

(Plate xiv., fig. 3.)

Thynnus affinis Macleay, Proc. Linn. Soc. N.S. Wales, v., 4, May 20, 1881, 556; Cat. Austr. Fish., i., 1881, 191 (Port Jackson, N.S.W.—specimen in Austr. Mus.). *Id.* Tenison-Woods, Fish. Fisher. N.S. Wales, 1882, 18. Not *T. affinis* Cantor, Journ. Asiat. Soc. Bengal, xviii., 1849 (December, 1850), 1088, from the Sea of Penang; the name preoccupied by *T. affinis* Guerin-Meneville, 1838, a species of insect.

Thynnus thunnina Ogilby, Rept. Comm. Fisher, N.S. Wales, 1886, 29. Not *T. thunnina* Cuvier & Valenciennes, Hist. Nat. Poiss., viii., "1831" = January, 1832, 104, pl. ccxii., from Mediterranean, etc.

Gymnosarda alletterata Waite, Mem. N.S. Wales Nat. Club, ii., 1904, 42 (N.S. Wales). *Id.* Stead, Edib. Fish. N.S. Wales, 1908, 95. *Id.* McCulloch, Rec. Austr. Mus., xi., 7, 1917, 183. Not *Scomber allitteratus* Rafinesque, Carat. n. gen., 1810, 46, from Palermo.

Euthynnus alletterata McCulloch, Austr. Zoologist, ii., 3, 1922, 105 and Austr. Zool. Handbook, i., 1922, 79.

Euthynnus allitteratus McCulloch, Austr. Mus. Mem., v., 1929, 262.

Mr. Wallis caught a Little Tunny with rod and line on an automatic striker off the North Brother Mountain, N.S. Wales, May 2, 1936, at 4 p.m. The head has been preserved (Austr. Mus., Regd. No. IA.6870) and the following characters were noted from the fresh specimen.

D. xv/11/8; A. 12/7; last finlets smallest. Dimensions in inches: Head, 5; eye, $\frac{3}{4}$; depth of body, $4\frac{1}{2}$; anterior dorsal spine, 3; base of first dorsal, $4\frac{3}{4}$; interdorsal space, 1; pectoral, $3\frac{1}{4}$; length to end of middle caudal rays, $18\frac{3}{4}$. Gill-rakers 9 + 23 in number on first gill-arch. Teeth on jaws and palatines, but not on vomer.

Body with small scales confined to its anterior portion or along the commencement of the single lateral line, which descends fairly evenly and is hardly waved below the dorsal fins. Pectoral fin short. Dorsal and anal lobes low. Caudal peduncle with a median keel.

Colour.—Blue above, with navy to green iridescence. Twelve or more dark grey oblique bands superiorly. Snout and fins greyish. All finlets smoky or greyish. Pupil of eye black; iris silvery. No markings on the silvery lower half of the body, except for two or three dark round blotches below pectorals. Inner surface of pectoral blackish, also part of inner surface of the otherwise white ventrals.

The stomach contained larval crabs and young Gurnards (*Dactylopterena volitans* C. & V.). Surface of liver not striated. Air-bladder absent. Long, thin, ribbon-like, pinkish testes.

Differs from Kishinouye's figure of *Euthynnus yaito* in having stripes instead of blotches superiorly, and is further distinguished by its lack of vomerine teeth. The form of the colour-markings also separate it from the figures of specimens of *allitteratus* given by Cuvier & Valenciennes, Günther, Day, Jordan & Evermann, and others.

Since the "Wanderer" specimen was not preserved in its entirety, I am selecting a specimen (Austr. Mus., Regd. No. IA.3474) from the Sydney fish markets as holotype of the new species.

This holotype agrees closely with the above description, having the following characters:—D. xv/12/8; A. 12/7, last finlets smallest. Head, 4.8 inches. Snout, 1.4. Eye, 0.7. Depth, 4.4. Interdorsal space, 0.7. Pectoral, 3. Length to end of middle caudal rays, 18.4. Gill-rakers 9 + 23. Pseudobranchiae present. Five prominent dark blotches on each side below the pectoral fin.

A few other species of fishes were obtained during the *Wanderer* trip, both at Lord Howe Island and off the coast of New South Wales, but they hardly call for special mention here. It is, however, of interest to consider the geographical distribution of the species found on the Middleton and Elizabeth Reefs, which is as follows:—

(E. = Elizabeth Reef, M. = Middleton Reef, L. = Lord Howe I., Q = Queensland.)

(1) *Galeolamnoides macrurus* is known from E., M., L., N.S. Wales, Q., and Southern Australia. (2) *Galeocerdo rayneri,* from M., L., N.S. Wales, Q., New Zealand. (3) *Synodus (Newtonscottia) houlti,* from E., L., and Q. (4) *Gymnothorax flavimarginatus annasona,* from M., L., Norfolk Island and Q., with its typical subspecies from Oceania, East Indies and Red Sea. (5) *Epinephelus forsythi,* from E., M., and L., and probably represented in Norfolk Island and Queensland. (6) *Arripis trutta,* from E., M., L., Norfolk Island, Kermadecs, N.S. Wales, New Zealand, and Southern Australia. (7) *Usacaranx insulanorum,* from E. and L. (8) *Regificola grandis,* from E., M., L., N.S. Wales, Q., New Zealand and Southern Australia. (9) *Lutjanus coatesi* is so far only known from Elizabeth Reef and North Queensland. (10) *Iredalella cyanea,* common at E., M., L., Norfolk Island and Kermadecs, but rare or perhaps extinct in New South Wales. (11) *Thalassoma lunare,* from M., L., Norfolk Island; a rare visitor to N.S. Wales, but occurs in Q., Oceania, and East Indies. (12) *Thalassoma quadricolor,* from M., L., and Norfolk Island, also Oceania and East Indies, but doubtfully identical with forms from the Red Sea and Mauritius. (13) *Coris aygula cyanea,* from M., L., Q., Norfolk Island, Oceania, East Indies, allied to the typical subspecies from Mauritius. (14) *Glyphisodon sexfasciatus,* from M., L., Norfolk Island, Queensland, Oceania, East Indies. (15) *Eviota viridis,* from M., L., Norfolk Island, with subspecies in Queensland and Oceania. (16) *Scorpaenodes scaber,* from M., L., and New South Wales (rare), allied to a form with more northern distribution in Oceania.

This analysis demonstrates that the ichthyfauna of the Middleton and Elizabeth Reefs is most closely allied to that of Lord Howe and Norfolk Islands, and therefore enters the Phillipian Province, but there is an infusion of tropical reef forms similar to those of the Indo-Pacific; these, however, are in the minority, and may have peopled the reefs by medium of the diverse currents which converge on them.

MOLLUSCA.

By Tom Iredale.

(Plates xv.-xvii.)

Owing to the circumstances detailed above by Mr. Whitley, the collection of mollusca is not very large, but, as it includes the normal striking forms, it may be regarded as representative. It is very important, however, as it indicates definitely the relationship of the molluscs and therefore it is of great value. It can be stated, without question, that the two reefs, Elizabeth and Middleton, have been a part of the Lord Howe plateau since the time of the separation of the Phillipian Region from the Montrouzierian Region, i.e., New Caledonia. This time may be comparatively geologically recent as the land mollusca of the two Regions are closely related, but it has been long enough to allow generic development in the group. On the other hand, the marine mollusca of the two Regions show little distinction, but one peculiar form has evolved, the now well known *Turbo cepoides* Smith, of Lord Howe Island. There are, obviously, no land molluscs on Elizabeth and Middleton Reefs, so we must depend on the marine forms, and there we are agreeably surprised to find this distinctive shell.

Having this clue it becomes easy to reconcile all the reef forms with those of Lord Howe Island, and thus prove the concordance of the faunulae. This will be best shown by a short discussion of the elements of the collection secured by Mr. Whitley. In the systematic order in which they will appear they will be shortly referred to without separating the forms from the two reefs, but these will be listed at the conclusion of this essay.

Dealing with the bivalves, the most noticeable were the Giant Clams, but here while a small form agrees in detail with the Lord Howe Island species, a large one is puzzling. It differs considerably from those of the Queensland Great Barrier Reef, and it is possible that it may occur on Lord Howe Island below low water. This may appear a prejudiced statement, but quite recently a large shell, *Charonia tritonis*, was found alive on the edge of the reef at Lord Howe Island, whence not even a fragment had previously been seen. However, a Codakioid was commonly found as valves, which agrees with the Lord Howe form, while a very striking *"Tellina"*, known as *T. quoyi*, was also met with. This will be particularly discussed hereafter. The other bivalves are not distinctive, but all have been found at Lord Howe Island, so that there is no question here.

The Loricata have proved one of the best guides in the whole molluscan world, and in the time available it could not be expected that these would be studied. However, Mr. Whitley secured two small examples, and these are referable to endemic Lord Howe Island forms, one of which has no relation yet on New Caledonia. It could not have been anticipated that the Gastropoda would give much assistance, but *Turbo cepoides* indicated decisively the alliance, and this is conformed by the remainder of the larger shells collected, all of which (save one) have been collected at Lord Howe Island. The exception is the prize of the trip, a *Calcar* form, distinct from the New Caledonian or Queensland forms, and which has not otherwise been found. A *Nannoscutum*, hereafter defined, is so far only known from Lord Howe Island, Norfolk Island and the Great Barrier Reef, but not from New Caledonia, but as it is not on record at all, it may still be found at the last-named locality. A curious case is that of the shell known as *"Drupa"*

or *"Sistrum" chaidea,* which is common at the Islands, but is so far only known from the southern end of the Great Barrier Reef. There is a distinct connection between New Caledonia, Lord Howe Island and the Capricorn Group, judging from the molluscs collected at these localities.

Phylum Mollusca.

The molluscan inhabitants of a coral reef of the Great Barrier Reef of Australia have never yet been completely accounted, but probably fifteen hundred species would be a fair estimate. This figure is deduced from my own experiences, complementing those of my talented predecessor, Hedley. From his first investigation, that of Mast Head Reef, Capricorn Group, Hedley recorded 447 species with more than 100 left unstudied, the result of one week's collecting. A little later, from the Hope Islands in about the same time, Hedley reported that he had secured more than seven hundred species. With a longer period, a month or so, Whitley and I made a collection of nearer one thousand species at Michaelmas Cay, and this has since been confirmed at Low Isles and North West Reef, Capricorn Group. Mr. Melbourne Ward collected at Lindeman Island, an inshore island with a small reef, and the same figures are applicable. On the other hand, a good collection, made at Lord Howe Island by Mr. Roy Bell, shows that faunula to be definitely smaller, about five hundred species, suggesting a maximum of one thousand. Notwithstanding these figures the significant species will probably appear in the first hundred or so collected in any given locality, and hence comparisons are valuable even with little material. Thus the fifty odd species can be dealt with, the lcoal conditions being known, and their relationships adjudged with a fair meed of accuracy. It is necessary, however, in such cases, to criticise each species closely, and determine correctly as far as possible its exact alliance.

Class Pelecypoda.

Obviously there could be little found in the way of bivalves upon such reefs, as most of these are buried in the sand. Giant Clams were, of course, visible, but most of the collection was picked up on the sand spit, and thus these can be scarcely regarded as representative, but merely as an indication of the possibilities. Only some seventeen species were found, but each one was suggestive, and some distinctive forms were secured.

Family Arcidae.

Some specimens of a small Ark were found under coral blocks, and an odd valve of a larger Ark was picked up, and both are related to Lord Howe Island species of, however, wider range.

Genus Acar.

1857. *Acar* Gray, Ann. Mag. Nat. Hist., Ser. 2, Vol. xix., p. 369. Logotype, Stoliczka, Palaeont. Indica, p. xxi., August 1, 1871. *A. divaricata* Sowerby.

Previously overlooked, this type designation appears to be earliest, and, as it is legitimate, Gray's *Acar* is still acceptable in its traditional usage. The habit of living in crevices under coral blocks lends this shell to a little distortion, and series are necessary for accurate determination.

Acar dubia Baird.

1873. *Arca* (*Byssoarca*) *dubia* Baird, Jottings Cruise Curaçoa, p. 453, pl. xlii., figs. 5-6. New Caledonia.

The specimens from Elizabeth Reef have been contrasted with series from Lord Howe Island, Norfolk Island, New Caledonia and Queensland, and agree best with those from the first-named locality.

Genus Arca.

1758. *Arca* Linné, Syst. Nat., xth ed., p. 693, January 1. Logotype, Anton, Verz. Conch., p. 12, 1838. *Arca barbata* Linné.

There has been much difference of opinion as to the usage of the generic name *Arca,* and I have given details in a report on the mollusca of Low Isles, Queensland, with the conclusion that the above is the earliest legitimate type designation. The valuation of the forms commonly confused is also there fully investigated. The valve picked up at Middleton Reef belongs to the series confused in Queensland under the name *"Arca foliata* Forskal", and otherwise as *Arca decussata* Sowerby. I have distinguished it clearly in my report, and this valve agrees with Lord Howe Island specimens, and these were recorded by Brazier (Austr. Mus. Mem., No. 2 (Lord Howe Island), pp. 28, 30, 1889) under Sowerby's name.

Family Ostreidae.

One oyster was brought back from Middleton Reef, and this belongs to the species Hedley reported from Mast Head Reef, under the name *Ostrea cerata* Sowerby. I have investigated the Oysters of Eastern Australia very closely, and my results are now under consideration in my report on the Mollusca of Low Isles, Queensland, and it is not desirable to anticipate that report in this place.

Family Limidae.

Among some small shells, sorted out of debris from Elizabeth Reef, were a couple of valves of a small *"Limatula"*, with little distinctive features, so that it may be the juvenile of a larger species of the so-called *"bullata"* series. The same remarks apply in this case as in the preceding, and it may be noted that many species of "Limoid" mollusca live on coral reefs.

Family Mytilidae.

This group was also reported upon for the Low Isles report, and the *"Lithophaga"* series provided an excellent study, many species and their habits being recorded. It was found that many were apparently restricted to one sort of coral. One small specimen can be seen inside a small piece of *Acropora* from Elizabeth Reef, but this cannot be specifically named. Small specimens of *Septifer* were picked up at both Reefs, and a small *Musculus* was found in the debris from Elizabeth Reef, and this is here described.

Genus Lithophaga.

1798. *Lithophaga* Bolten, Mus. Bolten, pt. ii., p. 156, September. Haplotype, *L. mytuloides* = *Mytilus lithophagus* Linné.

The general name *Lithophaga* is here used, as many distinct groups have been fully described in the Low Isles Report, and until that appears in print it is unwise to attempt any other nomination here.

Genus Septifer.

1848. *Septifer* Recluz, Rev. Zool. (Cuv.), 1848, p. 275, September no. = October. Orthotype, *Mytilus bilocularis* Linné.

Septifer bilocularis Linné.

1758. *Mytilus bilocularis* Linné, Syst. Nat., 10th ed., p. 705, January 1. "O. Indico" = East Indies or Ceylon.

The small specimens found on both Reefs may be juvenile shells referable to the large species above-named, or they may belong to some small distinct species, but the material available has shown so much individual variation that this point has not yet been satisfactorily settled even in connection with Queensland shells.

Genus Musculus.

1798. *Musculus* Bolten, Mus. Bolten, pt. ii., p. 156, September. Logotype, Iredale, Journ. Conch., Vol. xiv., p. 342, 1915, July 1. *M. discors* Bolten = *Mytilus discors* Linné.

Musculus nubilis *sp. nov.*

This small species is easily distinguished from any of the described Australian forms by its fine sculpture and pronounced posterior angle. The hingeline, however, shows numerous strong denticles for such a small shell, and these allow its discrimination as a new subgenus *Propetilus*.

Shell small, transversely oval, swollen anteriorly, equivalve very inequilateral, umbones very anterior, coloration pale brown.

The umbones are placed well forward, much incurved, the anterior steep but a little rounded, the ventral margin curving away to meet the posterior side at a rather sharp angle. The hinge line is almost straight and the posterior side is produced at an obtuse angle to meet the ventral margin somewhat acutely. The anterior sculpture is a little indistinct, the flattened ribs being about twelve. The median smooth area is not very wide, while the posterior ribbing is very fine and the posterior angled area is more coarsely transversely ribbed, thus separating it widely from the local species (Rec. Austr. Mus., Vol. xix., pp. 270-271, pl. xxi., figs. 1 and 10, 1936). It is more like *Modiola difficilis* Deshayes, from Reunion.

Length, 8 mm. Height, 4.5 mm.

Elizabeth Reef, picked off *"Tridacna"*.

Family Chamidae.

Two forms were secured at Middleton Reef, both too worn for specific record without knowledge of the forms inhabiting the adjacent localities. I have been studying the Australian species recently, and find that there are many species distinguishable when series of good specimens are available.

Family Tridacnidae.

Whenever a Giant Clam is now met with there will be trouble in determining the species until a great deal of study has taken place. One hundred and fifty years ago many species were distinguished, and then through the mistaken energy of the nineteenth century workers the species were merged. At the present time we know that many different animal forms have been developed in this group, and that these are recognisable by means of shell characters. The groups, known as *"gigas"*, *"squamosa"*, *"crocea"*, and *"elongata"*, are of complex ancestry, and each must bear a differential name, while under *"gigas"* apparently two or more distinct groups are confused. A large Clam was brought back from Elizabeth Reef (it was also seen at Middleton Reef, according to Whitley), and this has necessitated a study of these Clams. This was in progress in

connection with the Low Isles shells, and in this case publication of some results can be here allowed. A small Clam occurred at both Reefs, and the specimens secured agree completely with those from Lord Howe Island, which Hedley regarded as *Tridacna maxima* var. *fossor*, his type being from North West Reef, Capricorn Group, Queensland.

The determination of the use of the generic name is again at issue as *Tridacna* is credited to Bruguière from the fact that it appeared at the head of two plates in the Tabl. Encyclopedie Meth., Vers., without specific nomination. No explanation accompanied these plates at the time (1797), but nearly thirty years afterward.

Bory de St. Vincent suggested the following identifications:—

"Plate 235, fig. 1. *Tridacna gigas* Lam., 1819, ex L. ?
„ „ „ 2. *Tridacna crocea* Lam., 1819.
„ „ „ 3. *Tridacna serrifera* Lam., 1819.
„ „ „ 4. *Tridacna squamosa* Lam., 1819.
Plate 236, fig. 1. *Tridacna squamosa* Lam., 1819.
„ „ „ 2. *Tridacna hippopus.*"

The earliest type designation is by Anton (Verz. Conch., p. 12, "1839" = October, 1838), who selected *C. gigas* Linné, but Bruguière's figures do not show that species as now understood. Figure 1, the only figure that has been so regarded, is of a small shell with a large byssal gape and scalloping towards the edges of the shell. If Bruguière's name be rejected as suggested by some authorities, the next name perhaps even anterior in date is *Tridachna* of the Museum Calonnianum. As the names in this work have been rejected, though absolutely incorrectly, by the International Commission on Nomenclature, they are not here used, without prejudice.

The next usage is by Bolten, who spelt the name *Tridachnes*, and perhaps this spelling * must be used. The type of *Tridachnes* Bolten, does not appear to have been selected, so is here named as *T. gigas* as of Linné. The following year Lamarck used *Tridacna*, with *Chama gigas* Linné as the sole species, and this has since been commonly used, but not without opposition. Gray introduced the usage of *Hippopus*, referring the generic name back to "Martini, 1773", a non-Linnean authority. Morch, however, went further back still, and proposed the recognition of *Chametrachea* of Klein, a pre-Linnean writer. Morch was followed by H. and A. Adams, but this usage did not gain universal acceptance. A complication ensues here also, as Morch did not include the traditional *gigas*, when he reintroduced Klein's name correctly, so that another type must be selected, and this action makes *Chametrachea* the valid name for the *crocea* group. The facts must be displayed in full, as otherwise they cannot be easily understood, and at this time this becomes very necessary, as important anatomical differences have already been recorded in connection with the species, and these have been misunderstood through ignorance of the many species and genera being confused.

* This appears to be the correct classical spelling.

Genus Tridacna.

1797. *Tridacna* Bruguière, Tabl. Ency. Meth., Vers., pls. 235/6. Logotype, Anton, Verz. Conch., p. 12, 1838, *C. gigas*.

[1797. *Tridachna* Humphrey, Mus. Calonn., p. 50, ante May 1. Logotype here selected, *Chama gigas* Linné.]

1798. *Tridachnes* Bolten, Mus. Bolten, pt. ii., p. 171, September. Logotype here selected, *Chama gigas* Linné.

1799. *Tridacna* Lamarck, Mem. Soc. d'Hist. Nat. Paris, p. 86, May. Haplotype, *Chama gigas* Linné.
1801. *Tridacna* Lamarck, Syst. Anim. s. Verteb., p. 117, January. Haplotype, *Chama gigas* Linné.
1847. *Hippopus* Gray, Proc. Zool. Soc. (Lond.), 1847, p. 198, November. ex Martini, 1773 (non-binomial). Orthotype, *Chama gigas* Linné. Not *Hippopus* Lamarck, 1801.
[1847. *Hippopodes* Gray, Proc. Zool. Soc. (Lond.), 1847, p. 198, November. ex "Gevers, 1787", in synonymy.]

This generic name must be utilised for the Giant Clams of the Indian Ocean, however it may be spelt, or whosoever authority may be allotted to it. Some exactitude may later be determined as to the type, but there is more than one species of Giant Clam, the Queensland form being dealt with in detail elsewhere. A large specimen brought from Middleton Reef proved to be very different from the East Australian one, and is here described and figured. It certainly does not belong to the same series, but rather to the *derasa* Bolten = *serrifera* Lamarck group, and is here made the type of a new genus, *Persikima*.

Genus Persikima *nov.*

Type, *P. whitleyi nov.*

(Plate xv.)

This species is named for Mr. G. P. Whitley, as a mark of my gratitude for his constant enthusiasm in securing molluscan specimens, especially as he would not have deserved blame had he neglected such an awkward object as this Giant Clam.

Shell of large size, not much swollen umbonally, compressed ventrally, ribs depressed without any scalloping, almost equilateral. Hinge very much intruded upon, teeth almost obliterated. Muscle scars central, the large rounded anterior adductor scar apparently enveloping the narrowly elongate pedal adductor, or otherwise that must be much reduced. The hinge is quite unlike that of the Giant Clams, as here the cardinals are almost suppressed, and the laterals are also nearly obliterated.

The pedal gape is closed but the remains of the combing can be still seen pushed underneath the umbo which is so forward that the anterior side is absolutely shorter than the posterior. When Sowerby described his *obesa* he drew attention to this fact, stating that it happened in no other Giant Clam. The external ribbing is also flattened out so that the external edge is scarcely wavy, the margin being sinuate only, not at all dentate.

The specimen figured measures about 12 inches in length by about 9½ inches in height, and is a very old shell. It would be equivalent for comparative purposes to the large specimen of *"Tridacna gigas"*, measuring 3 feet in length by 2 feet in depth. Such a shell is now before me and its huge size suggests a similar age, and its anterior adductor scar is comparatively smaller, the pedal almost indeterminate.

Hedley figured a small specimen from Murray Island as *Tridacna derasa* Bolten, and this would appear to be the immature of a species very closely allied, if not identical, to the Middleton Reef shell. It is obviously immature, though about 7½ inches long, and shows a narrow pedal gape, with strong teeth, as indicated in the Reef shell. In this the pedal adductor scar can be seen adjacent to the anterior adductor, while the cardinal teeth are well defined, as also the laterals, the ligament being normal.

Before leaving the subject of Giant Clams, attention must be drawn to the geographical distribution of the species as necessitating early research. Thus the bulk of the early material came from the Indian Ocean and the East Indies, and Lamarck only knew the same localities. When Reeve figured the specimens for his Monograph, he observed "With the exception of *T. gigas,* from Navigator's Islands, all the species of which I have the habitat, are assigned to the Moluccas or Philippine Islands". Reeve figured as *gigas* a scaly shell, writing:—"This colossal species which attains the enormous size of from six to seven hundred pounds weight may be distinguished in all its stages of growth by a tendency to radiate anteriorly in an oblique direction, and by the closely scaled character of the ribs". This was named *T. lamarcki* by Hidalgo (Mem. R. Acad. Madrid, Vol. xxi., p. 385, 1903), while Hedley probably following Lamy has regarded it as *Tridacna mutica* Lamarck (Hist. Anim. s. Vert., Vol. vi., p. 106, 1819), a determination disagreeable with Lamarck's description. Then Sowerby (Proc. Mal. Soc. (Lond.), Vol x., pp. 29-31, March 8, 1912) recorded all the species from the Philippine Islands, reducing the known species to six, adding two new ones; probably these eight each represent a generic group. Sowerby had monographed the genus in the Thes. Conch., and had given an excellent illustration of the Giant Clam of the Navigator's Islands, which is seen to have very deep grooves and rounded smooth, or rather scaleless, ribs. This is apparently the common Giant Clam of the Pacific Islands, as it also occurs at Fiji and Gilbert Islands. A small specimen from the latter locality in the Australian Museum was named *derasa* by Hedley, but it is very distinct from Bolten's *derasa,* which is much more like my *Persikima whitleyi.* From the Philippines, Sowerby described *T. obesa,* while he also recognised *serrifera,* i.e., *derasa,* and *obesa* appears superficially referable to *Persikima.* The Pacific Giant Clams, however, appear very distinct, and I propose the generic name *Dinodacna,* naming the species, *cookiana* and selecting the Gilbert Islands specimen as type, while referring to Sowerby's figure as an illustration. In this genus the cardinal hinge teeth are developed to a great extent with the suppression of the laterals, while the ligament is always kept in subjection. The immature characters are retained until a length of two feet is reached, and then the shell probably increases very slowly, as at three feet they are apparently aged, and with a senile look. It may be as well to summarise the conclusions here as to the Giant Clams for further reference. *Tridacna* Bruguière, 1797, is doubtfully valid; *Tridachna* (Humphrey) 1797 has been wrongly rejected; *Tridachnes* Bolten, 1798, is next available name, with type, *Chama gigas* Linné, whatever that is, but definitely a scaly Indian Ocean or Moluccan shell. The Pacific Ocean Giant Clam is deeply ribbed, but the ribs are scaleless, and this has developed from a different source from the preceding, and is here generically differentiated as *Dinodacna,* the species being named *cookiana.*

A third group of Giant Clams is that known for centuries which I call *Persikima,* and to which the Middleton Reef shell belongs. It is also scaleless, but is very shallowly ribbed and the immature is of the *derasa* or *serrifera* style. These appear to be the Giant Clams proper, but the *"squamosa"* shells also grow to a large size. These are easily recognised by their large distant scallopping, the large pedal gape with its edges notably ridged, its subglobose form, the umbones being almost central, the hinge teeth well displayed, the external ligament normal and the adductor muscle scars median, the anterior a little forward, the pedal small and central. This group is named *Flodacna,* the type being *squamosa* auct.

Genus VULGODACNA *nov.*

Type *Tridacna maxima* var. *fossor* Hedley.

Shells of small size for the family, maximum size about ten inches in length, elongate, anterior side much produced, byssal gape large, lengthened, exterior deeply ridged, ribs closely scallopped. The exterior ligament inclined to be intrusive and taking charge of the hinge teeth, which thus degenerate. The circular anterior adductor placed far forward and succeeded by an attingent small suboval pedal adductor scar.

VULGODACNA FOSSOR Hedley.
(Plate xvi., fig. 1.)

1921. *Tridacna maxima* var. *fossor* Hedley, Rec. Austr. Mus., Vol. xiii., p. 171, pl. xxx., fig. 7 (type), pl. xxix., fig. 6, pl. xxxiii., fig. 11, April 12 (Lord Howe Is.), Masthead Is., Capricorn Group, Queensland.

When Hedley differentiated this Queensland clam from *elongata* Lamarck, of West Australia, he gave as type a Queensland shell, but used Lord Howe Island specimens mainly in his discussion. There is very little difference superficially in the shells, so they are not separated here, but further study may yet necessitate this. The Middleton and Elizabeth Reef shells are very similar in every detail to those of Lord Howe Island, and will undoubtedly belong with those if separation take place.

The exact relationship of this species to the West Australian shell is not known, and perhaps the *"elongata"* series is not even homogeneous, but specimens from Rarotonga collected by Mr. G. P. Whitley appear to be referable to this series. I figured a very distinct shell as *Tridacna troughtoni* (Rec. Austr. Mus., Vol. xvi., p. 75, pl. v., figs. 9, 10, 1927) from Vanikoro, and similar shells also occur at Rarotonga, and Samoa, and these agree generally with the species described as *T. acuticostata* by Sowerby (Proc. Mal. Soc. (Lond.), Vol. x., p. 30, March 8, 1912), from the Philippines. The shells are elongate, but the ribs are more numerous, and with curious costal ornamentation, but differ entirely in the muscle scars. These appear to be reversed as compared with those of the preceding group, the most anterior being smaller and more irregularly shaped as if it were the pedal adductor, the succeeding larger almost oval scar being that of the anterior adductor. Otherwise if the scars be normally placed the pedal adductor is much larger than the anterior adductor, an anomalous state. This major discrepancy needs investigation, so in order to incite study a new generic name *Sepidacna* is here proposed.

Superficially the *crocea* group appears to be the most distinct, as its facies indicates its different habit. It is small for the family, irregularly formed, ribs scaly, but scales flattened; gape, which is called by Hedley, pedal, very large, open; the lateral teeth elongate, cardinals rather short, the adductor muscles of medium size, the pedal small, the anterior large and rounded. The anatomical features have already been shown to differ notably as would be expected from a knowledge of these molluscs in life. A generic name is already available as when Morch revived *Chametrachea*, this species was included, and as H. & A. Adams gave it as an example, it is here named as type. This course is taken as only a form of *elongata*, *squamosa* and *crocea* were included, so that one of these must be selected. Under the name *crocea* more than one species is confused, while geographical forms are easily separable of the restricted *crocea* style.

Family CARDITIDAE.

The species of this family are not well differentiated in literature. so

that it is difficult to name exactly the small specimens from Elizabeth Reef. These are identical with the species common at Lord Howe Island, and recorded by Brazier under the name *Mytilicardia variegata* Brug.

Genus CARDITA.

1792. *Cardita* Bruguière, Ency. Meth. Vers., Vol. i., p. 401. Logotype, Gray, Proc. Zool. Soc. (Lond), 1847, p. 193. November. *Chama calyculata* Linné.

The limits and synonymy of this genus will be published later, as both are somewhat complicated in literature.

CARDITA VARIEGATA Bruguière.

1792. *Cardita variegata* Bruguière, Ency. Meth. Vers., Vol. i., p. 407. L'Ocean des Grandes Indes.

The specimens from Elizabeth Reef belong to the species common at Lord Howe Island, but which also occurs in Queensland, and the geographical variation has not yet been worked out.

Family CODAKIIDAE.

The large Codakioid shell, so common on the Lagoon beach at Lord Howe Island, was found at both Elizabeth and Middleton Reefs, while a small valve referable to *Epicodakia* was also secured at the former reef.

Genus LENTILLARIA.

1817. *Lentillaria* Schumacher, Essai nouv. Syst. Test., pp. 49-147. Haplotype, *L. punctata,* pl. xv., fig. 4, for Chem., 7, 15, t. 37, figs. 397, 398.

Commonly, but wrongly, classed under *Lucina,* these large shells were transferred to *Codakia,* but the type of *Codakia* is a West African shell, not much like our Pacific forms, the hinge and muscle scars being notably different.

LENTILLARIA PAYTENORUM *sp. nov.*
(Plate xvi., figs. 2, 3.)

This name is given as the shell is a well known Lord Howe Island form, the type being from that locality, and the Payten family has been long established there. Two members, Messrs. T. and F. Payten, accompanied the *Wanderer* to the reefs and back, and were of great assistance to the expedition.

This species was named *Lucina interrupta* Lamarck in Brazier's report on Lord Howe Island shells, probably from Reeve's figures (Conch. Icon., Vol. vi., *Lucina,* pl. ii., figs. 5a, b, May, 1850) of specimens from Buoly Island, Torres Straits (Jukes) so determined. But Lamarck's description refers better to the species known as *simplex* Reeve, especially as he denies the coloration of the island shell, writing: "Le bord interne n'est ni rose, ni pourpré". The Middleton Reef valves agree with those from Lord Howe Island and vary a little from Queensland specimens. Shell suborbicular, of medium compression, equivalve, slightly inequilateral, coloration externally white, concentrically ridged, radially striate, ligament large, semi-internal, lunule very small, deeply impressed, heart-shaped.

The juvenile shell is a little oblique, radials predominating, but growth ridges develop and growth periods are notable. In the shell figured about fifteen periods may be seen at a glance, the intervening ridges being finely striate between. Radials are noticeable in the central area, a little distant however and delicately cut, so that they do not produce nodulation, but at each side these ridges become more numerous and deeper, and form a prickly area at each side. The general surface is superficially rough, but

not as rough as *"exasperata"*, nor as smooth as *"simplex"*. Internally the general coloration is yellow with a deep rose border all round, save at the hinge. This coloration varies a little in strength, but generally it is constant. Height, 51 mm. breadth, 54 mm. Depth of conjoined valves, 23 mm. Type from Lord Howe Island.

Along the Queensland coast; common at the Capricorn Group.

Genus Epicodakia.

1930. *Epicodakia* Iredale, Rec. Austr. Mus., Vol. xvii., p. 390, June 27. Orthotype, *Epicodakia gunnamatta* Iredale.

An odd valve was only picked out of debris from Elizabeth Reef belonging to the series known as *Codakia bella* Conrad recently, and *Lucina fibula* Reeve formerly, but the correct name is not yet known, though neither of the above are strictly available.

Family Veneridae.

A valve from Elizabeth Reef is the only representative of this family secured, but it is interesting as it proves to be a form of *Pardosinia alma* recently described from Queensland, and not yet known from Lord Howe Island.

Genus Pardosinia.

1929. *Pardosinia* Iredale, Mem. Queensland Mus., Vol. ix., p. 264, June 29. Orthotype, *P. colorata* Iredale.

Pardosinia alma Iredale.
(Plate xvi., fig. 7.)

1929. *Pardosinia alma* Iredale, Mem. Queensland Mus., Vol. ix., p. 265, pl. xxx., figs. 15, 16, June 29. Michaelmas Cay, North Queensland.

The single valve is narrower than those in the typical series, and the sculpture is finer, but generally it agrees. As we do not yet fully understand the variation seen, this may be called *P. alma extranea* subsp. nov. The ridges may number more than one hundred, while its height is 23 mm., breadth 22.5 mm., and the depth of the single valve 6 mm.

Family Tellinidae.

Valves of a large Tellen were picked up at Middleton Reef, but not at Elizabeth Reef where, however, it almost certainly lives. It has a somewhat complex history, which may be briefly related here. A small valve of an entirely different Tellen was secured at Elizabeth Reef.

Genus Laciolina *nov.*

Type, *Tellina quoyi* Sowerby.

Shell large, inequilateral, inequivalve, smooth, right valve a little swollen, left valve flattened, anterior side longer and rounded, posterior side shorter and beaked. External ligament small, teeth weak, cardinals close together, laterals a little distant. The pallial sinus very low, extending half way across the shell and similar in shape in each valve.

The shell is similar in shape to *tongana*, and the hinge is not unlike, but the pallial sinus in *tongana* is high and angulate. The hinge is much weaker than in *virgata*, and the pallial sinus is quite dissimilar.

Laciolina quoyi Sowerby.
(Plate xvi., fig. 6.)

1868. *Tellina quoyi* Sowerby, Conch. Icon. (Reeve), Vol. xvii., pl. liii., sp. 314, October. North Australia.

Hedley (Proc. Linn. Soc. N.S.W., Vol. xxxviii., p. 272, 1913) discussed this very beautiful shell referring to "Deshayes, Proc. Zool. Soc., 1856, 130", but the name does not occur there, although Sowerby at the place cited also quoted it. Quoy and Gaimard figured a similar shell from Tonga Tabu, and Deshayes (Hist. Anim. s. Vert. (Lam.), 2nd ed., Vol. vi., p. 208, March 7, 1835) latinised the vernacular name appearing thereon as *Tellina lata*. The text to Quoy and Gaimard's plates appeared after that date (Voy. de l'Astrol., Zool., Vol. iii., p. 497 (for pl. 81, figs. 8, 9, 10), after March 17, 1835), with the same name. Deshayes worked on this group at the British Museum, and, observing that this name had been previously used, apparently altered it dedicating it to Quoy. These names were used in the British Museum collection, but were never published by Deshayes. Sowerby thereupon used it for a North Australian shell without investigation, but credited it to Deshayes, adding a fictitious reference. It has sometimes been confused with *Tellina chloroleuca* Lamarck (Hist. Anim. s. Vert., Vol. v., p. 524, July, 1818. Hab.?), but that species was described as "tenui . . . valves très minces . . . tenuissime striata . . . pellucente", none of which are applicable to this shell, as noted by Quoy and Gaimard when they described *lata*. Dautzenberg and Fischer (Res. camp. sci. Monaco, fasc., xxxvii., p. 518, June 15, 1912), noting that Quoy and Gaimard's name was preoccupied, introduced *Tellina astrolabei* as a novel substitute.

Upon comparison it was noted that while the shells agreed in general coloration, the proportions were seen to differ. Thus a normal shell from Lord Howe Island measured 86 mm. in length, 53 mm. in height, with the umbo at 40 mm. from the posterior end. A Norfolk Island norm gave 100 mm. in length, 70 mm. in height, with the umbo at 42 mm. from the posterior end. A Queensland shell from Michaelmas Cay measured 92 mm. in length, 50 mm. in height and the umbo at 40 mm. from the posterior end. This indicates that the Lord Howe Island form is smaller but deeper than the Queensland one, while it is proportionately less deep than the Norfolk Island. At New Caledonia a similarly shaped shell is pure white, and shows fine radial striation, and has been called *chloroleuca*, but there are also specimens of the colored shell from New Caledonia which are at once separable, and prove the distinction of the so-called *quoyi* from the so-called *chloroleuca* from the same locality.

The Middleton Reef valves agree best with those from Lord Howe Island, a series showing measurements: length, height, and umbonal point reading, respectively, 75, 74, 80; 51, 49, 51; and 32, 33, 35 mm.

The Norfolk Island form differs at sight and may be called *Laciolina francesae* sp. nov., pl. xvi., figs. 4, 5, while the Lord Howe Island and Middleton Reef form may be regarded as a subspecies, *Laciolina quoyi attracta* subsp. nov. So far this is known as a rare shell.

The small Tellen from Elizabeth Reef cannot be named from the single valve, as the small Tellens as a whole have not yet been studied and apparently many generic forms are confused. This shell recalls the *tenuilirata* series, but the hinge is quite dissimilar, the teeth being very strong, especially the laterals, which are short and thick.

Class Loricata.

Without plenty of time it is impossible to secure a representative collection in this group at any locality, so that the acquisition of two small specimens is noteworthy. These were procured at Middleton Reef and are of great importance, as they are definitely referable to Lord Howe Island forms. In no other molluscan group are the relationships so easily and

definitely determined as in these, and consequently these specimens indicate unquestionably the correct alliance of the faunulae of these reefs.

Family Cryptoconchidae.

One small shell belongs to the *Macandrellus* section of *Notoplax*, conspecific with the Lord Howe Island species, and more distantly related to the New Caledonian *Notoplax tridacna* Rochebrune.

Genus Notoplax.

1861. *Notoplax* H. Adams, Proc. Zool. Soc. (Lond.), 1861, p. 385. Haplotype, *Cryptoplax* (*Notoplax*) *speciosa* H. Adams.

1878. *Macandrellus* Dall, Proc. U.S. Nat. Mus., Vol. i., p. 299. Orthotype, *Acanthochites costatus* H. Adams & Angas.

Complete synonymy and discussion will be found in the Austr. Zool., Vol. vii., p. 59, 1931, and Mon. Austr. Loricates, p. 79, 1927.

Notoplax leuconota Hedley and Hull.

1912. *Acanthocites leuconotus* Hedley and Hull, Proc. Linn. Soc. N.S.W., Vol. xxxvii., p. 275, pl. xii., figs. 4a, b. Lord Howe Island.

The small shell is immature, but it is undoubtedly closer to this species than to the New Caledonian *N. tridacna* Rochebrune, which has been well illustrated by Hull and Risbec (Austr. Zool., Vol. vi., p. 378, pl. xxxi., figs. 8-15 and many text figures, February 13, 1931).

Family Chitonidae.

The juvenile is characteristic of the strange genus *Tegulaplax*, with a distribution at present known of the Red Sea, Maldives, Ceylon, Moluccas, Torres Strait, at all these places rare, but common at Lord Howe Island, and not yet known from New Caledonia. This fact associates Middleton Reef with Lord Howe Island in preference to New Caledonia.

Genus Tegulaplax.

1926. *Tegulaplax* Iredale and Hull, Austr. Zool., Vol. iv., p. 171, February 22. Orthotype, *Chiton howensis* Hedley and Hull.

As much as is known is given at the above reference and reprinted in the Mon. Austr. Loricates, p. 106, 1927, where it was recorded from Australian waters for the first time.

Tegulaplax howensis Hedley and Hull.

1912. *Chiton howensis* Hedley and Hull, Proc. Linn. Soc. N.S.W., Vol. xxxvii., p. 278, pl. xiii., figs. 7, a. Lord Howe Island.

The small shell has been compared with Lord Howe Island specimens, and agrees in detail.

Class Gastropoda.

The few Gastropods collected are such as would be anticipated, but the inclusion of the *Turbo, cepoides,* and the acquisition of a distinct form of a *Calcar* shell make them noteworthy. A few small forms were picked off the outside of *Tridacna* shells, and from the debris shaken from the dead shells. These suggest a fairly varied faunula of large extent, and it may be here recorded that a collection made at the Bampton Shoals, many years ago, indicated a very different faunula, showing many strange species. A survey of the shoals and reefs of the Coral Sea, especially of the molluscan fauna, would be very enlightening as to geographical distribution of many groups.

Family Fissurellidae.

The only member of this family was a strange slug-like form, which, when alive, might be mistaken for some sort of Tectibranch, as no shell was visible. So far this quaint development has not appeared in literature, although it has been known to myself for over twenty years. The genus *Scutus* was monographed some fifty years ago by Smith from Museum material, and he allowed a few species with extensive range. This is absolutely incorrect when the species are found living, and a review has been long prepared, but not yet published. The Lord Howe Island animal is unlike that of any Scutus yet known, and the opportunity is now taken to describe this new form.

Genus Nannoscutum *nov.*

Type, *N. forsythi nov.*

The animal of *Scutus* was figured by Quoy and Gaimard, and refigured by Hedley (Proc. Linn. Soc. N.S.W., Vol. xli., p. 704, pl. xlvii., figs. 7-9, April 4, 1917). A juvenile is shown in fig. 9, and the much smaller animal from the islands is nothing like this, as will be seen by the figures now given.

Shell small, stout, Scutoid, strongly lined concentrically. This is immediately differentiated from the shell of the same size, of an immature *Scutus* by its solidity and strong ridging, associated with the position of the apex. The animal is very elongate and narrow, blackish above with a pale greyish white foot underneath. Muzzle short, tentacles elongate, awl shaped, eyes at base on outside. Mantle covering shell in life, and body length about equal to that of the tail.

Length of extended animal about 28 mm., the tail being about 14 mm. The shell placed anteriorly in the body area, measuring 6.5 mm. in length, 3.5 in breadth, and 1 mm. in depth. The width of the extended animal is only about one-fifth its length.

Type locality: Lord Howe Island, under stones.

Observations: Among the dredgings secured by Mr. Roy Bell at Norfolk Island many years ago were some dead shells of a minute *Scutus*-like shell. Although these were only a few millimetres in length they showed strong growth ridges and thickened edge, indicating they were adult, and they differed appreciably from juvenile shells of any known species of *Scutus*. These were regarded as representing a distinct genus, and later similar shells were received from Lord Howe Island. From Michaelmas Cay, Queensland, dredgings a few comparable specimens were sorted out, while others have been collected at the Capricorn Group, S. Queensland. Whitley collected a curious little slug under a coral block at Elizabeth Reef, and made drawings of it, which are here reproduced. His notes read: "General colour dark greyish, apparently somewhat rubbed off near centre of back. Tentacles pale yellowish. Ventral surface dirty white with some grey reflecting through. Mouth brown. The foot seldom protruding beyond edge of mantle posteriorly". When preserved the mantle edges receded, showing a Scutoid shell, which is very like that of the Lord Howe Island species, the animal, however, apparently differing. Thus, while about the same length, Whitley's sketches show an animal twice as broad without the lengthened tail. Until more is known about this quaint group, it would be unwise to differentiate the Elizabeth Reef form, though the animal does not exactly agree.

Family Stomatiidae.

A broken dead shell was found at Elizabeth Reef, and this involves the

question of nomination of the species commonly referred to *Stomatella*. The type of *Stomatella* is *imbricata* Lamarck, and when Pilsbry (Man. Conch. (Tryon), Vol. xii.), monographed the family, which he incorrectly called *Stomatellidae*, he separated four groups without giving group names. His third group was that of *S. mariei* Crosse, and he gave a description of the animal of *S. godeffroyi* Dkr., which he regarded as a variety of Crosse's species. This animal was imperfect through the loss of the tail, which is cast off under annoyance, even as *Gena* and *Harpa* do. The animal is very active and entirely unlike that of *Stomatella imbricata*, which is small, covered by the shell and immobile. *S. imbricata* is common around Sydney, living on rocks under stones, and so fixed that the animal is often torn while attempting to remove it. Thiele (Mitth. Zool. Mus. Berl., Bd. 11, heft. 1, pp. 59-71, 1924) proposed *Pseudostomatella*, with type *papyracea* Chemnitz, but that again differs in shell and animal characters. The Queensland *rufescens* Gray, is a little more coarsely sculptured on the last whorl than *mariei*, but in general these are very closely allied.

Genus Stomatolina *nov.*

Type, *Stomatella rufescens* Gray.

As above noted, the animal of this species is more like that of *Gena* in its actions than that of *Stomatella*. The shell is thin, subglobose, spire short, conical, last whorl swollen, sub-depressed, sculpture fine spirals. Operculum small, horny, multispiral, nucleus central.

Stomatolina rufescens Gray.

1847. *Stomatella rufescens* Gray, Voy. Fly (Jukes), Vol. ii., p. 360, pl. 2, fig. 2. Raine's Is., North Australia.

The Elizabeth Reef shell is in poor condition, but it seems nearer the Torres Straits species than *S. mariei* Crosse, a common New Caledonian shell. It is coarser in its sculpture, but it may be noted that Pilsbry figures a *S. godeffroyi* as a variety, at most, of *S. mariei*, with coarse sculpture. However, Pilsbry included *Stomatella orbiculata* A. Adams, with localities "Darnley Id., Torres Sts. (Brazier), Mozambique (Cuming), Japan (Dkr.)" as similar to *mariei*. The first-mentioned locality is very close to that of *rufescens*, and Brazier's specimens are inseparable from Gray's species, which he had merely overlooked.

Family Trochidae.

A couple of small Trochoids were picked out of debris from Elizabeth Reef, and they both belong to the Lord Howe Island fauna, although also of New Caledonian alliance.

Genus Calliotrochus.

1879. *Calliotrochus* Fischer, Spec. Gen. Coquilles Vivants, Trochus, p. 418. Haplotype, *Trochus phasianellus* Deshayes.

Deshayes described a Reunion shell as *Turbo phasianellus*, but C. B. Adams had preempted that name. Fischer, receiving a similar shell from New Caledonia, with a horny operculum, transferred it to *Trochus*, preserving the invalid specific name. Then noting the incongruity of this solid little shell with a horny operculum provided it with the above subgeneric name.

It is certainly a very distinct little group, being small, turbiniform, weakly perforate, smooth, but the specific values have not been allotted. While Fischer stated that the Reunion and New Caledonian shells were

identical, Hedley (Proc. Linn. Soc. N.S.W., Vol. xlviii., p. 308, October 3, 1923) went a step further, and recorded it from Australia under a Pacific name *striatulus* Garrett, from Hawaii. This Hawaiian shell was described (Proc. Calif. Acad. Nat. Sci., Vol. i., "p. 102, 1857", according to Pilsbry, but it is on p. 114 in the December, 1873, reprint, which is the only one available here) as "Length, one line; diameter, the same". Pilsbry (Man. Conch. (Tryon), Vol. xi., p. 249, pl. 61, figs. 19-20, March 7, 1890) transferred the name to a species of *Monilea* from the Viti Is., measuring "Alt. 6, diam. 8 mill.; alt. 11, diam. 14 mill.", obviously a different shell. The figure displays, instead of a *Calliotrochus,* a shell referable to the genus *Talopena,* the columellar characters being unmistakeable. It may be called *Talopena discerna* sp. nov. It is further doubtful whether Garrett's species can be referred to *Calliotrochus,* but the specific name is invalid, as there is a prior *Trochus striatulus* (Deshayes in Leymerie, Mem. Soc. Geol. France, v., 1842, p. 3, *fide* Sherborn), so that the Hawaiian species is here renamed *Trochinella perconfusa* gen. et sp. nov., the description given by Garrett indicating a *"Margarita"* shell . . . thin . . . pellucid . . . surface marked with regular revolving striae . . . base somewhat flattened and umbilicated" . . . whereas *Calliotrochus* might be termed "solid . . . smooth . . . narrowly umbilicate".

The good figure by Deshayes shows a shell 6 mm. by 5 mm., more conical than the local shells with a minute perforation which may be called *Calliotrochus normalis* nov. This leaves the island shells still unnamed, and series from New Caledonia, Lord Howe Island and Norfolk Island, as well as Queensland are available for comparison. At first sight these represent different species, all the Norfolk Island-New Caledonia shells being small, while the Lord Howe Island and Queensland shells are larger. Fischer has given a figure of the New Caledonian shell (Coquilles Vivants, Trochus, p. 363, pl. iii., fig. 4, 1879), and this species differs in form, and sculpture from the Reunion one, and is therefore named *Calliotrochus symbolicus* sp. nov. The Norfolk Island shell is more conical, smaller, yet with a wider umbilicus than the New Caledonian shell, and also lacks the basal lining. Otherwise it is very similar, and may be called *Calliotrochus symbolicus alter* subsp. nov. The coloration has been subordinated, as it is variable, but the Norfolk Island shells are darker as a whole. The Elizabeth Reef shell is most like that of Lord Howe Island, which is notably larger, and of different shape from the others, and is here described.

Calliotrochus excellens *sp. nov.*

Shell large for the genus, broader than high, subglobosely turbinate, spire short, spire whorls small, body whorl proportionately very large, smooth, narrowly umbilicate.

Whorls five, the apical one smooth and a little elevated; the succeeding ones spirally finely lirate, the lirae numbering about twenty on the antepenultimate whorl, becoming obsolete on the penultimate and missing on the last whorl. This whorl, instead, shows fine regular closely set growth waves, scarcely pronounced enough to be classed as sculpture.

The whorls are rounded and increase rather rapidly, so that the last whorl is the bulk of the shell. The coloration is difficult to describe as the ground colour appears to be pale green, closely blotched and mottled with darker green, and through this runs a series of dotted concentric lines, the whole shimmering with the light through the pearly shell. The mouth is large, subcircular, the outer lip thin, but not sharp. The columella is a little curved, reflected, and the inner lip continues across the body whorl,

in the senile shell forming an almost completely free aperture. The umbilicus is very small and not very deep. The operculum is large, horny, multispiral, nucleus depressed, whorls comparatively few, six large and some minute.

Height, 6 mm. Breadth, 7 mm.
Type from Lord Howe Island.

Note.—An immature shell of a Trochoid of *"Minolia"* facies was found at Elizabeth Reef, but it cannot be determined either generically or specifically at present.

Family Turbinidae.

The most valuable information accrues from the finding, as a common shell on both reefs, of *Turbo cepoides* Smith. This species is a well-defined smooth Turbinid, which hitherto was only known from Lord Howe Island. In its smoothness it recalls *Turbo petholatus,* and less so *Turbo militaris* Reeve, the former living on New Caledonia and the Queensland coast, mainly on the reefs, while the latter is found on the South Queensland coast and New South Wales as far south as Sydney. It was necessary to determine to which of these the Lord Howe Island shell was more nearly allied.

The type of *Turbo* is *Turbo petholatus,* the well known glossy brightly coloured shell which produces the even better known "Cats-Eye" of commerce, that ornament being the operculum thereof. The species-group, *petholatus,* is divisible, but hitherto no definite means of separation has been recognised. Mr. E. Dranga, calling in at this Museum on his way back to America from the Pacific Islands, showed me series from Samoa and the Fiji Islands, pointing out the slight but constant differences in the opercula. At the same time, Mr. H. S. Mort noted the distinction between the opercula of the East and West Australian shells which was accompanied by distinct coloration. Investigation on these lines removed *Turbo cepoides* further away from *petholatus* (sensu latissimo), and still further from *militaris,* thus giving it a higher differential value still. This suggests that *Turbo cepoides* has been isolated on the Lord Howe Island plateau since before the development of *Turbo petholatus.* On the other hand, the operculum of *Turbo militaris* appears to connect this form with the giant *Turbo jourdani* as a more isolated group still. Under the latter name there appear to be two forms confused, a rather heavily ridged shell and a smooth one. The former is typical, and is also well figured by Reeve and probably came from West Australia. The South Australian shell is of different coloration, and is smooth on the body whorl without any sign of ribbing, while the penultimate whorl is also smooth, as also the antepenultimate or with very indistinct ridges. The shell appears more globose than the Reevean and Kiener figures. The operculum is large, oval, inner side a little elevated, and almost smooth. The specimen from Kangaroo Island, South Australia, measures 7 inches in height by 6½ inches in breadth, and is here named *Dinassovica verconis,* gen. et sp. nov., the opercular characters being diagnostic of the genus. A similar operculum is seen in the mouth of *Turbo militaris* Reeve, and juvenile shells are available with the operculum scarcely varying from that of the adult, the form being oval with the inner side a little elevated and the surface weakly pustulose.

The operculum of *"Turbo petholatus"* is almost smooth, subcircular, with the inner side elevated, the outer edge flattened, semi-grooved. Its coloration is characteristic, but the West Australian shell shows a dif-

ferently coloured operculum, so that our idea gained from Pacific Ocean shells may prove to be faulty, as the Moluccan shell might be nearer the West Australian one.

The adult operculum of *Turbo cepoides* is more elevated still, the inner elevated edge being smooth, the outer depressed subgrooved edge, as in *petholatus*, wrinkled and creamy brown; the coloration extends half way, this portion being pustulose, the smooth portion being white. In juvenile shells the operculum is less elevated, all white, and rather strongly pustulose throughout, the inner edge only becoming smooth. This operculum is at this stage, similar to that of *argyrostomus*, and if the pustules became exaggerated, instead of being lessened, we should get the style seen in *pulcher* Reeve, i.e., *intercostalis* Menke, of West Australia, whose shell is very different.

TURBO CEPOIDES Smith.

(Plate xvi., fig. 10.)

1880. *Turbo cepoides* Smith, Ann. Mag. Nat. Hist., Ser. v., Vol. vi., p. 397. Locality unknown.

1913. *Turbo cepoides* Hedley, Proc. Linn. Soc. N.S.W., Vol. xxxviii., p. 282, November 5. Lord Howe Island.

An odd unlocalised shell was described by Smith, as it was weakly perforate, apparently referable to the *petholatus* group, but of distinct (onion-like) coloration. Sowerby (Thes. Conch., Vol. v., p. 193, pl. 499, fig. 65, 1886) gave quite a good figure, but it was not recognised until Hedley examined the type, and reported the result as above.

The form is fairly distinct, more conical than the majority of *petholatus* forms, but the perforation is a very unstable feature. It is present as a chink in the very small juvenile shells, and is retained in some cases until senility. Just as often, however, it becomes closed at an early age and remains so. The coloration is generally green, but some juveniles from Lord Howe Island are beautifully mottled with shades of green, while others are unicolor brownish yellow. Old shells have always the last whorl smooth, but the earlier whorls are concentrically ridged.

The most extraordinary result was the recognition of a figure, apparently of *cepoides*, in the Conch. Cab. (Mart. and Chemn.) cont. Kuster, Bd. ii., Abth. 2, pl. 2, fig. 8. The text was written by Philippi, and there is no explanation to this figure. Searching for the reason for this neglect, it was seen that this plate was a reproduction from the original edition issued in 1781, and was plate clxxxiii. in Vol. 5. The figure was there numbered 1833, and on p. 223 a good description is given without any locality. The figure shows the elevated form, the semi-shouldering of the last whorl and the onion-peel style of colouring from which Smith coined the specific name *cepoides*. According to our history, Lord Howe Island was not discovered by Europeans until 1788, so that apparently there must be a mimic of *cepoides* existing elsewhere. Yet anyone would easily determine from the illustration the identity of our species.

As above noted, this species has hitherto been known only from Lord Howe Island, and its occurrence commonly on both Elizabeth and Middleton Reefs definitely determines the relationship of these Reefs. As shown above, the opercular characters, as well as those of the juvenile shell, suggest this to be a relict of an ancestral stage of the *Turbo-Senectus* series.

Genus CALCAR.

1810. *Calcar* Montfort, Conch. Syst., pt. ii., p. 134-5, May. Orthotype, *Calcar sporio* = *Turbo calcar* Linné.

The conical Turbinids have been a source of trouble as to their nomination and discrimination. Pilsbry (Man. Conch. (Tryon), Vol. x., 1889) used *Astralium*, but pointed out "this genus is composed of a number of quite diverse subgenera of various degrees of affinity to each other". He, however, accepted a world-wide range for his genus, although he showed that similar shells covered distinct animals. Thiele (Handb. Syst. Weicht., pt. i., p. 68, 1929) utilised "*Astraea* (Bolten) Röding" as the generic name for a universal genus allowing the same sections as Pilsbry, with a couple of additions. For the Queensland forms I advocated *Calcar*, restricting *Astraea* to the Neozelanic shells with a distinct radula.

Among the Australian shells there are very distinct groups, and their nomination is somewhat complicated by the inaccurate synonymy available.

The type of *Calcar* is a somewhat depressed shell with a convex base, imperforate, and the periphery dentate. This seems to show variation in that the periphery may be developed into a wavy flange, and the whorls become disunited, so that the adult is pagodoid in form. This may be regarded as a subgenus, *Pagocalcar*, the type being the shell known as *pileolum* Reeve (Conch. Syst., pl. 217, fig. 5, June, 1842), which seems to be *limbiferus* Kiener (Coquilles Vivants, Trochus, pl. 32, fig. 1, 1850) from Australia.

A very different production is a shell of a similar form, but with the periphery showing puckered transverse bars, and this must also be differentiated subgenerically as *Rugastella, rotularia* Lamarck, being the type.

Apparently a distinct generic group must be allowed the "Stella" series, but the name for this genus is doubtful. *Stella* has been used as of Klein, but the earliest lawful introduction seems to be that of H. and A. Adams (Gen. Rec. Moll., Vol. i., p. 398, May, 1854). These authors, however, cite "*Stellaria* Schmidt" as a synonym, and that is perhaps the earliest available name for the *stellare* group. Schmidt's name is given in Sherborn as appearing in "Möller, Isis (Oken), 1832, 130", but no species is cited. Stewart (Spec. Publ., No. 3, Acad. Nat. Sci. Philad., August 9, 1930) has drawn attention to Schmidt's essay, as published in 1818—apparently unaware that he was handling, as far as conchological students were concerned, an unique and much sought for work—dealing with it only as regards type designations, and thus we are no further ahead in this case. Reference to Schmidt's original publication is necessary to determine the status of *Stellaria*, so that it cannot be used at present. It may be available for the *stellare* group, or may be a pure synonym of *Calcar*, so that in order to avoid confusion the generic name *Distellifer* is introduced, with species *D. wallisi* as type.

Before leaving this series it may be noted that with further consideration of the beautiful shell Hedley named *A. aureolum*, shows more similarity with the Neozelanic *Cookia* than it does with the present series with which I formerly associated it.

Another very distinct genus is *Guildfordia*, the second species, *monilifera* Hedley and Willey (Proc. Linn. Soc. N.S.W., 1896, p. 107, pl. xii.) standing out very discordantly in the drawer of Astraeoid molluscs.

Genus Distellifer *nov.*

Type, *D. wallisi sp. nov.*

Shell tall, conical, with double row of spinose tubercles along the periphery, imperforate, operculum normal. These elevated Astraeoid mol-

luscs appear to differ essentially from the depressed species of *Calcar* proper, and the radular features may also separate them.

Distellifer wallisi *sp. nov.*

(Plate xvi., fig. 9.)

Shell very elevated, trochoid in form, periphery keeled, solid, imperforate, whorls probably ten or more, flattened, tending a little to become pagodoid with age.

Coloration obscured by growth, columella area deep purple, outer edge of mouth pale bluish green. Six or seven adult whorls may be counted, but there may be three or four more juvenile ones. Sculpture, radials, more or less coarse, the periphery being surrounded by a double row of elevated nodules, sixteen or so in each row. Sometimes these are produced into blunt spines, while at others the lower row becomes reduced to small nodules, and the upper part of the whorl varies in roughness. The base is ringed with small squamae, closely set, and about a dozen rows. The columella is curved, ending in a tooth anteriorly, and is white with a deep purple expansion on to the base of the whorl which continues across to the outer lip. The mouth internally is bluish white, the edge of the aperture being sharp and of a pale bluish green. The operculum is oval, irregularly elevated, greenish white, the outer edge depressed and purplish in colour.

Height of type, 55 mm. Breadth, 43 mm. The tallest of a series of six measures 65 mm high, and 49 mm. broad, the others ranging 62, 56, 55, and 51 mm. in height, by breadth 45, 48, 40 and 41 mm. respectively.

This Middleton Reef species has been compared with numbers of shells, which had been determined as *petrosum* Martyn. As Martyn's names are now rejected, it will be necessary to fall back upon *rhodostomus* Lamarck, and the exact locality of that form was unknown. Judging from Delessert's figure, as also that of Kiener, the typical *rhodostomus* is quite unlike the present species in size and ornamentation. From New Caledonia shells are smaller than the present species and have a faint purplerose columella and agree fairly well with Martyn's *petrosum,* but as noted above that name is invalid. Many Queensland shells from Murray Island, Torres Straits to the Capricorn Group are similar, the Capricorn series being a little taller and with a purple tinge on the columella than the Murray Island ones, which are broader and more depressed and are greenish on the columella. These Queensland shells are definitely smaller and may be named *Distellifer queenslandicus* sp. nov., the rows of nodules being also fewer, and the height not exceeding 40 mm. The sculpture on the base is regular, but a little coarser than on the Middleton Reef species, but on *rhodostomus* it is displayed as coarser and irregular.

Family Neritidae.

Two Nerites were found on both reefs, *Theliostyla albicilea* Linné, and *Melanerita melanotragus* Smith, the latter being unexpected, save that it does occur at Lord Howe Island. The former is a common Indo-Pacific shell occurring throughout that area.

Genus Theliostyla.

1852. *Theliostyla* Mörch, Cat. Conch. Yoldi, pt. i., p. 167, August. Logotype, Kobelt Illustr. Conch., p. 147, 1878 (*Theliostoma* errore) *Nerita albicilla* Linné.

In form this is an easily distinguished genus, the opercular characters and the radular features confirming this status.

THELIOSTYLA ALBICILLA Linné.

1758. *Nerita albicilla* Linné, Syst. Nat., 10th ed., p. 778, January 1, based on "Rumph. mus. t. 22, fig. 8. Hitoe.

In this and the succeeding species I can find no local variation over an extensive range even with good series.

Genus MELANERITA.

1889. *Melanerita* Martens, Conch. Cab. (Mart. & Chemn.), ed Kuster, Bd. ii., heft 29, p. 125, ante May. Logotype, *N. nigra* = *melanotragus* Smith.

This black Nerite is very different in form from the preceding, and it was a surprise to meet with it from this place, though of course common on Lord Howe Island.

MELANERITA MELANOTRAGUS Smith.

1884. *Nerita melanotragus* Smith, Zool. Coll. Alert, p. 69.
1884. *Nerita saturata* Hutton, Proc. Linn. Soc. N.S.W., Vol. ix., p. 354.

These two names were given simultaneously, and Hedley accepted the former as having been published on August 1st, and the other as being issued on August 23. It has since been ascertained that the Alert appeared on July 12, and the Linnean Society's proceedings on August 19. Abstracts of the latter appeared earlier, but Hutton's name was not included. In the abstract, however, that was given in the N.Z. Journ. Sci. for July, 1884, Hutton's name was recorded, and that monthly was stated to come out on the second Saturday of the month, i.e., July 12. Smith's name is here used in continuance of custom.

Family HIPPONICIDAE.

The first rule in systematics is apparently ignored by many writers as they persist in the usage of the family name, Amaltheidae, and the generic name *Amalthea,* although it should be well known that these are invalid. Since the publication of Sherborn's Index Animalium, Part ii., there can be no excuse for such conduct.

Amalthea was introduced by Schumacher in 1817 with two sections; a, with only one species *Amalthea conica*; b, with *A. ungarica* alone.

Gray, in 1847, selected the latter as type of *Amalthea* b, and made this a synonym of *Capulus* Montfort, 1810, a correct procedure; he then allowed *Amalthea* as a valid name, with type *A. conica.* As a synonym he quoted "*Sabia* Gray, 1833. 1844, 63".

Unless some other name intervenes, or *Sabia* has some other application, it is available for the valueless *Amalthea.* Unfortunately the reference to Gray, 1833, appears to be a lapsus, and a later reference to Gray, 1839, with a citation to zoology of Beechey's voyage, has not been found by Sherborn. Sherborn gives as earliest reference to *Sabia* "Synops Contents Brit. Mus., ed. 43, 1841, p. 126" (after June 12), where it is a *nomen nudum.* Reeve (Conch. Syst., Vol. ii., p. 34, April, 1842) gave a note about *Sabia,* but here also it is a *genus coelebs.* It did not appear in the 42nd edition of the Synopsis, as it is not given in my Collation (Proc. Mal. Soc. (Lond.), Vol. x., p. 294, et seq, March, 1913), so that the 1833 and 1839 citations are doubtful. Thiele (Handb. Syst. Weicht., pt. i., 1929) uses the family name Amaltheidae (p. 241), and even a Stirps Amaltheacea (p. 238), while including in the family the genus *Cheilea* Modeer, 1793, which has an internal cup and would be better placed in the succeeding Stirps. Under *Amalthea,* Thiele cites *Hipponyx* Defrance, *Sabia* Gray, *Cochlolepas* H. & A. Adams, and *Malluvium* Melvill, as synonyms, and *Amathina* Gray, as a

subgenus. Peile has rejected *Malluvium* Melvill in favour of *Amalthea*, stating that the radula corresponded with that of *A. conica*, the type of *Amalthea*. His specimens were from Kii, Japan, and may have had nothing to do with the true *Capulus lissus* Smith, as there are similar smooth Capulid like shells found in deep water off the coast of New South Wales. Peile there (Proc. Mal. Soc. (Lond.), Vol. xxi., p. 251, March, 1935) suggests that *Saptadanta*, placed by its authors in Lepetellidae, should be transferred to the Amaltheidae. At this point the shells collected at Middleton and Elizabeth Reefs come into the matter as these are commonly known as *"Amalthea conica"*, and otherwise agree with Quoy and Gaimard's *Hipponix acuta*. These authors gave a figure of the animal (Voy. de l'Astrol., Zool. Atlas, pl. 72, figs. 35-38), and H. & A. Adams (Gen. Rec. Moll., pl. xli., figs. 4, 4a, b, c) gave figures of the shell and animal of *A. conica*. Troschel (Gebiss der Schnecken, Vol. i., p. 163 (361 at top of page), pl. xiii., fig. 15, 1861) gave an excellent figure of the radula of *Hipponyx (Amalthea) conica*. All these generally agree with the Reef shells, which belong to a form common throughout the Tropics on Trochoid, Turbinid and other Gastropod shells. All the details agree with Prashad and Rao's *Saptadanta nasika* (Rec. Ind. Mus., Vol. xxxvi., p. 2, text fig. 1, and pl. i., figs. 3 and 4, March, 1934), and both that generic name and the species may be regarded as synonymous. A group-synonymy, such as given by Thiele, would read *Sabia* = *Amalthea* (preoccupied) = *Amathina* = *Malluvium* = *Pilosabia* = *Saptadanta*, but I do not advocate such, and would allow *Amathina*, *Pilosabia* and *Malluvium*, but still *Saptadanta* would appear to fall under *Sabia*.

The specific name is not easily determined, as probably there may be geographical differences, and thus *conica* may displace *nasika*, but *acuta* may become valid. The elevated form of *conica* is a little strange, but these shells vary in shape, according to their environment.

The generic name *Hipponix* is based on a fossil, and therefore reference to animal characters cannot be made, but that generic name may be used as the basis of the family name.

Genus Sabia.

1847. *Sabia* Gray, Proc. Zool. Soc. (Lond.), 1847, p. 157, November (as of Gray, 1833, 1839, neither of which have been traced), ex Synops Cont. Brit. Mus., 43rd ed., p. 126, 1841, *nom. nud.*, and Reeve, Conch. Syst., Vol. ii., p. 34, April, 1842, *genus coelebs*). Orthotype, *Amalthea conica*.

1817. *Amalthea* Schumacher, Essai nouv. syst. Test., pp. 56-181. Logotype, Gray, supra, *Amalthea conica*.
Not *Amalthea* Rafinesque, Analyse Nat., p. 123, 1815.
Nor *Amaltheus* Montfort, Conch. Syst., pt. i., p. 90, 1808.

1934. *Saptadanta* Prashad & Rao, Rec. Ind. Mus., Vol. xxxvi., p. 2, March. Haplotype, *S. nasika* Prashad & Rao.

On the data given this result is inevitable.

Sabia acuta Quoy and Gaimard.

(Plate xvi., fig. 8.)

1835. *Hipponix acuta* Quoy and Gaimard, Voy. de l'Astrol., Vol. iii., p. 437, pl. 72, figs. 35-38, after March 17. New Ireland (Carteret Harbour).

The specimen figured may appear different from figures already given, but this is merely due to the great age of this shell, younger ones agreeing exactly with Quoy and Gaimard's figures.

Some small specimens of the shell known as *Hipponyx foliacea* Quoy and Gaimard, were also found on *"Tridacna"* from both Reefs. This species was admitted in the New South Wales Check-List, but that shell has long been regarded as distinct, though as yet unnamed. Quoy and Gaimard stated that in their species (Voy. de l'Astrol., Zool., Vol. iii., p. 439, pl. 72, figs. 41-45 (after March 17) 1835) from Guam, the young had the form of a Nerite with longitudinal striae. The Sydney shell has a minute rissoid smooth nucleus, and to complicate matters there appear to be two species from Lord Howe Island of similar appearance, but with different sculpture. In these the nucleus is neritoid, but it appears smooth. In order to avoid confusion the Reef shell may be regarded as Quoy and Gaimard's *foliacea*, until Guam specimens can be re-examined. This species lives under stones, and is obviously of different origin from the *"conica"* series. It is much more like the style of the fossil *Hipponix*, and should be separated from *Sabia*, even as all the old workers recognised. Fischer (Journ. de Conch., Vol. x., pp. 1-17, January, 1862) has given an account of the West Indian *"Hipponyx antiquata"*, showing an animal similar to that of *Sabia* = *Saptadanta*, but figures a spirally lirate nucleus. The local animal may later be investigated, but in order to lessen the confusion a name, *Antisabia*, is proposed for the *foliacea* series, and the different forms will later be segregated.

Thiele included *Cheilea* in his family, Amaltheidae, an extraordinary procedure at first sight, because in life it is so unlike, and would better be classed with the other shelf-bearing shells as *Calyptraea* and *Crepidula*. A small specimen with rather strong radiating sculpture was picked out of debris from Elizabeth Reef, but it cannot be, at present, specifically named. Tryon (Man. Conch., Vol. viii., p. 137, 1886) recognised a species, *Mitrularia equestris* Linné, giving it a circumtropical distribution, and recording some twenty-five names as synonyms, and then a var. *tortilis*, with another ten synonyms. Such action has prejudiced later workers, so that thirty years later Hedley included the Sydney form as *Cheilea equestris porosa*. A little later he emended the name to *Cheilea undulata* Bolten, giving its range as Sydney Harbour, N.S.W., northwards to Torres Straits. But in Queensland waters I have separated four very distinct species of *"Cheilea"*, indicating the absurdity of the grotesque lumping indulged in by Tryon. There is a very large species corresponding to the conventional *"equestris"*, with wrinkled sculpture and a large internal appendage. A smaller more regular shell has regular fine radials and a medium cup, and two smaller species have very small internal cups, but one is stout and heavily radially lirate, and the other is very thin and covered with elevated pustules.

Family Rissoinidae.

Two shells belonging to this family fell out of the debris from Middleton Reef, one of which was the commonest Lord Howe Island clathrate species, the other of the *"Rissolina"* style, also common at Lord Howe Island. Hedley (Mem. Austr. Mus., iii., p. 419, 1899) recorded the former as *Rissoina exasperata* Souverbie, a New Caledonian species, but noted that the Lord Howe specimens differed. The *Rissolina* was in too dead condition to determine exactly, but was of the *R. plicata* series.

Family Cerithiidae.

From the debris from Middleton Reef a small Cerithioid was sorted out, which may be referable to *Clypeomorus*, the species being known as *Ceri-*

thium nassoides Sowerby, in collections from New Caledonia, but it is obviously not the true *C. nassoide*, which was described by Sowerby (Thes. Conch., Vol. ii., p. 875, pl. 183, figs. 200-201, 1855) from the Sandwich Islands. The Middleton Reef shell is not uncommon at Lord Howe Island.

Family Vermetidae.

Some specimens were picked up, but on the *Turbo* and other shells, many living specimens of a small form which is well known, but does not appear to have been named were seen. On the small Clams another species was also seen, but is not here determined.

Genus Veristoa *nov.*

Type, *V. howensis nov.*

(Plate xvii., fig. 8.)

Spiroglyphus of Daudin was used by Tryon (Man. Conch., Vol. viii., 1886, p. 177) for similar small shells, but these are not easily differentiated. Mörch reviewed the Vermetidae (Proc. Zool. Soc. (Lond.), 1861, pp. 145-181, pl. xxv., September 16, and pp. 326, 365, April 7, 1862), and unfortunately his conclusions are not easy to follow; apparently they were not regarded as final, but rather preliminary. Thus in one place, *Stoa* de Serres, is mentioned as a synonym of *Siphonium* Gray, and then in another it is used subgenerically, and then later subordinated in part to *Spiroglyphus*. In some cases the operculum is regarded as calcareous, in others horny; while the nuclear characters, a very important feature, are not characterised. Consequently the present species is distinguished, both as a new genus and species.

The nuclear shell is minute, rissoid, brown, of two and a half whorls, longitudinally flexuously regularly striate: it settles mouth down, and then the adult shell of stronger texture encircles the nucleus, forming strong ridges above, and commonly boring into the surface of the shell upon which it has settled. The adult is purple brown in coloration, and, often, after circling, will lengthen out in a strong line. The nucleus is about 1 mm. in length, and .75 mm. in greatest breadth, the small completed shell before elongation being about 3 mm.

Common on both Reefs, on Lord Howe Island, and probably the same species on the Great Barrier Reef of Queensland.

"Genus Bivonia."

1862. *Bivonia* Mörch, Proc. Zool. Soc. (Lond.), 1862, p. 54, June 1.

It is questionable whether this is the same as Gray's *Bivonia*, but the matter is too complex for discussion here.

Bivonia constrictor Mörch.

1862. *Bivonia constrictor* Mörch, Proc. Zool. Soc. (Lond.), 1862, p. 63, June 1. Australia.

Hedley (Proc. Linn. Soc. N.S.W., Vol. xxxviii., p. 294, pl. xviii., fig. 71, November 5, 1913) has figured the type, and this agrees with Lord Howe Island specimens. A dead mass was picked up at Middleton Reef.

Family Naticidae.

A dead worn specimen from Middleton Reef belongs to the form regarded as *Uber pyriforme* by Hedley (Rec. Austr. Mus., Vol. xiv., p. 161, 1924), but the matter is more complicated than Hedley concluded. I am endeavouring to elucidate the species, but here it may be concluded that

the Middleton Reef shell agrees generally with the North Queensland shell. It has only once been sent from Lord Howe Island up to the present, so must be a very rare shell there.

Family Cypraeidae.

A dead worn shell of the common Cowry, *Mystaponda vitellus* Linné, and a fragment of the equally common *Ravitrona caputserpentris* Linné, were picked up on Middleton Reef. These are both very common at Lord Howe Island, as well as North Australia and New Caledonia, and so far no geographical variation has been determined.

Family Conidae.

Only a few odd shells were picked up, and these represent half a dozen species, all well known and common throughout the Indo-Pacific area, so that no good result would accrue from criticising them in any way. The accepted specific names are here utilised for ease in reference, as *Virroconus ebraeus* Linné, *V. musicus* Brug., *V. coronatus* Dillwyn, *Stephanoconus lividus* Brug., *Chelyconus rattus* Brug., and *Rhizoconus planorbis* Born. The first two were secured at Elizabeth Reef, the other four at Middleton Reef.

Family Turridae.

One small Turrid was found among debris from Middleton Reef, and this belongs to the group named *Iredalea* by Oliver, and the specimen is similar to the type of the genus, *subtropicalis*, described from the Kermadec Islands. Hedley (Rec. Austr. Mus., Vol. xiii., p. 258, pl. xlv., fig. 52, September 30, 1922) figured a shell from Torres Straits under this name, and the shell in hand will fall into the limits thus assigned. Shells of the same appearance are known from Lord Howe Island and New Caledonia.

Family Pyrenidae.

A living specimen of the Columbellid recorded from Lord Howe Island as *varians* Sby. was collected at Middleton Reef. It is fairly common at the former locality, and the series is not unlike the figures 49-50 of pl. xxxvii. in Sowerby's Thes. Conch., Vol. i., 1844. Some specimens also agree very closely with figs. 47-48, which suggests that the colour variation is similar. Sowerby's note (p. 118) is somewhat ambiguous: "Found in the Gallapagos Islands, H. Cuming. Numerous specimens were brought by the Endeavour, Capt. Cook". It would be interesting to know the locality whence the latter came.

At Lord Howe Island the more common species is *"versicolor* Sby." in a small form, about the same size as *varians*. This probably also occurs on the Reefs, and would have been of more value, as the Queensland form of *versicolor* is a large shell, easily distinguishable. The generic name to be used, at present, for these species is *Euplica*.

Family Thaididae.

It would be anticipated that members of this family would be met with as these shells are characteristic of coral reefs. Five species were collected at Middleton Reef, one of which had only been found at Elizabeth Reef. Two items are of interest in their connection, the occurrence of *"Drupa chaidea"* and *"D. marginalba"*. I have pointed out the curious range of the former in my introduction, and the latter is one of a pair that is continually and easily confused. According to my experience in Queensland,

marginalba is the coastal shell, coming as far south as Sydney, New South Wales, where it is common, attacking oysters, and being known as the Oyster Drill. The other shell of the pair is known as *tuberculata,* but an older name is *granulata* Duclos, and this lives on the outer edges of the coral reefs, and this should have been the form found at Middleton Reef. It was the *marginalba* shell, which was, however, collected. The commonly used names of the five species are *Thais pica, Drupa horrida, D. morus, D. marginalba* and *D. chaidea.* Instead the names at present valid are *Menathais pica, Drupa morum, Morula uva, Morula marginalba* and *M. nodulifera.* The discussion in connection with these is too long for insertion here, so will be dealt with in detail elsewhere. The outlines are here only noted.

Genus MENATHAIS *nov.*

Type, *Purpura pica* Blainville.

The type of *Thais* Bolten (Mus. Bolten, pt. ii., p. 54, September) is here fixed as *T. lena* Bolten = *Murex fucus* Gmelin, the shell commonly known as *Purpura neritoides* Lam. The present species is unlike in form, having an elevated spire, a much smaller mouth, which is striated inside. This is apparently a rather large Pacific group of great complexity, four or five species living in North Australia, the figure in Reeve (Conch. Icon., Vol. iii.), pl. viii., fig. 36, showing the typical form with the widest range.

MENATHAIS PICA Blainville.

1832. *Purpura pica* Blainville, Nouv. Ann. Mus. Paris, Vol. i., p. 213, pl. 9, fig. 9, July (cites Martini, 956-8). Tonga.

Dead shells, inhabited by hermitcrabs, only from Middleton Reef; has been rarely found alive at Lord Howe Island.

Genus DRUPA.

1798. *Drupa* Bolten, Mus. Bolten, pt. ii., p. 55, September. Logotype, Rovereto, Atti. Soc. Ligustico (Genoa), Vol. x., p. 105, 1899, *Drupa morum* Bolten.

1807. *Canrena* Link, Verz. Rostock Samml., pt. iii., p. 126. Logotype, here selected, *C. neritoidea* pt. Martini, figs. 972, 973 = *D. morum* Bolten.

1810. *Sistrum* Montfort, Conch. Syst., Vol. ii., pp. 594-5, May. Orthotype, *S. album* = *Bucc. echinatum* Lam. ined. = *Murex ricinus* Linné.

1816. *Ricinula* Lamarck, Ency. Meth., Vers., Vol. iii., Liste, p. 2, December, for Ency. Meth., Vers., Vol. i., pl. 395. Logotype (Children), Quarterly Journal Science, Vol. xvi., p. 56, October, 1823. *Ricinula horrida* Lamarck.

1817. *Ricinella* Schumacher, Essai nouv. syst. Vers., pp. 72-240. Logotype, here selected, *Ricinella purpurata* Schum. = *Drupa rubusidaeus* Bolten.

1852. *Pentadactylus* Mörch, Cat. Conch. Yoldi, pt. i., p. 87, August, as of Klein pre-Linnean. Type here selected "*globosa* Mart." = *horrida* Lam. Not *Pentadactylus* Gray, 1845.

If the generic name *Drupa* be restricted to the forms about *morum,* the name *Ricinella* will be available for the open mouthed species, similar to *rubusidaeus,* as *aperta* Blainv., as shown by Cooke (Proc. Mal. Soc. (Lond.), Vol. xiii., p. 102, fig. 19, April, 1919).

DRUPA MORUM Bolten.

1798. *Drupa morum* Bolten, Mus. Bolten, pt. ii., p. 55, September, for Martini, 3, t. 101, figs. 972, 978 (sic). East Indies.

1816. *Ricinula horrida* Lamarck, Ency. Meth., Vers., Vol. iii., Liste, p. 2, December, for Ency. Meth., pl. 395, figs. 1a, b.
1817. *Ricinella violacea* Schumacher, Essai nouv. syst. Test., p. 240, for Mart., 3, p. 280, t. 101, figs. 972, 973.
1822. *Ricinula horrida* Lamarck, Hist. Anim. s. Vert., Vol. vii., p. 231, Aug., cites Martini, 3, t. 101, figs. 972-973, and Ency. Meth., pl. 395, fig. 1. L'Ocean Indien.
1852. *Ricinula globosa* Mörch, Cat. Conch. Yoldi, pt. i., p. 88, Aug., ex Martini, nonbinomial, for *horrida* Lam., and *morum* Bolt.

This common widely spread species has only once been found at Lord Howe Island, as it frequents the outer edges of the coral reefs. Two living specimens were collected at Middleton Reef. Although no geographical variation is yet known, apparently a distinct form lives at Samoa, according to shells so labelled in this Museum.

Genus Morula.

1817. *Morula* Schumacher, Essai nouv. syst. Test., pp. 68-227. Haplotype, *M. papillosa* = *Drupa uva* Bolten.

The name *Morula* should be restricted to the "mulberry" forms, as these small species have been shown to be of polyphyletic origin.

Morula uva Bolten.

1798. *Drupa uva* Bolten, Mus. Bolten, pt. ii., p. 56, September, for Martini, 3, t. 101, fig. 970. East Indies.
1816. *Ricinula nodus* Lamarck, Ency. Meth., Vers., Vol. iii., Lister, p. 2, December, for Ency. Meth., Vers., Vol. i., pl. 395, figs. 6, a, b.
1817. *Morula papillosa* Schumacher, Essai nouv. syst. Test., p. 227, for Martini, 3, p. 278, t. 101, fig. 970.
1822. *Ricinula morus* Lamarck, Hist. Anim. s. Vert., Vol. vii., p. 232, August, cites Martini, 3, t. 101, fig. 970, and Ency. Meth., pl. 395, fig. 6. Mers d'Ile de France.
[? 1832. *Purpura sphaeridia* Duclos, Ann. Sci. Nat. Paris, Vol. xxvi., p. 111, pl. 2, fig. 10, May. "Californie."]
1852. *Ricinula alba* Mörch, Cat. Conch. Yoldi, pt. i., p. 87, August, ex Martini, for Mart., 3, 970, = *uva* Bolten and *morus* Lam.

One live shell from Middleton Reef, also rarely met with at Lord Howe Island.

Morula marginalba Blainville.

1832. *Purpura marginalba* Blainville, Nouv. Ann. Mus. Paris, Ser. 3, Vol. i., p. 209, pl. 10, fig. 6, June-August. Mers Australes.

This is distinguished by its open mouth and dark teeth, the intervals of the outer lip being light coloured. The species following has been confused, but the mouth is cramped, two white teeth in the centre of the outer lip, the rest being dark. The latter has been commonly known as *tuberculata*. *M. marginalba* is common at Lord Howe Island.

[Morula granulata Duclos.

1832. *Purpura granulata* Duclos, Ann. Sci. Nat. Paris, Vol. xxvi., p. 111, pl. 2, fig. 9, May. New Holland.
[1832. *Purpura tuberculata* Blainville, Nouv. Ann. Mus. Paris, Ser. 3, Vol. i., p. 204, pl. 9, fig. 3, June-August. Madagascar.
The figure shows four evenly spaced teeth in mouth.]

1908. *Sistrum chrysalis* Sowerby, Proc. Mal. Soc. (Lond.), Vol. viii., p. 17, pl. i., fig. 5, March. New Caledonia.
(Seems to be based on a local aberration.)

The figure in the Ency. Meth., pl. 395, figs. 6, a, b, upon which *Ricinula nodus* Lamarck is based, is more like this species than it is similar to *uva*, with which *morus* Lam. has been commonly identified, the description belonging to that species.]

MORULA NODULIFERA Menke.

1829. *Purpura nodulifera* Menke, Conch. Samml. Malsb., p. 33 (pref. May 18). No locality.
1832. *Purpura chaidea* Duclos, Ann. Sci. Nat. Paris, Vol. xxvi., p. 106, pl. i., fig. 4, ex Vol. xxv., p. 94, January, 1832, *nom. nud.* Locality unknown.
1832. *Purpura nassoidea* Blainville, Nouv. Ann. Mus. Paris, Ser. 3, Vol. i., p. 205, June-August, for Quoy & Gaimard, pl. 38, figs. 7-9. Tonga.
1833. *Purpura nassoides* Quoy and Gaimard, Voy. de l'Astrol., Zool., Vol. ii., p. 564, pl. 38, figs. 7-9. Tongatabu; figs. 10-11, New Holland.
1868. *Sistrum rugulosum* Pease, Amer. Journ. Conch., Vol. iv., p. 93, pl. ii., fig. 7, November 3. Howland Island.

This shell is really dissimilar in sculpture and form, so that it should be separated as a subgenus, for the present, with the name *Oppomorus*; the mouth becomes cramped, but the teeth on the outer lip are insignificant, and the shell resembles *Cronia*, but is not closely related to that genus. It was the commonest of the series at both Reefs, and it is also common at Lord Howe Island.

Family QUIBULLIDAE.

A dead shell was all that was secured, but probably many Tectibranchs live on the Reefs.

Genus QUIBULLA.

1929. *Quibulla* Iredale, Austr. Zool., Vol. v., p. 349, March 24. Orthotype, *Bulla botanica* Hedley.

Study of the animals may enable us to determine the generic limits of the Bulloid molluscs, but there is very little to get hold of in the shells.

QUIBULLA SCOTTI *sp. nov.*

(Plate xvi., fig. 11.)

When I was reporting upon Strange Molluscs from Sydney Harbour (this Journal, Vol. v., pp. 349-50, 1929) I allowed Pilsbry's name *angasi*, but that was incorrect. Pilsbry had introduced *A.* (that is, *Bulla*) *angasi* for *Bulla solida* of Sowerby, not of Gmelin, and only reproduced Sowerby's description and figure from unknown locality. Therefore, Pilsbry's name must follow Sowerby's account, and, as Pilsbry himself admitted, that does not agree with Port Jackson shells, though he added that locality ex Angas. But Angas did not regard his Port Jackson shells as *solida* of Sowerby, but that shells similar were named *Bulla solida* Gmelin, not Bruguière in the British Museum. There appears to be one or two names available for the Sydney shell, as Angas called it *Bulla magdelus* ex Lister, and gave *Bulla ovulum* Gld. MS., as a synonym. Lister is pre-Linnean, and he had spelt the name *amygdalus*, and this had been used by Dillwyn for Lister's shell from the West Indies. If, therefore, *magdelus* Angas, be rejected as merely a mis-spelling, *ovulum* will become valid, and there appears to be no prior use of that name. It may be that Gould altered his

ovulum to *vernicosa,* as that Gouldian published species is quite similar. For Lord Howe Island specimens *Bulla adamsi* has been used, but *Bulla adamsi* Menke (Zeits. für Malak., 7th year, 1850, p. 162, April, 1851) must be restricted to the Mazatean shell he described. Menke also quoted *Bulla australis* A. Ad. in Sow., Thes. Conch., Vol. ii., p. 576, pl. 122, figs. 64-66, 1850, a figure of a Tahitian shell. This was not *Bulla australis* Quoy & Gaimard, a West Australian shell, and Brazier (Proc. Linn. Soc. N.S.W., Vol. x., p. 92, June 4, 1885) renamed the Tahitian shell *Bulla adamsi,* ignorant of Menke's usage previously.

The Elizabeth Reef shell is the same as one common at Lord Howe Island, and which is here described. It is more regularly elongately oval than *botanica,* as well as being stouter, but is definitely narrower than any of the *ampulla* series, as well as smaller. The apical umbilicus is very narrow, but deep, and there are about four spiral incisions internally; there is a strong deflection of the inner lip over the umbilicus, but little glaze posteriorly; the outer edge is slightly sinuate, but almost straight. Growth lines are well marked, almost forming a regular incised sculpture; there are no striae round the base.

Coloration: Mottled closely with brown on a whitish ground, with four indistinct transverse bluish bands.

Length of type, from Lord Howe Island, 40 mm.; breadth, 27 mm.

The common Sydney shell is smaller, narrowed a little posteriorly, and therefore a different shape, the apical umbilicus narrow, closely finely incised inside (I do not lay any stress upon this variable feature), but sometimes the incisions are strong, at others obsolete. Shell mottled and clouded with dark and light brown, but never banded. It must apparently be called *Quibulla ovulum* Angas.

Family Retusidae.

A small Retusid shell from the debris of Elizabeth Reef does not appear to fit in with any known group. The erect pupoid apex of the Tornatinid series is here flung down, and almost immersed by the surrounding adult shell, which is crowned with a puckered frill.

Genus Decorifer *nov.*

Type, *D. elisa sp. nov.*

(Plate xvii., figs. 9, 10.)

A retusoid shell with slight columellar fold, two whorled pupoid nuclus laid transversely, the surrounding whorls becoming elevated, so that the crown becomes a shallow saucer, edges puckered and compressed, a shallow groove separating this from the smooth shell, on which faint growth lines only are distinguishable. Transparent, clouded with milky blotches.

Length, 3.25 mm. Breadth, 1.5 mm.

The figure of *Bulla planispira* A. Adams (Thes. Conch. (Sowb.), Vol. ii., p. 568, pl. 121, fig. 32, 1850), from the Is. of Luzon, recalls this, but our shell is not longitudinally grooved, while as there is no mark for size alongside the figure, which is four times the length of this shell, the comparative sizes are unknown.

Family Ringiculidae.

Some small shells sorted out of debris from Elizabeth Reef are smooth, and therefore referred to *Ringiculadda.*

Genus Ringiculadda.

1936. *Ringiculadda* Iredale, Rec. Aust. Mus., Vol. xix., p. 332, April 7. Orthotype, *Ringicula semisculpta* Hedley.

This genus was proposed as having less callus on the body whorl, with teeth less notable, and the outer lip less varied; the shells under review agree in those features.

RINGICULADDA ASSULARUM Watson.

1880. *Ringicula assularum* Watson, Journ. Linn. Soc. (Lond.), Zool., Vol. xvii., p. 291. Flinders Passage, Torres Straits, 7 F.

1886. *Ringicula assularum* Watson, Rep. Sci. Res. Chell., Vol. xv., p. 635, pl. xlvii., fig. 10.

The specimens are almost identical with Australian ones, and a Lord Howe Island shell is very similar. Four species of *Ringicula* have been recorded from New Caledonia, and all these are strongly sculptured, the present species being smooth.

The species referred to may be listed as follows:—

	Middleton Reef.	Elizabeth Reef.
Acar dubia Baird	—	E
Arca "decussata"	M	—
"Ostrea cerata"	M	—
"Limatula bullata"	—	E
Lithophaga sp. indet.	—	E
Septifer bilocularis Linné	M	E
Musculus nubilis Ired.	—	E
Chama 2 spp. indett.	M	—
Persikima whitleyi Ired.	(M)	E
Vulgodacna fossor Hedley	M	E
Cardita variegata Brug.	—	E
Lentillaria paytenorum Ired.	M	E
Epicodakia "bella"	—	E
Pardosinia alma extranea Ired.	—	E
Laciolina quoyi attracta Ired.	M	—
"Tellina" sp. indet.	—	E
Notoplax leuconota Hed. & Hull	M	—
Tegulaplax howensis Hed. & Hull	M	—
Nannoscutum forsythi Ired.	—	E
Stomatolina rufescens Gray	—	E
Calliotrochus excellens Ired.	M	E
Turbo cepoides Smith	M	E
Distellifer wallisi Ired.	M	—
Theliostyla albicilla Linné	M	E
Melanerita melanotragus Smith	M	E
Sabia acuta Quoy & Gaimard	M	E
Antisabia foliacea Quoy & Gaimard	M	E
Cheilea sp. indet.	—	E
"Rissoina exasperata"	M	—
Rissolina (plicata)	M	—
Clypeomorus (nassoides)	M	—
Veristoa howensis Ired.	M	E
Bivonia constrictor Mörch	M	—
"Uber pyriforme Hedley"	M	—
Mystaponda vitellus Linné	M	—
Ravitrona caputserpentis Linné	M	—

Virroconus ebraeus Linné	—	E
musicus Brug.	—	E
coronatus Dillwyn	M	—
Stephanoconus lividus Brug.	M	—
Chelyconus rattus Brug.	M	—
Rhizoconus planorbis Born.	M	—
Iredalea subtropicalis Oliver	M	—
Euplica varians Sowerby	M	—
Menathais pica Blainville	M	—
Drupa morum Bolten	M	—
Morula uva Bolten	M	—
marginalba Blainville	M	—
Morula nodulifera Menke	M	E
Quibulla scotti Ired.	—	E
Decorifer elisa Ired.	—	E
Ringiculadda assularum Watson	—	E

In addition to the new species described, the following novelties are introduced and here noted for the benefit of the Zoological Record compiler.

Propetilus subgen. nov., type, *Musculus nubilis* Ired.

Dinodacna gen. nov. (for Giant Clams of the Pacific Ocean), type, *D. cookiana* Ired.

Flodacna gen. nov. (for Squamose Clams), type, *Tridacna squamosa* auct.

Sepidacna gen. nov. (for small prickly Clams), type, *Tridacna troughtoni* Ired.

Laciolina francesae Ired., Norfolk Island.

Talopena discerna Ired.

Trochinella perconfusa Ired.

Calliotrochus normalis Ired.

symbolicus Ired.

alter Ired.

Dinassovica gen. nov. for *D. verconis* Ired. (*Turbo jourdani* pt.).

Pagocalcar subgen. nov., type, *Trochus limbiferus* Kiener.

Rugastella subgen. nov., type, *Trochus rotularius* Lam.

Distellifer queenslandicus Ired.

SEA SLUGS.

Subclass Opisthobranchia.

By Joyce Allan.

(The Australian Museum, Sydney.)

Amongst the Opisthobranchia were two small sea-hares and a Nudibranchiate sea-slug. One other seahare was sighted, and recognised as similar to the large, greenish brown species previously noticed at Lord Howe Island. It had a characteristic black mark on the tail, and is reasonably supposed to be *Tethys angasi* Sowerby, a species fairly common along the New South Wales coast.

Family Tethyidae.

Genus *Dolabrifera* Gray, 1847.

Dolabrifera Gray, Proc. Zool. Soc., 1847, p. 162. Type, *D. dolabrifera* Cuvier, 1818, from Mauritius.

Dolabrifera brazieri Sowerby.

Dolabrifera brazieri Sowerby, Proc. Zool. Soc., 1870, p. 250. Type locality, Botany Bay, N.S. Wales.

Two immature, curled specimens are obviously young of this species, which is common under rocks at low tide along the N.S.W. coast. The general colour is greenish brown, the surface almost smooth, with only a slight suggestion of pustules and filaments, a fact noticed in immature specimens of the New South Wales form. The eyes are conspicuous and black and placed a little in front of the dorsal tentacles. Length of animal, 21 mm. Breadth, 11 mm.

The shell was very similar in shape to that of Sydney and Lord Howe Island forms of *Dolabrifera brazieri,* and unlike any other species of the genus. It was strong for its size, white and solid, with straight sides and fairly strong growth lines, and a suggestion of an almost central groove running from the apex to the margin. Length of shell, 6 mm. Breadth, 3 mm.

Habitat: Two specimens, Middleton Reef, South Pacific Ocean, in pools, *Annasona* wreck. Coll. G. P. Whitley, 18th April, 1936.

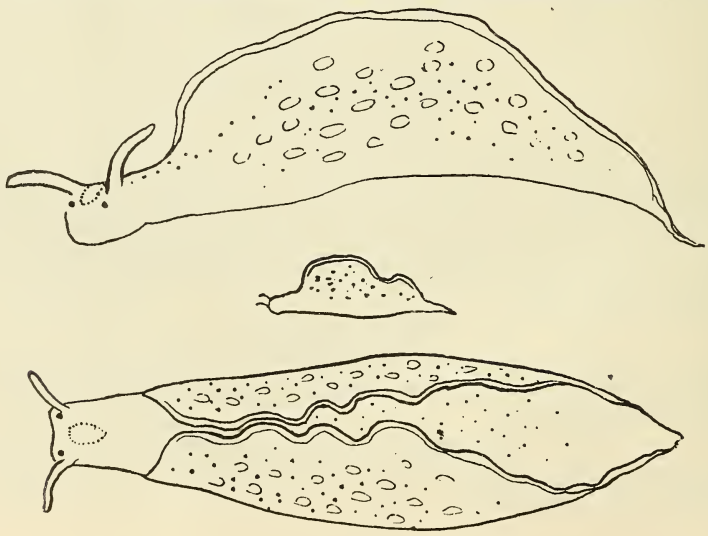
Family Elysiidae.

Genus *Elysia* Risso, 1818.

Elysia, Risso, Journ. de Phys., lxxxvii., 1818, p. 376. Type, *E. viridis* Mont.
Elysia (*Pterogasteron*) *marginata* Pease, 1860.

Pterogasteron marginatus Pease, Amer. Journ. of Conch, 1871, Vol. vi., p. 304. pl. 21, fig. 3. Type locality, Island of Huaheine.

Colour notes were made of the single specimen collected, and, as these correspond generally to those of the above species, the Middleton Reef individual is determined as such. Although smaller than Pease's specimen, the general description given by him applies equally well to this one, and the following colour notes made on the spot show little dissimilarity. "General colour green. Uniform green on bottom of foot. Sides of mantle lobes flecked with large white spots and sparsely dotted with black. Edges of mantle orange, bordered with black. Inside of mantle flaps plain green, back green, with some black dots. Tentacles rich brown with darker tips; a white mark on the head between them. Eyes, tiny, black". There is no mention in this colour description or does it show in the preserved specimen, of the white line in the marginal colour which Pease describes in his species,



and the tentacles are noted as rich brown with darker tips, compared with orange tipped ones in the Huaheine form. The size of the type specimen is given as 2½ inches, and the Middleton Reef specimen is only 1 inch long, but these differences are not sufficient to warrant the specimen being regarded as new, or identified as other than *Elysia marginata*.

Habitat: Middleton Reef, South Pacific Ocean, near wreck of *Annasona*, Coll. G. P. Whitley, 17th April, 1936.

Eliot (Proc. Zool. Soc. (Lond.), 1904, Vol. ii., pt. vi., p. 296, pl. xvi., figs. 7, 8; pl. xvii., fig. 18) describes a species collected at Zanzibar, the colour of which, and the size, closely resemble the specimen from Middleton Reef. Several specimens were examined by him and found to vary slightly in colour, but to all he applied the name *Elysia marginata*.

THE CRUSTACEA.

By Frank A. McNeill.

In the collection are representatives of five families of the Decapoda. Nineteen genera are included and these accommodate 23 species.

Most of the forms occur at both Norfolk and Lord Howe Islands, and a Great Barrier Reef-New Caledonia influence is evident. A notable exception is the species *Leptograpsus variegatus* which, although found at the two islands mentioned, is normally more southern in its distribution and its presence on a true coral reef is considered interesting.

Two species are recognised from Australian seas for the first time.

Order Decapoda.

Suborder Natantia.

Tribe Carides.

Family Crangonidae.

Crangon edwardsii (Audouin).

Crangon edwardsii Rathbun, Proc. Zool. Soc. Lond., 1914, pt. 3, p. 654, and references.

One example of this well distributed species was collected. It has been recorded from Norfolk Island, and there are several specimens in the Australian Museum collection from Lord Howe Island.

Locality: Middleton Reef.

Suborder Reptantia.

Tribe Anomura.

Family Paguridae.

Calcinus elegans (H. M. Edw.)

Pagurus elegans H. M. Edw., Ann. Sci. Nat., vi., 2nd ser., Zool., 1836, p. 278, pl. xiii., figs. 2, 2a.

Calcinus elegans Whitelegge, Mem. Austr. Mus., iii., pt. 2, 1897, p. 143.

Two females (one adult, one juvenile).

The references quoted are concerned with records from New Ireland and Funafuti in the Ellice Islands respectively.

In the Australian Museum collection there are specimens from near Noumea in New Caledonia. The present record appears to be the first from Australian seas.

Locality: Middleton Reef.

Tribe Brachyura.
Subtribe Brachygnatha.
Superfamily Brachyrhyncha.
Family Xanthidae.

Daira perlata (Herbst).

Daira perlata Alcock, Journ. Asiatic Soc. Bengal, n.ser., lxvii., pt. 2, No. 1, 1898, p. 155 (and references).

One mature female and three carapaces from smaller examples.

Locality: Middleton Reef.

Phymodius ungulatus (H. M. Edw.).

Phymodius ungulatus Alcock, Journ. Asiatic Soc. Bengal, n.ser., lxvii., pt. 2, No. 1, 1898, p. 162 (and references).

One large and one small male. One small carapace.

Locality: Middleton Reef.

Chlorodiella niger (Forskal).

Chlorodius niger Alcock, Journ. Asiatic Soc. Bengal, n.ser., lxvii., pt. 2, No. 1, 1898, p. 160 (and references).

One large male and one carapace from a large example.

Locality: Middleton Reef.

Chlorodiella laevissima (Dana).

Chlorodius laevissimus Dana, Proc. Acad. Nat. Sci. Philad., 1852, p. 80, and U. States Explor. Expd., Crust i., 1852, p. 215, pl. xii., figs. 4, a-g.

Chlorodiella laevissima McNeill, Austr. Zoologist, iv., pt. 5, 1926, p. 310 (and references).

One female of this small species. The specimen is similar to those upon which the previous Australian records by McCulloch and McNeill were based, and the remarks by the latter (*loc. cit.*) apply also in the present case.

Locality: Elizabeth Reef.

Ozius truncatus (H. M. Edw.).

Ozius truncatus Haswell, Catal. Australian Crust., 1882, p. 63 (and references).

One young male example.

A species recorded from Norfolk Island and represented in the Australian Museum collection by many specimens from Lord Howe Island.

Locality: Elizabeth Reef.

Leptodius sanguineus (H. M. Edw.).

Xantho (*Leptodius*) *sanguineus* Alcock, Journ. Asiatic Soc. Bengal, n.ser., lxvii., pt. 2, No. 1, 1898, p. 119 (and references).

Two adult examples (one male and one female).

Locality: Elizabeth Reef.

Leptodius exaratus (H. M. Edw.).

Xantho (*Leptodius*) *exaratus* Alcock, Journ. Asiatic Soc. Bengal, n.ser., lxvii., pt. 2, No. 1, 1898, p. 118 (and references).

One very juvenile male example, lacking the major cheliped, is somewhat hesitatingly referred to this widely distributed and notoriously variable species.

Locality: Elizabeth Reef.

Eriphia sebana (Shaw).

Eriphia laevimana Alcock, Journ. Asiatic Soc. Bengal, n.ser., lxvii., pt. 2, No. 1, 1898, p. 214 (and references).
Eriphia sebana Rathbun, Bull. U.S. Fish. Comm., xxiii (for 1903), pt. iii., p. 865 (references and synonymy).
One female (ovigerous).
Locality: Elizabeth Reef.

Euxanthus melissa (Herbst).

Euxanthus melissa Alcock, Journ. Asiatic Soc. Bengal, n.ser., lxvii., pt. 2, No. 1, 1898, p. 110 (and references).
One carapace from an adult example.
Locality: Middleton Reef.

Actaea tomentosa (H. M. Edw.).

Actaea tomentosa Alcock, Journ. Asiatic Soc. Bengal, n.ser., lxvii., pt. 2, No. 1, 1898, p. 140 (and references).
Carapaces from two fully adult examples.
Locality: Middleton Reef.

Etisodes electra (Herbst).

Etisodes electra Rathbun, Bull. U.S. Fish. Comm., xxiii. (for 1903), pt. iii., 1906, p. 851, pl. ix., fig. 7 (and references).
Two female examples.
Locality: Middleton Reef.

Platypodia granulosa (Rupp.).

Lophactaea granulosa Alcock, Journ. Asiatic Soc. Bengal, n.ser., lxvii., pt. 2, No. 1, 1898, p. 101 (and references).
One adult male example.
There are specimens of this species in the Australian Museum collection from Lord Howe Island, a locality close to the place of origin of the present record.
Locality: Elizabeth Reef.

Cyclodius ornatus Dana.

Chlorodopsis (*Cyclodius*) *ornata* Alcock, Journ. Asiatic Soc. Bengal, n.ser., lxvii., pt. 2, No. 1, 1898, p. 171 (and references).
Cyclodius ornatus Rathbun, Mem. Mus. Comp. Zool., xxxv., No. 2, 1907, p. 51, pl. v., fig. 5; pl. vii., fig. 8.
One juvenile male example, 5.5 mm. wide is referred to this species. As far as it is possible to ascertain, the form has not previously been recorded from Australian seas.
Locality: Middleton Reef.

Trapezia cymodoce (Herbst).

Trapezia cymodoce Alcock, Journ. Asiatic Soc. Bengal, n.ser., lxvii., pt. 2, No. 1, 1898, p. 219 (and references).
Two male examples.
Localities: Middleton Reef and Elizabeth Reef.

Trapezia digitalis Latr.

Trapezia digitalis McNeill, Austr. Zoologist, iv., pt. 5, 1926, p. 314 (and references).

The examples recorded agree well with Alcock's description, except for the presence of a spine, instead of a notch at the junction of the antero-lateral and postero-lateral border. It appears that either a notch or a spine may be present in the position indicated, and that the character alters with age. Details are to be found in the work quoted.

Localities: Middleton Reef (1 small ovig. female). Elizabeth Reef (1 adult female).

Family Portunidae.

Thalamita admete (Herbst).

Thalamita admete Rathbun, Mem. Mus. Comp. Zool., xxxv., No. 2, 1907, p. 63 (and references).

One adult male and two juvenile females.

Locality: Middleton Reef.

Thalamita stimpsoni A. M. Edw.

Thalamita stimpsoni Alcock, Journ. Asiatic, Soc. Bengal, n.ser., lxviii., pt. 2, No. 1, 1899, p. 79 (and references).

One very juvenile male example only 8.8 mm. wide is considered referable to this well known species.

Locality: Middleton Reef.

Caphyra rotundifrons (A. M. Edw.).

Camtonyx rotundifrons A. M. Edw., Nouv. Arch. Mus. Paris, v., 1869, p. 156, pl. vii., figs. 11-12.

Caphyra rotundifrons McNeill, Australian Zoologist, iv., pt. 5, 1926, p. 307.

One young female example.

There is a faint pattern of lines on the carapace suggestive of that found in the allied species *C. laevis,* which is a commensal of the soft alcyonarian *Xenia.* Whether the lines in question simulate too the polyp pattern of some coral host is doubtful, as no data are yet available respecting the specific habitat of *C. rotundifrons.*

Locality: Elizabeth Reef.

Family Grapsidae.

Pachygrapsus transversus Gibbes.

Pachygrapsus transversus Grant and McCulloch, Proc. Linn. Soc. N.S. Wales, xxxii., 1, 1907, p. 154 (and references).

This cosmopolitan species has been listed from Norfolk Island (*loc. cit.*), a locality near the place of origin of the present records.

Localities: Middleton Reef (1 adult and 2 juvenile males). Elizabeth Reef (1 male and 1 female).

Leptograpsus variegatus (Fabr.).

Cancer variegatus Fabricius, Ent. Syst. Suppl., ii., 1793, p. 450.

Leptograpsus variegatus Miers, Challenger Zool., xvii., 1886, p. 257 (and references).

One large male, one small male, one small female. One carapace from a large example.

This widely distributed species occurs both at Lord Howe and Norfolk Islands. It is normally an inhabitant of rocky shores, and its occurrence on a true coral reef is interesting.

Locality: Middleton Reef, on rock ballast from the hull of a wreck.

Percnon planissimum (Herbst).

Liolophus planissimus Alcock, Journ. Asiatic, Soc. Bengal, n.ser., lxix., pt. 2, No. 3, 1900, p. 439 (and references).

Percnon planissimum Grant and McCulloch, Proc. Linn. Soc. N.S. Wales, xxxii., pt. 1, 1907, p. 153.

One female example, 16 mm. wide.

The species has been recorded as common at Norfolk Island, and in the Australian Museum collection are many specimens from Lord Howe Island nearby.

Locality: Elizabeth Reef.

THE ECHINODERMATA.

By A. A. Livingstone,

(The Australian Museum, Sydney.)

The five species listed below have been recorded from Lord Howe Island and are well known to the writer as occurring commonly in that locality. It seems fitting that only the hardier forms should be found in such exposed places as Middleton and Elizabeth Reefs, where mortality is so high that apparently only prolific breeders are permitted permanently to establish themselves.

Material collected is as follows:—

Coscinasterias calamaria (Gray).

Asterias calamaria Gray, Ann. Mag. Nat. Hist., vi., 1840, p. 179.

Coscinasterias calamaria Mortensen, Saert. Vid. Medd. Dansk nat. Foren, Bd. 79, 1925, p. 320 (synonymy).

Locality: Elizabeth Reef (one specimen).

Ophiactis savignyi (Müller and Troschel).

Ophiolepis savignyi Müller and Troschel, Syst. der Ast., 1842, p. 95.

Ophiactis savignyi Lütken, Add. ad Hist. Oph., 1859, pt. 2, pl. iii., figs. 7, a, b.

Middleton Reef, under boulders.

Ophiocoma brevipes Peters.

Ophiocoma brevipes Peters, Arch. Naturg., xviii., 1, 1852, p. 85.

Ophiocoma brevipes H. L. Clark, The Echinoderm Fauna of Torres Strait (Dept. Marine Biol. Carnegie Inst., Washington, Vol. x.), 1921, p. 129, pl. 13, fig. 7; pl. 34, figs. 3-4.

Locality: Elizabeth Reef (one specimen).

Echinometra mathaei (Blainville).

Echinus mathaei de Blainville, Dict. Sci. Nat., xxxvii., 1825, p. 94.

Echinometra mathaei H. L. Clark (*loc. cit.*), p. 151.

Locality: Elizabeth Reef (1 specimen). Middleton Reef (1 specimen).

Echinoneus cyclostomus (Leske).

Echinoneus cyclostomus Leske, Add. ad Klein, nat. disp. Echin., 1778, p. 173, pl. 37, figs. 4-5.

Echinoneus cyclostomus de Loriol, Mem. Soc. Phys. Hist. Nat., xxviii., No. 8, 1883, p. 38, pl. v., figs. 3-6.

Breynia australasiae (Leach).

Spatangus australasiae Leach, Zool. Misc., ii., 1815, p. 68.
Breynia australasiae A. Agassiz, Rev. Echini, 1873, p. 578, pl. xv., figs. 7-9; pl. xxv., fig. 32; pl. xxvi., fig. 20.

Locality: Middleton Reef (fragments of a test).

A species of black holothurian was also noticed to be common at Middleton Reef; from description it appears to be *Holothuria atra* Jaeger.

CORALS FROM ELIZABETH REEF.

In the Journ. Proc. Roy. Soc. N.S. Wales, xvi., 1882 (1883), p. 257, and the N. Zeal. Journ. Sci., i., 1882 (1883), p. 343, we read the following:—

Mr. C. S. Wilkinson, Government Geologist, exhibited a number of corals which had been collected for him by Mr. Barling, of the Harbour and Rivers Department, on his visit to the Elizabeth Reef, Lord Howe Island, for the purpose of seeing that the provisioned lifeboat kept there in the event of shipwreck was secure He had submitted them to the Rev. Mr. Tenison-Woods for his inspection, and that gentleman had made some notes on them.

The Rev. Mr Tenison-Woods said that the corals were all of reef-building formation, such as were never found out of tropical or very warm seas; and as Lord Howe Island was some 300 miles to the south of any place where such corals were known to be formed on the Australian coast. there must be some peculiar condition of temperature in that locality to account for their occurrence—probably a warm current from the north. The collection included several new species, among others that named the "brain coral", which would be subsequently described by him, and which were all found on the north-eastern Barrier Reef of Australia in warm seas. There was a coral reef off the coast of Western Australia named the Houtman's Abrolhos, in probably the same latitude as the Elizabeth Reef, Howe Island, and which was known to be in the midst of a warm current, flowing south from the Indian Ocean.

VERMES.

Several specimens of Polychaet worms were collected in pools in the hull of the *Annasona* wreck, but they have not been specifically identified. Gephyrean worms were also fairly common, burrowing into coral.

ZOOGEOGRAPHY.

By G. P. Whitley.

From their external appearance, as coral atolls, the Middleton and Elizabeth Reefs might have been expected to support a tropicopolitan fauna like that of the Great Barrier Reef or that of the outlying South Pacific Islands. But such was not the case. The corals were not collected, through lack of time and facliities, but looked similar to those I have seen in many places from Queensland to Rarotonga. However, it is dangerous to generalise, for Crossland has pointed out the fundamental differences between the superficially similar coral reefs of the Red Sea and Tahiti, and perhaps the corals of Middleton and Elizabeth Reefs might prove distinct upon expert examination (compare Tenison-Woods, Journ. Proc. Roy. Soc. N.S. Wales, xvi., 1883, p. 257). With the fishes, crabs, echinoderms and molluscs, we are on surer ground, for specimens were collected and have been carefully determined by specialists, and practically all of these animals

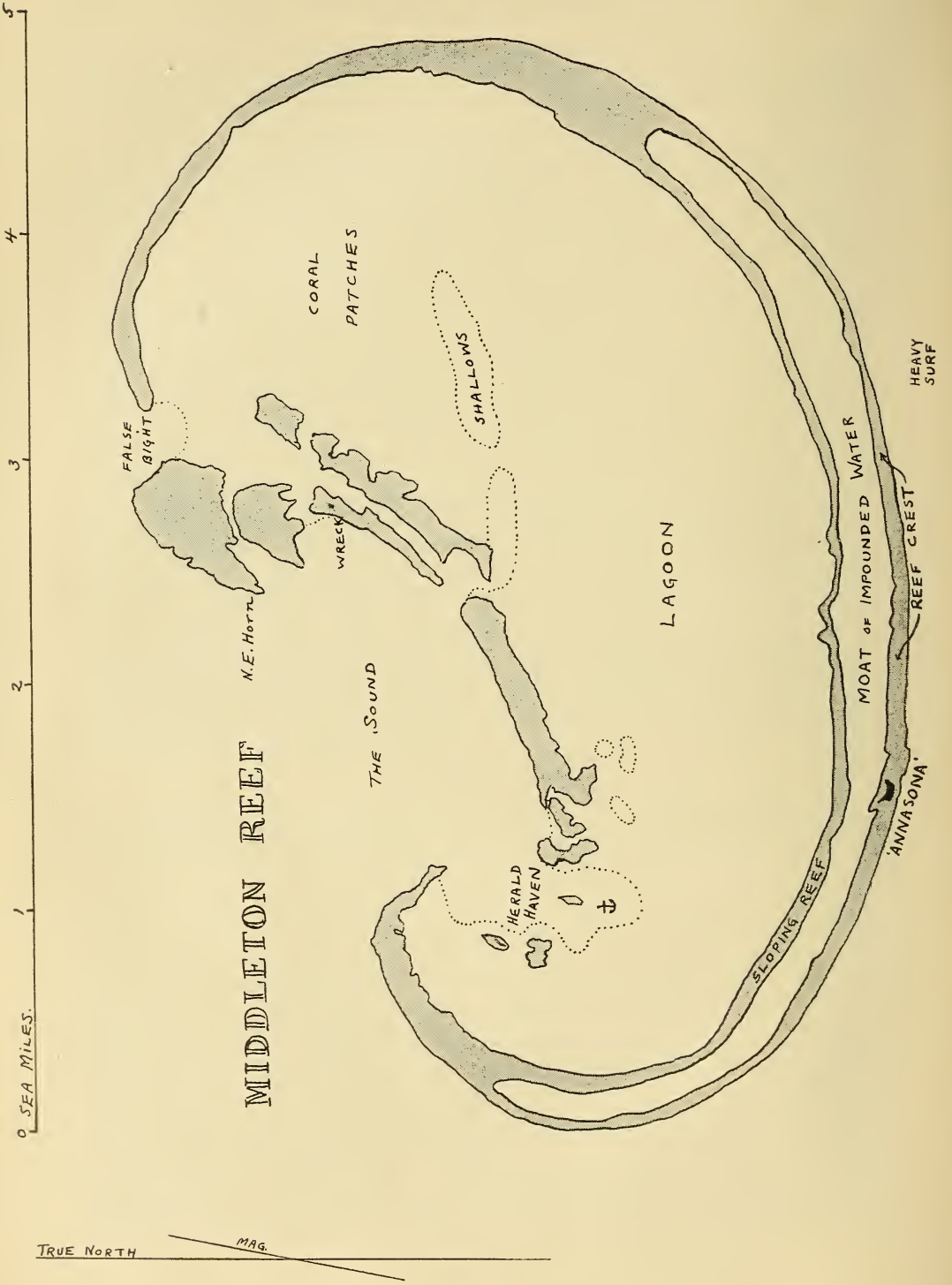
were identifiable as species already known from Lord Howe Island, and indicated the very close faunal relationship between the reefs and that island, the southernmost place in the world in fact, where a coral reef flourishes.

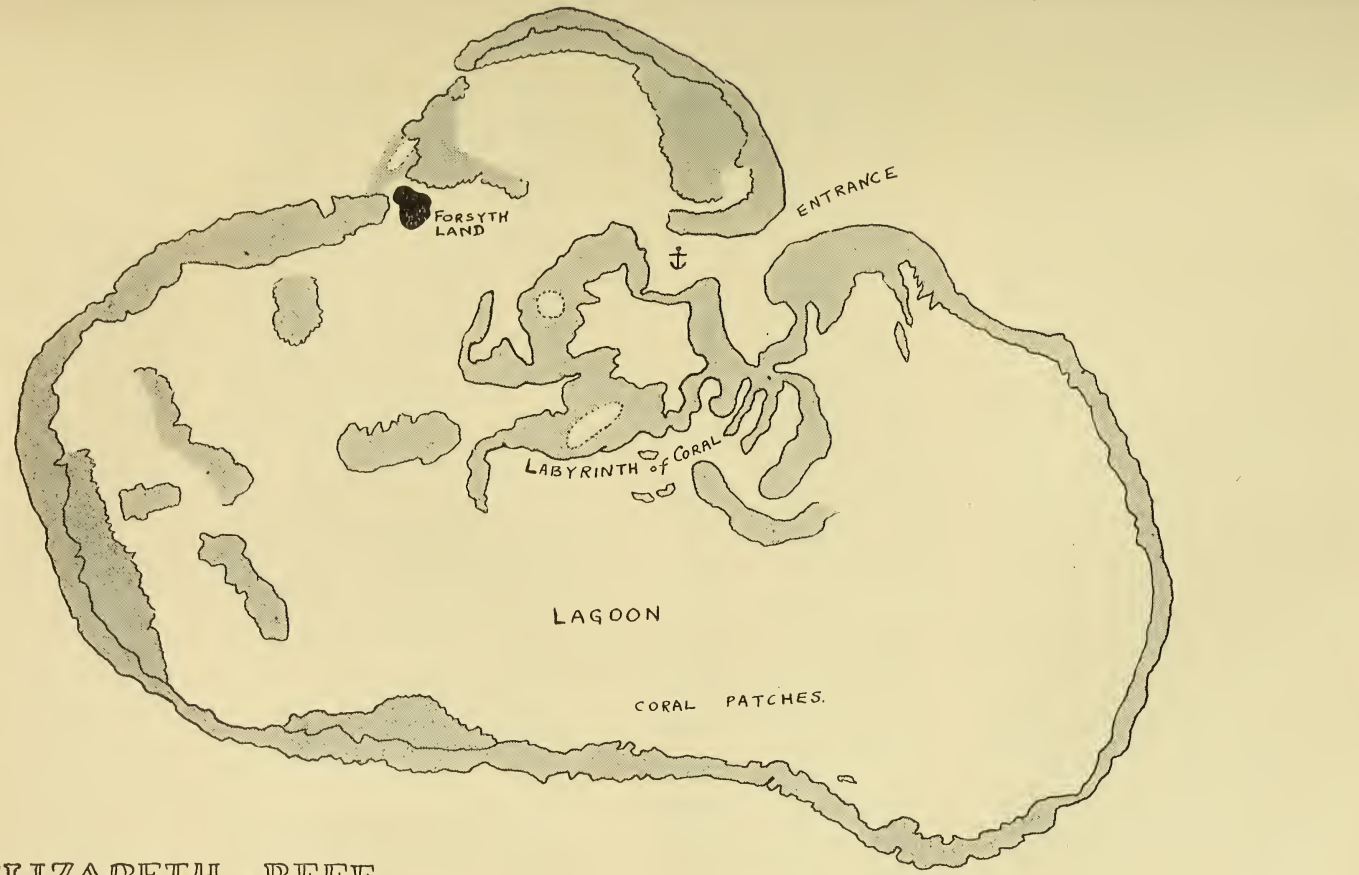
In 1932, I published (Australian Naturalist, viii., December, 1932, pp. 166-167 and map) a map of the Marine Zoogeographical Regions of Australasia, gathering together the names given to our different faunal regions by various marine biologists and providing further names for regions which deserved separation. Since then, I (Whitley, Austr. Mus. Mag., v., 1933, p. 25) have added the "Garrettian Province" to this nomenclature to include the vast festoon of islands commencing in the north-west with the Marshall Group and passing through the Gilbert, Ellice, Samoan, Cook, Society and other islands to the Low Archipelago. The Elizabeth and Middleton Reefs were terrae incognitae when this plan was formulated, but now, even on the basis of my small collections, they readily fall into a definite place in the scheme. The marine animals of these Reefs are Phillipian, having their allies in Norfolk and Lord Howe Islands, rather than in New Caledonia or on the Great Barrier Reef. I must mention, however, as the result of studying Australian marine collections, that some Phillipian animals extend to the Capricorn Group in Queensland, to Sydney, and even, occasionally, south to Shellharbour, New South Wales, but these erratics do not upset the zoogeographical groupings which have been established, being apparently merely exiles which have become widely dispersed, probably at long odd intervals of time, by favourable currents. The presence of the fish *Lutjanus coatesi* at Townsville, Queensland, and Elizabeth Reef is a mystery, which will only be solved when fresh data are available.

Iredale and Hull (Austr. Zool., v., 1929, p. 306) have provided an excellent map of the Neozelanic Region, which must now be very slightly extended in a north-westerly direction to include the Middleton and Elizabeth Reefs in their rightful place. An earlier map of the New Zealand submarine plateau which shows the relationships of the Reefs to the adjacent continents, islands, and ocean depths was given by Farquhar (Trans. N. Zeal. Inst., xxxix., 1907, p. 135, pl. v.).

A recent paper by Dr. H. I. Jensen (Proc. Linn. Soc. N.S. Wales, lxi., December, 1936, p. 272) concerning the geology of New Caledonia concludes with a dissertation upon ocean soundings and their bearing on past continental areas in these regions. In this paper, the geologist details findings which are strikingly corroborated by the data afforded by the distribution of marine animals. Middleton and Elizabeth Reefs were not specifically mentioned by Jensen and, as we have seen, are still little enough explored, but I may quote in conclusion some of Jensen's observations which bear upon the marine zoogeography of the seas under discussion.

"The Lord Howe platform with depths ranging from 400 fathoms to 1,000 fathoms extends north-east to within 100 miles of New Caledonia, where the ocean deepens, though it does not exceed 2,000 fathoms. The ocean chart, therefore, shows a strong cynclinal or downfaulted block east of south-eastern Australia, running in the same direction as the Australian coast and a less depressed, extended, but older, continental area, round Lord Howe Island, which extends right to Northern New Zealand, but which is separated from New Caledonia by a depression to 2,000 fathoms, which is of recent and late Tertiary development. . . . Thus from the soundings it would appear that in times as remote as the Trias there was a continent extending over the Coral Sea, and also over the vast area between the Aus-


MIDDLETON REEF
FALSE BIGHT
N.E. Horn
WRECK
CORAL PATCHES
SHALLOWS
THE SOUND
LAGOON
MOAT or IMPOUNDED WATER
REEF CREST
HEAVY SURF
'ANVASONA'
SLOPING REEF
HERALD HAVEN
0 SEA MILES. 1 2 3 4 5
TRUE NORTH
MAG.



ELIZABETH REEF

tralian coast and New Zealand and New Caledonia (the Lord Howe Island continent). The present volcanic chain through Samoa and Tonga, the Kermadecs and New Zealand represented its eastern fringe. The Triassic rocks of New Zealand, New Caledonia, and Eastern Australia were deposited over lacustrine areas and marine transgressions over the continental shelf.

"More transgressions followed in Jurassic and Cretaceous times, but in the upper Mesozoic periods the foundering of the Lord Howe Island continent had already commenced and had split it into groups of islands, while waves of thrust from the subsidence areas caused the Cretaceous and post-Cretaceous uplift of the east Australian Mesozoics. The last portion to disappear was the Coral Sea portion, and the thrusts in Northern Australia connected with the deeps and affecting the earth movements of the present day in North Queensland are Tertiary and recent. The Coral Sea subsidence probably commenced in the late Cretaceous and is continuing even at present with attendant elevatory movement under the Gulf of Carpentaria."

ECONOMICS.

Because of their isolation and the various dangers inherent in the reefs, it is doubtful whether they will ever be of economic importance. The turtles, sharks, and fish could be more easily obtained elsewhere, though the outer waters might yield game-fish to venturesome anglers. The commonest species of bêche-de-mer is commercially valueless and, so far as could be seen in the short time available, there are no Trocas or Pearl shells.

The suggestion has been made that, with a little engineering, the reefs might be made serviceable for emergency seaplane landing-places, but I make no comment on this aspect.

ACKNOWLEDGMENTS.

For the opportunity to visit the little-known Elizabeth and Middleton Reefs, I am primarily indebted to Mr. Norman Wallis, the skipper of the "Wanderer", whose idea it was that a naturalist should accompany his party. To him and to all the members of the crew I am obliged for assistance in collecting specimens, but, above all else, for their good comradeship under what were often trying conditions. Words cannot express my gratitude to the Lord Howe Islanders for their hospitality.

On the academic side, I gratefully acknowledge the co-operation of my friends, Tom Iredale, Frank A. McNeill, A. A. Livingstone, and Miss Joyce Allan, of the Australian Museum, who have identified specimens and contributed to this report. The staff of the Mitchell Library, Sydney, have assisted me with books on the early history of the regions under discussion.

Some of the blocks of the illustrations of this paper have been kindly loaned by the Trustees of The Australian Museum.

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EXPLANATION OF PLATES.

(Plate xiii.)

Fig. 1. *Galeolamnoides macrurus* Rams. & Og.
„ 2. *Usacaranx insulanorum* Whitley.
„ 3. *Coris cyanea* Macleay.
„ 4. *Epinephelus forsythi* Whitley.

(Plate xiv.)

Fig. 1. *Thalassoma quadricolor* Lesson.
„ 2. *Iredalella cyanea* Macleay.
„ 3. *Wanderer wallisi* Whitley.

(Plate xv.)

Persikima whitleyi Ired.

(Plate xvi.)

Fig. 1. *Vulgodacna fossor* Hedley, inside.
„ 2, 3. *Lentillaria paytenorum* Ired., outside and inside.
„ 4, 5. *Laciolina francesae* Ired., outside and inside.
„ 6. *Laciolina quoyi attracta* Ired.
„ 7. *Pardosinia alma extranea* Ired.
„ 8. *Sabia acuta* Q. & G., on base of succeeding shell.
„ 9. *Distellifer wallisi* Ired.
„ 10. *Turbo cepoides* Smith.
„ 11. *Quibulla scotti* Ired.

(Plate xvii.)

Figs. 1, 2, 3. Animal and shell of *Nannoscutum forsythi* Ired.
„ 4, 5, 6, 7. Animal of Elizabeth Reef *Nannoscutum.*
„ 8. Shells of *Veristoa howensis* Ired.
„ 9, 10. *Decorifer elisa* Ired., from side and above.

SIX NEW BATS (MICROCHIROPTERA) FROM THE AUSTRALASIAN REGION.

By E. Le G. Troughton, C.M.Z.S.*

Although their age-old mastery of the air resulted in bats becoming probably the most widely distributed order of non-aquatic furred animals, they are possibly the least known members of the mammalian class, owing to the difficulty of observing flying creatures of mainly nocturnal habits, and extremely secretive ways resulting from their acutely sensitive nervous organization.

The smaller kinds are usually just glimpsed in flight, but when killed accidentally in falling trees, or purposely under the mistaken idea that there is a risk of entanglement in people's hair, when they are actually engaged in ridding houses of mosquitoes and other flying pests, casual examination generally dismisses them as "just a common little bat".

Even regarding size, the most elastic feature of wing-spread is made the criterion, rather than the body or the more reliable forearm-length, while the less striking but more diagnostic characters are naturally overlooked. It is not generally realized, therefore, that many interesting genera occur in Australia, embracing about forty species, while many more are listed from New Guinea and adjacent groups of the south Pacific.

In some kinds, such as the leaf-nosed species described below, remarkable elaborations of the nose and facial skin provide striking diagnostic features. Identification of the considerable number of less specialized genera and species of the family Vespertilionidae, however, necessitates close comparison of cranial and minute dental characters, so that careful examination of large spirit collections may yield many interesting discoveries. Re-examination of collections in association with recent acquisitions has resulted in the discovery of unique specimens amongst the large chiropteran "old collection" of the Australian Museum, some of which have been supplemented by new material owing to the encouragement of voluntary collectors or the field activities of the Museum staff.

A striking example of how the less conspicuous kinds of small bats may remain unnoticed even in the most populous areas is provided by the broad-nosed species now described from the Sydney district. Although bats had been sent abroad since the earliest days of settlement, and lodged in the Australian Museum since its inception in 1827, this well-defined species was apparently overlooked for more than a hundred years until in 1926 the author and Museum taxidermists, Messrs. H. S. Grant and J. H. Wright, visited All Saints' Church, Hunter's Hill, at the request of the Rev. M. G. Hinsby to advise him regarding an infestation of small bats.

During the united effort to dislodge a colony, including an impromptu storm fantasia on the organ, a series of a well known species was obtained amongst which an unfamiliar kind was discovered. As a result of further efforts by Messrs. Grant and Wright, including considerable climbing and setting of nets, a second example was secured. The next specimen was brought to the Museum by Mr. Ronald Kaye of Mosman in September, 1931, who had observed it fall from a tree near Taronga Park. Finally, in May, 1936, through the forethought of Mr. J. H. Hinchliffe, Senior, of Hunter's Hill, an excellent series of eleven specimens,

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*Contribution from the Australian Museum.

including the only female obtained, was secured from the Church, where he had been carrying out some work during the Museum visitation.

The source of old collection material used in this paper is acknowledged in the descriptions, with a grateful thought for the enthusiastic interest of such naturalists and collectors as the late Dr. E. Pierson Ramsay, past Curator of the Australian Museum, the late George Masters, and many others who built up the basis of fine collections.

More recent material of the new forms includes a broad-nosed bat collected by the late Dr. Herbert Basedow in the Kimberley district of Western Australia in 1917, and specimens of a striking new race of large leaf-nosed bat collected by Mr. A. J. Vogan, F.R.G.S., in the Trobriand Islands a few years ago, when he kindly burdened himself with a can of preservative while engaged upon archaeological research in the region of south-eastern New Guinea.

The two new forms of leaf-nosed bats belong to the large typical species of the *Hipposideros diadema* group, which is already represented by a number of closely allied species and races over a wide range extending through the Indo- and Austro-Malayan Subregions to San Christoval, south-easternmost island of the Solomons. The north Queensland race now described, includes this striking species in the Australian fauna for the first time, which is not surprising in view of its apparent rarity.

Hipposideros diadema reginae subsp. nov.

Diagnosis.—Length of forearm, 3rd metacarpal, skull, and cheek-teeth according with the maximum for *pullatus* of Papua, but distinguished by the decidedly smaller ear, and relatively shorter adult tibia and tail, more slender skull, and brighter coloration. Forearm 79.5—82 mm. *Habitat*:—Cape York to Cardwell district, north-east Queensland.

Description.—Colour bleached but evidently, according to Ridgway's "Standards", a brighter brown originally than the dark "approaching seal-brown" coloration given for the back of *pullatus,* and lacking its strongly marked white dorsal patches and stripes, represented only by pale buffy spots behind the shoulders. Back now between ochraceous-tawny and cinnamon-brown, without marked posterior contrast, the dorsal coloration continuing around the neck and across the chest and contrasting with the palish ochraceous-tawny tinge of the rest of the undersurface; large pale-buffy areas under the shoulders further define the continuation of the dorsal colour over the chest.

Nose-leaf of the normal type, the hind section definitely wider than the front and its upper margin without a strong median projection; the projection on the sella is not unusually developed, and there is no trace of a fourth supplementary leaflet, the third in the female 3 mm. long and well developed, shorter and rather obsolete in the male. Forearm length as in *pullatus,* but ear decidedly shorter and narrower, and tibia and tail relatively shorter than in the Papuan race.

Skull of similar length but relatively narrower, as indicated by the zygomatic, anteorbital, and maxillar width. Upper and lower cheek-teeth length as in *pullatus,* but the mandible definitely shorter.

Dimensions.—In alcohol: Holotype male, allotype in brackets; forearm 82 (79.5); head and body 87 (81); tail 48 (48); tibia 30.5 (30); pes 14.5 (14); ear, length 26 (25), breadth 24 (22); 3rd metacarpal 60.5 (59) mm.

Skull of holotype: Total length, 31.1; zygomatic width, 17.1; braincase, 11.9; anteorbital width, 9; mastoid width, 14.6; maxillar width, 11.2; across

cingula of canines, 8.2; mandible, condylus to incisors, 21.9; cheek-teeth, upper row, 12.5, lower, 13.7 mm.

Specimens and habitat.—The holotype male, No. M1243, from the Bloomfield River in the Cooktown area, purchased from Mr. George Hislop in 1897; allotype entered No. 140, and mounted paratype 139, in Palmer's early register, as presented by the late Dr. E. Pierson Ramsay in 1875, from Cardwell, north-east Queensland.

Remarks.—This race, which provides the first record of the species occurrence in Australia, is distinguished from the nearest geographical ally, *pullatus,* of Papua, by the much smaller ear, which is actually smaller than in the Trobriand form, with a smaller forearm range, described below. The brighter colouring appears to be richer than usual for the species and to have approached the russet or yellowish mars-brown of the typical form of Java and Timor, rather than the darkish seal-brown of the adjacent race.

Hipposideros diadema trobrius subsp. nov.

Diagnosis.—Forearm range definitely smaller but 3rd metacarpal relatively much longer, and the skull stouter, but the anteorbital width distinctly less than in the adjacent geographical race, *pullatus.* Forearm 73.8-76.8. *Habitat:* Kiriwina Island, Trobriand Group, north-east of Papua.

Description.—Lower back lightish mummy-brown, the dark tipping repeated on the shoulders and nape so that there is no marked contrast with the anterior region; the dark colour of the back of an olivaceous brown, rather than the purplish shade of the seal-brown given for *pullatus* (according to Ridgway), and lacking the contrasting dorsal spots and stripes of that race, possibly due to a darker underfur which is nearest avellaneous, and therefore not so pallid as the "ecru-drab with a silvery tinge" given by Anderson as broadly typical of the species. A light line extends along the sides of the body owing to a lack of dark tipping. There is a light cinnamon-brown wash around the face and ear-bases, and the undersurface is drabby avellaneous.

Nose-leaf of more extreme type, a strongly marked median projection on the hind leaf imparting a trilobate effect regarded as peculiar to the Ceylonese species of the *diadema* group (*lankadiva*); the sella and its projection are very prominent, and the 3rd supplementary leaflets are short but deep. Size of forearm, tibia, and ear relatively smaller, and 3rd metacarpal much longer, than in *pullatus.*

Skull relatively wider and more inflated than in *pullatus,* the zygomatic width being distinctly greater and the arches remarkably heavy and strongly inflected posteriorly. In contrast, the anteorbital width is decidedly narrower, possibly not exceeding that of the smallest members of the *diadema* group. Size of cheek-teeth apparently much as in *pullatus.*

Dimensions.—In alcohol: Holotype male, paratype male in brackets; forearm 76.8 (73.8); head and body 84 (84.5); tail 47 (45.5); tibia 29.5 (28.5); pes 13.8 (14); ear, length 26.8 (25.5), breadth 25 (26); 3rd metacarpal 60 (57) mm.

Skull of holotype: Total length, 30.4; zygomatic width, 18.2; braincase, 12.5; anteorbital width, 8.2; mastoid width, 14.5; maxillar width, 11.4; across cingula of canines, 8.6; mandible, condylus to incisors, 21.4; cheek-teeth, upper, 11.9, lower, 13.2.

Specimens and habitat.—Holotype and paratype males, Nos. M5181-2 respectively, in the Australian Museum collection from Kiriwina Island, Trobriand Group, collected and presented by Mr. A. J. Vogan, F.R.G.S.

Remarks.—One is indebted to the donor's efforts on behalf of the Museum for the opportunity of describing this interesting and very distinct race which appears to have developed characteristic features associated with its isolated habitat. It is readily distinguished from the geographically intermediate Papuan *pullatus* by the contrasted shorter forearm and longer 3rd metacarpal, and the wider and heavier zygomatic arches and narrower anteorbital width.

The forearm, 3rd metacarpal, and skull are larger than in *mirandus* of the Admiralty Group, and, although the forearm averages somewhat nearer that of *oceanitis* of the Solomons, the range is actually smaller, while the 3rd metacarpal is relatively longer, the tibia much shorter, and the ear decidedly smaller.

Broad-nosed Bats from Australia and New Guinea.

The following species and races of bats belong to a less spectacular family, the Vespertilionidae, characterized by a lack of nose-leaf ornamentation, and the simple or unspecialized tail structure in which the inter-thigh membrane extends to the tail-tip. The species of *Scoteinus* are distinguished by the peculiar glandular almost hairless expansion of the nasal region, and the marked dental distinction of having only a single pair of upper incisors, which are situated close to the canines and therefore separated by a wide interval.

The genus has a wide distribution, occurring in India, Africa, and throughout Australia, but not so far recorded from Tasmania. The small species now described from New Guinea was first recorded in 1897, but has hitherto been confused with the smallest Australian form, *S. greyi,* which appears to be restricted to the central region from Darwin to Adelaide.

On the mainland also occurs the very large *S. ruppellii* of New South Wales, the medium-sized *S. influatus* of central north Queensland, and the somewhat smaller *S. balstoni* of Western and South Australia, of which a new north-western race is now described. A new and well differentiated species is now added to the list from the eastern coast, which, like its western ally, is represented by a distinct race in the north.

Scoteinus orion sp. nov.

Diagnosis.—Allied to *balstoni* in size and cranial features, but with darker less markedly bicoloured fur, smaller ear, and shorter tibia and 3rd metacarpal, broader and more inflated skull, and relatively narrower upper molars. Forearm 34.5-36.3. *Habitat.*—Eastern New South Wales.

Colour.—Richer brown above than in *balstoni,* a light shade of brussels-brown when smoothed out, owing to the basal fur being about Prout's brown and the tips washed with cinnamon to clay colour, the dorsal fur therefore toning and less markedly bicoloured. Head of a clearer tone, approaching tawny-olive, with a faint ochraceous wash on the cheeks and ears. Basal fur of undersurface a paler shade of Prout's brown washed with pinkish-buff, producing a general colour of about the shade of "mole" (not given by Ridgway), and apparently of a darker buffy tone than in *balstoni.* No notable variation in twelve fresh specimens of both sexes except that younger animals may be somewhat brighter dorsally.

External characters.—Ear definitely smaller than in *balstoni,* narrower and less pointed or broadly convex in posterior outline or inner angle, the contour more as in the smaller *greyi* but relatively narrower; tragus more

broadly convex posteriorly and of thicker texture than in either allied species. Forearm range similar to *balstoni,* but 3rd metacarpal and tibia shorter, and calcaneal lobe decidedly wider and more conspicuous.

Skull and dentition.—Skull more robust and inflated than in *balstoni,* relatively broader in all but maxillar width, the latter indicative of the narrower upper molar rows; anteorbital and interorbital distinctly broader. Skull of female allotype relatively wider than male crania but interorbital narrower, though decidedly wider in both sexes than in *balstoni.* Cheek-teeth comparatively longer and narrower, the contrast most marked in females.

Dimensions.—Holotype male, allotype in brackets: Forearm 35.8 (36); head and body 61 (59); tail 33 (33); tibia 12 (12); pes 7.8 (8); ear, inner edge 9, total length 13 (13.3), width 10 (10.5); 3rd metacarpal 33.5 mm.

Skulls: Total length 15 (14.9); zygomatic width c 10.8 (11.1); brain-case 7.5 (7.8); anteorbital width 5.8 (6.1); interorbital width 4.4 (4.1); mastoid width 9 (9.2); maxillar width 6.8 (7); palate length 5.3 (5.1); cheek-teeth, upper row 5.6 (5.8), lower 6.2 (6.4) mm.

Specimens examined.—Fifteen, including the holotype male No. M6115, and allotype M6117, in the Australian Museum from suburbs of Sydney, New South Wales. Specimens collected by Messrs. Grant and Wright (taxidermists) and donations by Mr. J. H. Hinchliffe, senior, and Mr. Ronald Kaye.

Remarks.—This well defined species, so long incognito in the Sydney district, provides the first authentic record of the occurrence of a second species of the genus in New South Wales. It is evidently the eastern ally of *S. balstoni* from which it is readily distinguished by the smaller ear, 3rd metacarpal, and tibia, and cranially by the broader ante- and inter-orbital width, and relatively longer and narrower cheek-teeth rows. The much smaller size distinguishes it from its State compatriot, *S. ruppellii,* and it is separated from *S. influatus* of central north Queensland by the smaller forearm. It is represented, like the western ally, by a northern race, both of which are now described.

Scoteinus orion aquilo subsp. nov.

Diagnosis.—Size generally smaller, but tail longer, 3rd metacarpal and tibia relatively longer, and skull and teeth smaller than in the typical race. Forearm 32.5-34.5. *Habitat*:—East coastal Queensland, from Bowen to Rockhampton.

Description.—Colour, from old specimens, apparently similar to the typical race above, and somewhat lighter tipped and therefore more bicoloured below. Size of forearm, body, pes, and skull smaller, but tail longer; 3rd metacarpal and tibia equalling, and therefore relatively longer than, those of the typical race. Ear narrower and less obtusely rounded above, with a slight emargination behind the tip, and a narrower outer lobe, not concealing the base of tragus when pressed in; tragus shorter, broader, and more obtusely rounded above, the greater convexity at middle of hind margin. Narrower calcaneal lobe.

Skull of similar outline but smaller proportions and less inflated cranium; interorbital and maxillar widths decidedly narrower, the latter indicative of the narrower molars. Upper and lower cheek-teeth rows decidedly shorter.

Dimensions.—Holotype female, old spirit specimen: Forearm, 34.5; head and body, 50.5; tail, 35.5; tibia, 12.3; pes, 6.7; ear, inner edge, 9, total length, 12.3, greatest width, 8.8; 3rd metacarpal, 33.5 mm.

Skull: Total length, 13.8; zygomatic width, 10.4; braincase, 7.4; anteorbital width, 5.3; interorbital width, 3.7; mastoid width, 8.6; maxillar width, 6.4; palate length, 4.8; cheek-teeth, upper row, 5.1, lower, 5.6 mm.

Specimens examined.—Adult female holotype, No. 209 (Nobbs), in Palmer's earliest Australian Museum register, from Bowen, and paratype adult female, A10630 (Masters and Barnard, 1881), agreeing well in external dimensions, from the Dawson River, near Rockhampton, coastal Queensland.

Remarks.—This northern race is well defined by the generally smaller external and cranial dimensions, and shorter cheek-teeth. The longer ear, larger dimensions, and more robust skull leave no doubt of its distinction from *S. greyi,* while indicating specific affinity with the typical form of *orion.*

Scoteinus balstoni caprenus subsp. nov.

Diagnosis.—Size smaller generally than in southern *balstoni,* the difference specially notable in the forearm, 3rd metacarpal, tibia, and pes; skull shorter but with equal interorbital width, and narrower maxillar width indicative of the smaller molar rows. Fur not as strongly bicoloured and undersurface paler than in typical form. Forearm 32.5-34 mm. *Habitat*:—Kimberley region, north Western Australia.

Description.—Colour of back, in dried spirit specimen, apparently a duller drabby or more olivaceous brown throughout, and therefore less strongly bicoloured than in the typical race; fur of undersurface paler throughout, therefore less bicoloured also, and contrasting more strongly with the back. Ear much as in typical form, the upper half somewhat shorter and more obtusely rounded; tragus decidedly shorter and more broadly rounded above. The forearm and 3rd metacarpal decidedly shorter, and the tibia and pes also smaller than in the typical race. Skull of similar outline, shorter and with narrower less inflated cranium, but equal interorbital width, and relatively heavy rostral region shown by the similar anteorbital width. The narrower maxillar width is indicative of the relatively shorter and narrower cheek-teeth rows. Lower incisors more crowded, distorted, and less distinctly trilobate than in true *balstoni* or *greyi*; 1st lower premolar smaller and more rounded than in typical race, and less crowded by the canine and 2nd premolar, which have weaker inner talons to the posterior and anterior cingula respectively.

Dimensions.—Spirit specimens, holotype old male, and paratype male in brackets: Forearm 34 (32.5); head and body 51.5 (50); tail 33.5 (34); tibia 12.8 (12.7); pes 6.5 (6.6) ear, inner edge 9.2 (8.9), total length 13 (13), greatest width 9 (9.5); 3rd metacarpal 31.5 (32) mm.

Skull of holotype: Total length, 14.2; zygomatic width (—); braincase, 6.8; anteorbital width, 5.3; interorbital width, 3.5; mastoid width, 8.5; maxillar width, 6; palate length, 4.7; cheek-teeth, upper row, 5.1, lower, 5.8 mm.

Specimens and habitat.—Holotype old male, No. M1322 from Roebuck Bay, originally collected for the Oslo Museum by Dr. Knut Dahl and received by exchange in 1898; paratype male, M2688, collected at King Sound by the late Dr. Herbert Basedow and presented in 1917. Habitat, the Kimberley region of north Western Australia.

Remarks.—This north-western race is distinguished from the typical southern race by the smaller forearm, 3rd metacarpal, and other dimensions, the smaller skull with relatively broader ante- and interorbital width, and smaller teeth. The shortness of the 3rd metacarpal is shown by its

agreement with that of *S. greyi,* which is otherwise distinguished from this and all other mainland forms by its decidedly smaller size. External dimensions generally similar to those of the north-eastern race of *orion* but the ear larger, 3rd metacarpal shorter, and the skull longer, but relatively more slender and lightly built.

Scoteinus sanborni sp. nov.

Diagnosis.—Body and tail proportions similar to *S. greyi,* but the ear decidedly smaller and 3rd metacarpal longer, and the forearm and pes longer than in the small Australian species, while the skull and dentition is decidedly more robust. Forearm 32-33.3 mm. *Habitat:*—South-eastern New Guinea.

Description.—Fur shorter and sparser above and below than in *greyi,* the colour above apparently a deeper brown, with narrower and less contrasted tipping on both surfaces, the bicoloration of the fur therefore less marked, and the undersurface a duller buffy-brown.

Forearm longer and 3rd metacarpal decidedly longer than in *greyi,* the pes larger but the ear distinctly smaller; tragus broader above, the greatest convexity in upper third of hind margin, almost straight below.

Skull definitely larger and more robust, with much more elevated upper profile owing to the greater cranial expansion and height of the occipital crest. Upper and lower incisors and cheek-teeth decidedly longer and heavier than in *greyi,* the heaviness specially marked in the proportionately much larger protoconid area and wider posterior angle of the enlarged inner flange of the upper second molar.

Dimensions.—Holotype adult female, in spirit: Forearm, 33.3; head and body about 46.5; tail about 31.5; tibia, 12; pes, 7; ear, inner edge, 7.8, total length, 10.8, greatest width, 8; 3rd metacarpal, 33 mm.

Skull: Total length, 13.6; zygomatic breadth (—); braincase, 7.1; anteorbital width, 5.5; interorbital width, 3.6; mastoid width, 8.1; maxillar width, 6.1; palate length, 4.2; cheek-teeth, upper, row, 4.8, lower, 5.5 mm.

Holotype.—Adult female, No. A3176, in the early Australian Museum register, from East Cape, Papua, collected by the late Kendal Broadbent and purchased in 1878. The locality is evidently the south-easternmost point of New Guinea and not near Port Moresby as indicated in Sanborn's list.

Remarks.—This small Papuan form is specifically distinguished from *S. greyi* of Australia, with which it has hitherto been reconciled, by the greater forearm and 3rd metacarpal length contrasted with the relatively much smaller ear, as well as by the more robust skull, larger teeth, and shorter and less strongly bicoloured fur.

As pointed out in Sanborn's comprehensive list of "Bats from Polynesia, Melanesia, and Malaysia" (Field Mus. Nat. Hist., Zool., ser. xviii., 2, 1931), Thomas recorded specimens from Aroma and near the mouth of the Kemp Welch River, in Ann. Mus. Genova, 1897. Sanborn lists two specimens from Port Moresby in the Field Museum, which were smaller in skin and skull dimensions than a specimen presumed to be *S. greyi* from "Lincoln, Northern Territory, Australia", in the U.S. National Museum collection.

Inquiry has failed to discover any place named Lincoln in the Northern Territory, whereas if the locality referred to the Lincoln, near Ingham, north-east Queensland, or Port Lincoln, South Australia, one of the larger forms, *orion aquilo* or *balstoni,* is probably represented by the "Lincoln"

specimen, thus accounting for the apparently smaller dimensions of the Port Moresby specimens. It appears that the true *greyi* inhabits the less wooded central area of Australia from north to south, and the disparity in habitat thus shown, coupled with the larger dimensions of the Papuan form, in comparison with the type dimensions of Dobson, and a specimen from north-western Queensland, leaves no doubt of its specific distinction.

The name of Colin C. Sanborn, Assistant Curator of Mammals in the Field Museum of Natural History, is associated with this species in appreciation of his careful work upon the Chiroptera of the south Pacific, and the well remembered hospitality afforded at the Field Museum and his home during a visit to Chicago at the end of 1930.

ON NEW FORMS OF THE EASTERN SWAMP RAT, AND THE RELATIONSHIP OF MASTACOMYS.

By E. Le G. Troughton, C.M.Z.S.*

The fact that it has been customary in the past to accord far too extensive a range to many individual forms of Australian mammals is specially emphasised by the study of coastal races of indigenous rats, which are not subject to the drastic and prolonged changes, and extensive migrations, experienced by inhabitants of the central regions.

It was quite understandable that explorer-naturalists in a vast new land should fail to appreciate the definite effect of zoo-geographical barriers, now made apparent by detailed survey and more or less continuous lines of communication. It is surprising, however, to find a present day tendency to minimise the importance of obvious geographical barriers on the mainland, as well as those represented by a considerable expanse of sea such as that of Bass Strait.

During the course of early and remarkably comprehensive work upon the smaller mammals, examination of the superficial features of colour and pelage of odd specimens taken in somewhat similar surroundings, but often over a thousand miles apart, led to the merging of forms which a study of diagnostic criteria found in their skulls and dentition now proves to be specifically distinct, or at least represented by intermediate races.

A notable instance of the above is provided by the group of dusky-footed swamp rats, the south Western Australian form of which (*fuscipes,* 1839) was originally accorded an immense coastal range extending to Tasmania and north coastal New South Wales. The fallacy of this conception was recognised when Oldfield Thomas decided to regard all eastern members of the group as representing *lutreolus* of Gray (1841). He was in error, however, in selecting as lectotype of *lutreolus* a Gouldian specimen from the Hunter River district of mid-coastal New South Wales, as the South Australian habitat of Gray's original specimen is clearly established.

Previously Thomas had described (1882), from Tasmania, a rather poorly defined soft-furred animal of the group as *velutinus,* which he then regarded as occurring coincidentally on the island with *"Mus fuscipes"* of the south-west. It is notable of the Tasmanian animals that no examples have since been recognised and recorded as *velutinus,* while examination by the author in 1930 of British Museum series, including types of *velutinus,*

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*Contribution from the Australian Museum.

and specimens labelled *lutreolus* of Tasmania, indicated that there was apparently but one extremely variable form of the group occurring in Tasmania, which may appropriately be listed as *R. lutreolus velutinus* in tribute to its obvious mainland affinity.

Regarding colour variation in the group, Finlayson [1] expressed the view that the brighter toned animals were from mountainous regions, and the colder toned more blackish ones from about sea level in coastal areas. In Tasmanian lowland series, however, one finds marked variation, from fuscous to ochraceous-toned animals irrespective of sex, while in New South Wales a richly rufous-toned animal occurs in swampy coastal areas. The latter is less variable in colour and appears to represent a stouter built, coarser furred, warmer coloured animal than the typical southern form, as might be expected from the disparity in range, and it is now described as a new geographical race of *lutreolus*.

An interesting extension of the vast coastal range of *lutreolus* is provided by a male and female from Imbil, near Gympie, south-eastern Queensland, which are now described as representing a new geographical race, and supply the first record of the species occurrence in the northern State. The specimens were submitted with other species by the Forestry Department for identification in regard to damage by rats to the Hoop Pine plantations, and forwarded by Mr. W. A. MacDougall, of the Bureau of Sugar Experiment Stations, together with a north Queensland collection submitted in connection with the investigation of rat problems on the canefields.

The habitat of the dusky-footed swamp rats appears to be quite similar, irrespective of altitude, over their remarkably extensive and naturally coastal mainland range. The haunts of the south-western *fuscipes* given by Gould are similar to those recorded by Waite for the Blue Mountains specimens of eastern *lutreolus*, when quoting the donor as saying that a peaty ridge was their favourite burrowing place, from which long surface runways were made to the water which seemed essential and in which they swam freely.

In Tasmania Finlayson found them inhabiting the same complex labyrinth of runways as *Mastacomys fuscus* in matted grass and alpine vegetation, in a high valley where even in summer the grassy surface is always sodden and often awash. It is notable that the habitat of *lutreolus* appears to be definitely more swampy than that of the paler-footed *R. culmorum* of north coastal Queensland, which is further distinguished by its paler but more coarsely grizzled and spinous coat, longer tail, smaller molars, and much larger tympanic bullae.

In the course of considerable work upon the indigenous rats, undertaken with a view to providing a more informative treatment of the group in the forthcoming popular work on Australian mammals, as well as assisting in the study of health and economic problems, it was hoped to have published detailed notes made during examination of the British Museum collection in 1930. As this has not been possible, an individual note on the hitherto unrecognised pseudomyid relationship of broad-toothed rats of the genus *Mastacomys* is given in conclusion, which may prove of interest to fellow workers in mammalogy.

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[1] Finlayson.—Trans. Roy. Soc. S. Austr., lix., 1935, p. 225.

RATTUS LUTREOLUS CAMBRICUS *subsp. nov.*

Diagnosis.—A more stoutly built, warmly, but coarsely grizzled, harsher and shorter furred form than the typical southern one; pes and tail longer, the skull larger and more heavily built, and with longer palatal foramina and molar rows. *Habitat.*—Coastal region of New South Wales.

Description.—Main dorsal pelage shorter and more rigid, less silky to touch than in French Island or Tasmanian specimens, due mainly to the greater coarseness of the long pile. General dorsal tone much warmer tawny brown owing to the longer and richer light tipping, which is ochraceous-tawny (Ridgway) instead of buckthorn-brown, and the lighter more coppery brown instead of mummy to blackish brown tone of the dark tips and longer pile. Tail, pes, and ear relatively longer than in the southern form. Basal fur darker above and below, and the undersurface washed with a richer tone of ochraceous-buff.

Skull more heavily built, with wider more coarsely ridged interorbital region, larger nasals, and longer palatal foramina; the length and width of the nasalia of the smallest adult female equal to that of a large southern male, and the palatal foramina definitely surpassing the alveolar line instead of barely attaining it. Bullae somewhat smaller, with which is correlated a relatively smaller ear. Upper molar row longer, both in crown and alveolar length.

Dimensions of Holotype.—Large adult male, in the flesh: Head and body, 197; tail, 133; pes, including claw, 37; ear, 21 mm.

Skull.—Total length, 43.5; basal length, 39.9; basilar length, 37; zygomatic breadth, 22.4; interorbital width, 5.5; braincase breadth, 16.5; nasals, 16.8 × 4.9; palate length, 24.2; palatal foramina, 7.7 × 1.9; upper molar rows, 7.9 and 8.2; alveolar length, 8.4; width of m^1, 2.6 mm.

Specimens and Habitat.—Holotype male and allotype female, Nos. M.3192-93 respectively, and paratype males, Nos. M.3190-91, in the Australian Museum collection from Booloombayt, in the Myall Lakes district, north of Newcastle, New South Wales, collected and prepared by Mr. H. Barnes, of the Museum staff, in association with Mr. Harry Burrell. Other specimens from the Sydney, Blue Mountains, Port Macquarie, and Guy Fawkes districts of coastal New South Wales.

Remarks.—Apart from slight variation in tone, examination of a series of over twenty specimens leaves no doubt that the New South Wales form is readily distinguishable by the characters detailed above. Excepting when supported by a difference in fur texture, coloration in the *lutreolus* group is of little importance, and the distinction of the New South Wales race is indicated by the coarser, as well as brighter pelage, the coloration of which varies less in all specimens than in those from one district in Tasmania, in addition to the cranial features listed.

RATTUS LUTREOLUS IMBIL *subsp. nov.*

Diagnosis.—Of similar body and tail proportions, but with a decidedly richer tawny dorsal coloration and shorter and sparser fur than in *cambricus*. The nasalia decidedly narrower anteriorly, and the bullae shorter than in the intermediate geographical race. *Habitat.*—Gympie district of south-eastern Queensland, the holotype from Imbil.

Description.—Pelage shorter and sparser than in *cambricus* and the dorsal coloration richer and more coarsely grizzled owing to the greater width of the brighter tawny tipping, contrasted with the blacker dark tipping and long pile. Fur darker basally above and below, the under-

surface washed with cinnamon. Pes somewhat darker above, about fuscous. Tail of similar length, but ear definitely shorter. Pes less robust and the pads not so strongly defined, notably the subsidiary ones of the 1st and 4th interdigital pads.

Skull of similar general appearance, but cranial region relatively broader and more rounded, and the nasals decidedly narrower anteriorly than in *cambricus*. Palatal foramina surpassing the alveolar margins but relatively shorter and narrower, the bullae shorter, and the upper molar row of similar length to, but wider than those in a skull of *cambricus* of the same length and sex from the nearest locality.

Dimensions of Holotype.—From alcohol: Head and body, 181; tail, 111; pes, 32.5; ear, 18.5 × 15.5 mm.

Skull.—Total length, 40.7; basal length, 37; basilar length, 33.8; zygomatic breadth, 22.1; interorbital width, 5.3; braincase breadth, 16.6; nasals, 15.5 × 3.9; palate length, 23.2; palatal foramina, 7.7 × 1.8; upper molar row, 7.9; alveolar length, 8.3; width of m^1 2.6 mm.

Holotype.—Adult male skin and skull, No. M.6228 in the Australian Museum collection, from Imbil, Gympie district, south-eastern Queensland, received from the Forestry Department of the State through Mr. W. A. MacDougall, of the Bureau of Sugar Experiment Stations of the Queensland Department of Agriculture.

Remarks.—The race is the brightest coloured and shortest coated of the species, and is further distinguished by having a definitely shorter ear, correlated with shorter bullae, and decidedly less expanded nasals anteriorly than in *cambricus,* while the palatal foramina are shorter and the molars wider than in the nearest known specimens of the intermediate race, from the Armidale district of New South Wales.

It is distinguished externally from *culmorum* of north coastal Queensland by the much brighter coloration and less spinous coat, shorter tail, and longer and darker feet, and cranially by the relatively longer skull and much smaller bullae, and larger molars. Distinguished from *sordidus* of the Darling Downs by its much richer brown coloration, shorter tail, decidedly shorter palatal foramina, and somewhat longer more slender nasals.

The typical specimens of the new race of *lutreolus* were included with those of *Rattus assimilis* and *Melomys littoralis* for identification concerning damage by rats in hoop-pine plantations, and it is hoped that description of this race will assist in deciding which species are involved in the destruction.

Rattus lutreolus velutinus Thomas.

Mus velutinus Thomas, Ann. Mag. Nat. Hist. (5), ix., 1882, p. 415, June 1. Tasmania (A. Simson).

It is notable regarding the Tasmanian form of narrow-toothed swamp rat that no specifically definable specimen of *velutinus* has been recorded since its description in 1882, either by its author or other workers. The species was described from sub-adult and immature specimens, thus lessening the comparative value of the measurements, and the main diagnostic cranial feature stressed by the author. The front edge of the zygomatic plate was described, and figured, by Oldfield Thomas as slanting forward from the top and thus differing from all other Australian rats, in which it either projects above or is strongly concave below.

Examination of a large series of *lutreolus* collected by Mr. Harry Burrell on the north-west coast of Tasmania in 1921, however, show the profile of the zygomatic plate to be extremely variable, ranging from the normal sinuous outline to the immature slanting condition, while one individual has the plate slightly but evenly concave immediately below the top edge, approaching the condition seen in *Pseudomys* and *Mastacomys*. The slanting profile of the plate is not only a feature of immaturity, but is variable in individuals and cannot therefore be regarded as diagnostic of a distinct species, although the upper profile appears to be less boldly rounded than in typical *lutreolus*.

The coloration is extremely variable irrespective of sex in series from one locality, one lowland series varying dorsally from a similar, and even darker, fuscous-brown than French Island animals, to a bright clay colour faintly pencilled with darker brown, and washed with cinnamon-buff below.

In regard to the variability of colour and cranial features it may be noted that the similarity of habitat, irrespective of altitude, in the more restricted insular region renders differentiation of races unlikely, while the general similarity to southern mainland animals appears to indicate that only one species of narrow-toothed swamp rat is at present recognisable from Tasmania, as represented by the above extremely variable race of *Rattus lutreolus*.

The Pseudomyid relationship of Mastacomys.

Since Thomas described the original broad-toothed form (*fuscus*) as a new genus and species in 1882, and Lydekker in 1885 listed cranial remains from the mainland Wellington Caves, no further references were made to the genus until 1922, when Thomas described a smaller form (*mordicus*) from cranial fragments obtained by Professor Wood Jones in a guano cave at Mt. Gambier, South Australia. Subsequently, Finlayson[2] reviewed a series collected in north-west Tasmania, and Brazenor[3] provided a superficial review of Victorian specimens which are recorded as representing the Tasmanian *fuscus*.

Although Thomas noted and figured the markedly concave zygomatic plate, and stressed the reduction of mammae, it is surprising to find that both he and subsequent authors have compared *Mastacomys* with *Rattus* concerning its characteristics, and have overlooked the very definite pseudomyid affinity indicated by these and other characters.

The oversight has doubtless been due to a natural tendency to stress the importance of the unusual molar width which, though comparatively great, is much emphasised by the extraordinary narrowness of the palate, a feature which appears to be at least as important as that of molar width. As to the molar pattern, it is notable that Thomas stressed the difference from "*Mus*" (*Rattus*), while comparison of his figure with various specimens shows the upper molar pattern of *Mastacomys* to agree with that of *Pseudomys higginsi* in having three cusps only on the middle lamina of m^1 and anterior lamina of m^2, and also therefore in lacking a definite anterior 3rd or outer cusp to m^1, and the secondary or outer cusps to the hind lamina

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[2]Finlayson.—*Loc. cit.*, lvii., 1933, pp. 125-29, pls. vi.-vii.

[3]Brazenor.—Mem. Nat. Mus. Melb., No. 8, 1934, pp. 159-161.

of m^1 and m^2 which characterise *Rattus*. The length and width of the molar row of course greatly exceeds that of *Pseudomys*, as well as the Tasmanian form of *lutreolus*, and is 1.8 longer and .4 mm. wider than the largest molar row of the New South Wales race of *lutreolus*.

The conformation of the skull, apart from the uniformly greater size, agrees with that of *Pseudomys*, rather than *Rattus*, in the marked globular anterior expansion of the braincase contrasting with the long parallel-sided interorbital constriction, as well as in the lack of interorbital ridges. The even concavity of the anterior edge of the zygomatic plate, with the consequently strong projection above, is remarkably similar to the structure seen in members of the typical genus of the *Pseudomys* group, as well as in the allied genus *Thetomys*.

The external proportions and plastic features are relatively unimportant in comparison with the above, as is the matter of coloration, but it may be noted that the larger ear, and length and slenderness of the pes, agree more with *Pseudomys* than *Rattus*, as does the duplication of the 1st interdigital pad, which is more strongly marked in the former. It is interesting to note that, although the tail of *Mastacomys* is proportionately shorter than in either local forms of those genera, it is distinctly though variably lighter below, thus reproducing to some extent a striking feature of *Pseudomys higginsi*, while providing a definite distinction from *Rattus lutreolus* which has a uniformly blackish brown tail.

The superficial resemblance of various cranial features to those of foreign water voles (*Arvicola*), referred to in Finlayson's review of *M. fuscus*, evidently has no significance regarding the heritage and homologies of *Mastacomys*. On the contrary, comparison of the figures suggests that the skull differs markedly in the more evenly globular cranium, widely separated interorbital margins, heavier rostrum, and extremely narrow palate which emphasises the greater width of the molars, the patterns of which cannot be regarded as generically homologous with the microtine dentition of *Arvicola*. It is notable that the incurved zygomatic plate common to both, is not entirely associated with similarity of habitat, as the feature is characteristic of *Pseudomys*, which favours drier and at times sub-desert surroundings, and that the number of mammae is less than in *Arvicola*.

The above comparative review of the characteristics of *Mastacomys* would appear to leave no reasonable doubt of its relationship with *Pseudomys*, of which it is apparently a specialised and possibly ancestral form. The adoption of an extremely swampy habitat and unusual diet has apparently involved increased masticatory power, which is evidenced in the bringing together and enlarging of the molar rows, the patterns of which have retained the pseudomyid character, in common with the deeply incurved zygomatic plate and paired inguinal mammae.

The swampy habitat in association with *R. lutreolus velutinus* apparently accounts for the superficially *Rattus*-like general appearance of *Mastacomys*, but this community of existence actually serves to confirm the phylogenetic distinction shown in the cranial, dental, and mammary characters, while providing the obvious source of differentiation from the allied genus *Pseudomys*, which occurs in the same areas but inhabits drier scrubland.

A BASIC LIST OF THE LAND MOLLUSCA OF AUSTRALIA.

By Tom Iredale.

(By Permission of the Trustees of the Australian Museum.)

An illustrated account of the Land Mollusca has been long a desideratum, but the determination of scores of novelties delays the work so much that it is felt the publication of a list of the already described species will assist in inviting co-operation. No list is in existence, as Cox's Monograph was published in 1868, when only a fraction of the faunula was known. It is extraordinary that no lists of Queensland or New South Wales forms have been prepared, the reason being the aforementioned glut of new species to be dealt with. I am at present preparing accounts of South Australian and West Australian faunulae, and may later follow with those of Queensland and New South Wales.

The difficulties attending the collation of such lists lie in the varied nature of the faunulae, and here at once the distinction between natural faunulae and State boundaries impresses the worker. As one consequence geographical knowledge becomes the main factor in the elucidation of the puzzling creatures, and much local study is necessary before any useful basis can be provided. Hence this is termed a Basic List, as it is very incomplete owing to the lack of accurate data, but every care has been taken in checking all the references, literature and specimens, but in the last-mentioned there is no certainty. The older workers ignored accuracy and much of the material is incorrectly labelled and not adequately identified, the authors sending out material often at variance with their own descriptions and figures.

It is therefore very desirable that future workers should carefully record the localities, and study their material in view of the known natural faunal boundaries. From a study of the birds of Australia I suggested a nomination of the faunulae and areas in agreement with that of the marine littoral regions recognised by Hedley. The present investigation of the land mollusca has confirmed the results of my avifaunal studies with, as would be anticipated, emendations in accord with the greater knowledge of this restricted land faunula.

Thus the nomination introduced was:—

The Papuan or Torresian Faunula inhabiting the Solanderian Area (including the Dampierian Sub-Area).
The Euronotian or Bassian Faunula inhabiting the Peronian Area (including the Maugean Sub-Area).
The Eremian or Eyrean Faunula inhabiting the Centralian Area.
The Autochthonian Faunula inhabiting the Leeuwinian Area.

The Land Mollusca emphasise the distinction of the Leeuwinian Area, but also indicating a very marked *Caurine* Faunula living in the Dampierian Sub-Area, while a northern *Oxleyan* Sub-Area may be separated in the north of the Peronian Area.

If this is set out with the characteristic molluscan forms it may become better understood, and this is very necessary in order to appreciate the varied faunulae. The Solanderian Area covers the coastal Queensland belt from Torres Straits to about Port Curtis, and the Papuan or Torresian Faunula found herein is very unlike any of the other Australian series. Many large Helicoid species are found, formerly referred to as *Hadra* or

Thersites; associated are *"Papuina"* and *"Chloritis"*, and a series of Pupinid molluscs with a few Cyclophorids. The smaller forms are not yet well known, but comparatively, Endodontids, are not common. Altogether it is a very fine faunula, but very unlike, in facies, to that of the North West, the area otherwise attached to the Solanderian.

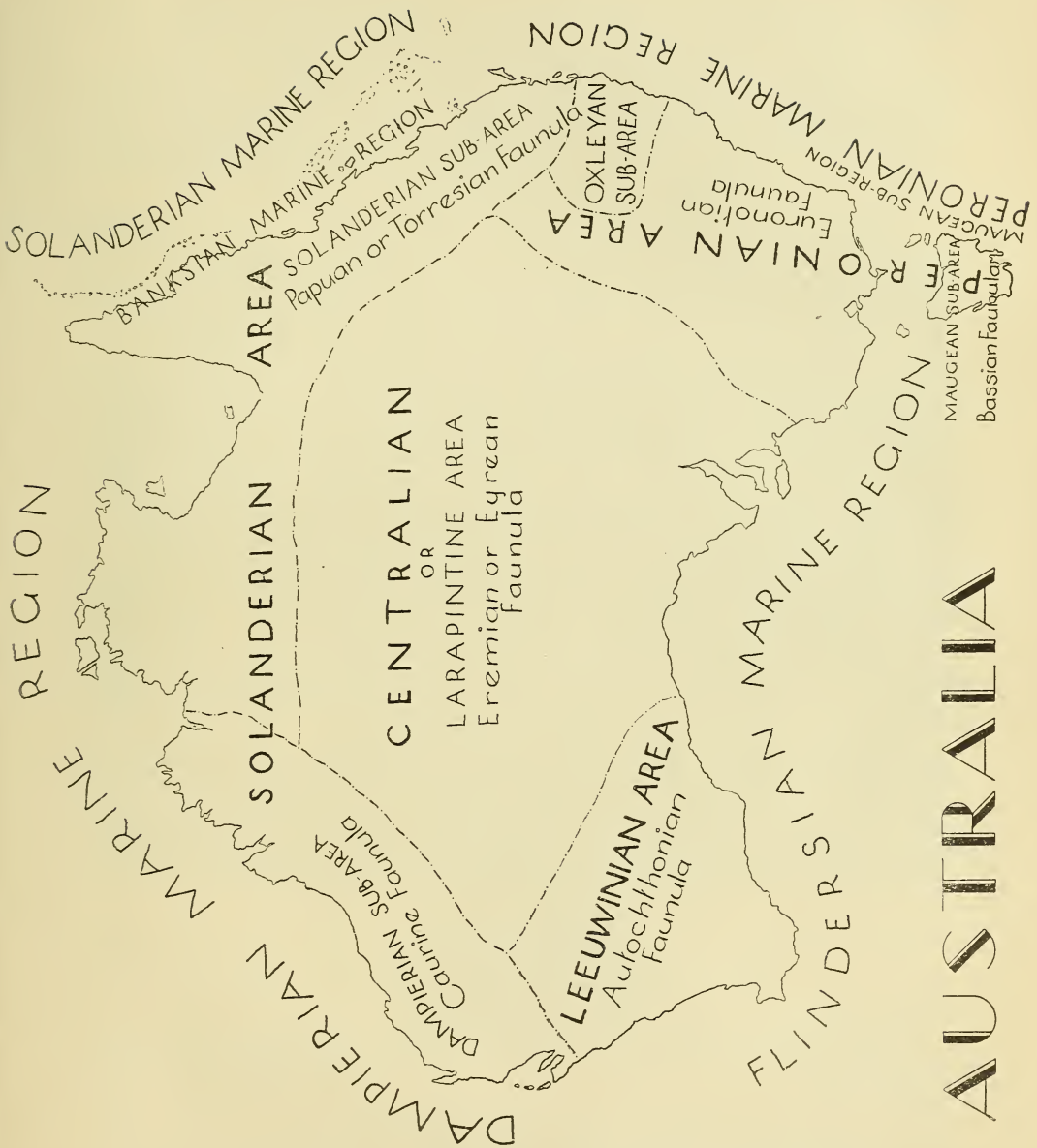
West of Torres Straits the marine fauna differs a little from that of the Queensland coast, and Hedley separated the Dampierian Region. Later workers found less distinction, and the two regions were merged, the latter being regarded as a subregion only. However, North West Australia has a land molluscan faunula so unlike the Papuan that it is here distinguished as the Caurine Faunula. There are no Helicoid *Thersites* or *Hadra,* no *"Papuina"*, a single *"Chloritis"* or so, and so on. Instead there is a very interesting series of *"Rhagada"*, a group not occurring in Eastern Australia, and whose affinities are with Timor species. This faunula is as distinct in appearance as the Papuan series, the dissimilarity being very pronounced.

South West Australia, which I have called the Leeuwinian Area, inhabited by the Autochthonian Faunula, provides even a greater surprise as therein occurs a varied series of Bulimoid molluscs, *Bothriembryon,* without relations in any adjacent territory outside Australia. A member penetrates into Centralia, and a couple occur along the southern coast in South Australia, but the Tasmanian representative may not be closely allied. A few Endodontids occur, but the only Helicoids appear to be intruders from the Centralian or Larapintine Area.

The whole interior of Central Australia, known as the Centralian or Larapintine Area, is represented by the Eremian or Eyrean Faunula, which is distinctive in its shells of desert appearance and varied form. These have been called *Xanthomelon, Chloritis, Thersites,* whichever shell form they recalled. The molluscs do appear to be degenerates of those groups, but among them are many others whose appearance is less noticeable, and it would be very unwise to attach any of these to coastal groups. One name, *Glyptorhagada,* suggests contrast with the Caurine Rhagadas, but this is not necessary.

This leaves us the Peronian Area to consider and here appear three rather distinct series, which are regarded as distinctive of three subareas, the Maugean, the Peronian proper and the Oxleyan. The Maugean is the richest faunula in small molluscs, probably a hundred or so of the so-called Endodontids living therein, and this Bassian Faunula crosses Bass Straits and occupies South Victoria. The bizarre *Anoglypta* and the no less strange *Caryodes* are two remarkable constituents of this faunula, a third perplexing factor being the Paryphantid forms. The number of small Endodontids is only paralleled in New Zealand, and the relationship of the Bassian faunula appears to be with that Dominion.

The Peronian faunula is not very strong, the genus *Meridolum,* a Helicoid of "Thersites" facies, but perhaps not allied, being notable, Endodonts in fair number differing a little from those of the Bassian faunula and a few stragglers from the Solanderian Area. The great peculiarity of the Region is the massing in the Oxleyan Sub-Area of the largest Australian Helicoids of unexpected form. These are *Hedleyella* (the better known *Panda* of the earlier writers), the flattened *Pedinogyra* and the sharply trochoid *Annakelea.* It has been shown that Bassian forms such as *Cystopelta,* a shell-less slug derived from *Helicarion,* occur on mountain tops throughout the Peronian Region, while the apparently Peronian true



FAUNAL AREAS AND REGIONS OF AUSTRALIA.

Rex Iredale, del.

slug, *Triboniophorus,* is somewhat of an enigma as it recurs in North Queensland and may be related to a New Hebrides group.

At the end of this List, the species listed will be grouped, both according to faunulae and State boundaries, so that any worker can appreciate the distinctions and similarities. It may be pointed out here that States such as Victoria and South Australia show a mixture of regional faunulae, while West Australia covers two very different faunulae. The Euronotian faunula enters into South Queensland, while the remainder of Queensland shows a fairly pure Papuan or Torresian faunula.

While this essay deals only with the Land Mollusca it may be recorded that study of freshwater molluscs, not yet completed, confirms in every manner the conclusions here proffered. The Freshwater Mussels have been listed already, and the main items in this connection are the lack of species in the south of the Maugean Sub-Area, the very curious *Cucumerunio* in the Oxleyan Sub-Area and the peculiar *Lortiella* in the Dampierian Sub-Area. The numerous "Bullinid" molluscs also show similar differentiation, the Larapintine *Isidorella* being quite characteristic, while the flat-topped *Amerianna* seem to be northern Larapintine forms. A notable Maugean representative is the Neozelanic *Potamopyrgus,* while even the Viviparine molluscs feature determinate forms, such as *Centrapala,* a remarkable Larapintine group, and *Larina,* just as peculiar a Solanderian evolution, while the series appears to be absent from the Leeuwinian Area and the Maugean Sub-Area. Even the Ancylids provide an abnormal development in *Legrandia* (= *Tasmancylus*) peculiar to the Maugean Sub-Area, while our so-called *Gundlachia* appear to be southern aberrations of an Ancylid series, quite different from the northern true *Gundlachia* with which they were at first sight confused.

As to the higher groupings of the Land Mollusca, there is no good scheme available and will not be until a lot more knowledge has been assembled. There can be no doubt that the operculate Pulmonates have had entirely different origin from the Helicoid forms. Thiele forms the latter into a Sub Class, Pulmonata, and this is here used with reservation. The former he places in the subclass Prosobranchia and, as this is a well known name, it is here used. Thiele's Orders, Archaeogastropoda for the Hydrocenidae and Helicinidae, and Mesogastropoda for the Cyclophorids, Pupinids and Diplommatinids are not however introduced into Australian literature in this place, the older Pectinibranchia being preserved.

Phylum MOLLUSCA.
Class GASTROPODA.
Subclass PROSOBRANCHIA.
Order PECTINIBRANCHIA.
Family HYDROCENIDAE.

This family is used for some small Australian shells which have been rarely found as yet, but which may be widely spread, judging from their occurrences.

Genus OMPHALORISSA Iredale, 1933.

1933. *Omphalorissa* Iredale, Rec. Austr. Mus., Vol. xix., p. 57, August 2. Orthotype, *Georissa multilirata* Brazier.

OMPHALORISSA MULTILIRATA Brazier, 1875.

1875. *Georissa multilirata* Brazier, Proc. Zool. Soc. (Lond.), 1874, p. 670, pl. 83, figs. 8-10, April 1, 1875. Fitzroy Island, North Queensland (Brazier).

1889. *Georissa multilineata* Hedley, Proc. Roy. Soc. Queensland, Vol. vi., p. 101, June. Error only.
North Queensland (Fitzroy Island).

OMPHALORISSA MINUTA Odhner, 1917.

1917. *Omphalotropis minuta* Odhner, Kungl. Svensk. Vetenskap., Handl., Bd. 52, No. 16, p. 99, pl. 3, figs. 113-114, September 19. Chillagoe Caves, North Queensland (subfossil ?).
North Queensland (Chillagoe Caves district, living).

OMPHALORISSA POSTULATA *sp. nov.*

Differs from *O. multilirata* in the suppression of spiral lirae, and the dominance of growth thread lines; from *O. minuta* in its smaller size and lack of strong spiral lirae. Olsen's Caves, near Rockhampton, Queensland.

South Queensland (near Rockhampton).

OMPHALORISSA LASERONI *sp. nov.*

Differs from *O. postulata* in being more obese, and having regular fine spiral lirae, the lirae being however much weaker than those in *O. multilirata* and *O. minuta.* Sherwood, Macleay River, Northern New South Wales (C. Laseron).

Northern New South Wales (Macleay River district).

[Pfeiffer described *Hydrocena malleata* (Proc. Zool. Soc. (Lond.), 1854, p. 308, May 8, 1855) from Australia, and the type, from a painting by Angas, was figured by Cox (Mon. Austr. Land Shells, p. 104, pl. xix., fig. 15, May, 1868). It appears to be referable to *Omphalotropis* (s.l.), a group not Australian. In this Museum there are some shells collected at Bundaberg, Queensland, bearing a MS. name given by Pilsbry as *Omphalotropis,* but these are not referable to *Omphalotropis* auct., and will be dealt with later.]

Family HELICINIDAE.

The members of this family are of similar form and of great difficulty in determination. Wagner, thirty years ago, monographed the family, and altered his conclusions two or three times in a couple of years. As many species were overlooked by him (Fulton, Proc. Mal. Soc. (Lond.), Vol. xi., pp. 237-241, March 29, 1915), and there are more to be described from Australia, the present nomination must be regarded as tentative.

Genus PLEUROPOMA Möllendorff, 1893.

1893. *Pleuropoma* Möllendorff, Ber. Senckenb. Nat. Ges. Frankfürt, 1893, p. 140, "July". Orthotype, *Helicina dichroa* Möllendorff.
1905. *Aphanoconia* Wagner, Denksch. K. Akad. Wissen. Wien., Math. nat. Class, Vol. lxxvii., p. 388. Logotype, here designated, *Helicina verecunda* Gould.
1905. *Reticulata* id. ib., p. 389 (sectional name). Tautotype, *Helicina reticulata* Pfeiffer.
1905. *Sculpta* id. ib., p. 398 (sectional name). Tautotype, *Helicina sculpta.*
1905. *Dichroa* id. ib., p. 403 (sectional name). Tautotype, *Helicina dichroa* Möllendorff. Not *Dichroa* Illiger, Mag. f. Insekt., Vol. v., p. 49, 1806.
1909. *Albocincta* Wagner, Syst. Conch. Cab. (Mart. & Chemn.) cont., ed. Kuster, Bd. I., Abth. 18, (heft, ccxxv., lief, 535), p. 169. Tautotype, *Helicina albocincta* Hombron & Jacquinot.

1909. *Sphaeroconia* Wagner, Syst. Conch. Cab. (Mart. & Chemn.), cont., ed. Kuster, Bd. I., Abth. 18, (heft ccxxviii., lief 538), p. 189. Logotype, here selected, *Helicina sphaeroconus* Möllendorff.

(Note.—The sectional names were proposed for "Formenkreise", and I would have ignored them, but I find that they are recorded as valid sectional names in the Zoological Record for 1905, and are therefore apparently citable as above.)

PLEUROPOMA GOULDIANA Forbes, 1851.

1851. *Helicina gouldiana* Forbes, Narr. Voy. Rattlesnake (Macgillivray), Vol. ii., p. 382, pl. iii., fig. 3, "1852" = mid-December, 1851. Two Isles, off North Queensland coast (Macgillivray).

1863. *Helicina reticulata* Pfeiffer, Proc. Zool. Soc. (Lond.), 1862, p. 277, April 10, 1863. Cape Flattery, North East Australia. Figd. Sowerby, Thes. Conch., Vol. iii., p. 287, pl. 272 (Helic., pl. vii.), figs. 231-232, 1866.

1866. *Helicina fumigata* Sowerby, Thes. Conch., Vol. iii., p. 290, pl. 275 (Helic., pl. x.), fig. 345, new name for *H. gouldiana* Forbes. Cape Flattery, Queensland.

1868. *Helicina lizardensis* Cox, Mon. Austr. Land Shells, p. 107, pl. xvii., fig. 12, May. Lizard Is., North Queensland (Macgillivray).
North Queensland.

PLEUROPOMA EXTINCTA Odhner, 1917.

1917. *Aphanoconia extincta* Odhner, Kungl .Svensk. Vetensk. Handl., Bd. 52, No. 16, p. 98, pl. 3, figs. 110-112, September 19. Chillagoe Caves, North Queensland (subfossil).
North Queensland (Chillagoe Caves district, living).

PLEUROPOMA YORKENSIS Pfeiffer, 1863.

1863. *Helicina yorkensis* Pfeiffer, Proc. Zool. Soc. (Lond.), 1862, p. 277, April 10, 1863. Cape York, Queensland. Figd. Sowerby, Thes. Conch., Vol. iii., p. 290, pl. 275 (Helic., pl. x.), figs. 342-343, 1866.
North Queensland (Cape York district).

PLEUROPOMA WALKERI Smith, 1894.

1894. *Helicina walkeri* Smith, Proc. Mal. Soc. (Lond.), Vol. i., p. 99, pl. vii., fig. 26, June. Queen's, Baudin and Parry Is., North West Australia.

1909. *Aphanoconia* (*Sphaeroconia*) *baudinensis* Wagner, Syst. Conch. Cab. (Mart. & Chemn.), cont., ed Kuster, Bd. I., Abth. 18, p. 217, pl. 43, figs. 11-13, as of Smith, errore, new name for *walkeri* Smith. Baudin Island.
North West Australia (Islands off coast).

Genus CERATOPOMA Möllendorff, 1893.

1893. *Ceratopoma* Möllendorff, Ber. Senckenb. Nat. Ges. Frankfürt, 1893, p. 139, "July". Orthotype, *Helicina caroli* Kobelt.

1905. *Diversicolor* Wagner, Denksch. k. Akad. Wissen. Wien., Math-nat. Class, Vol. lxxvii., p. 431 (as Formenkreis of *Orobophana* loc. cit. p. Tautotype, *Helicina diversicolor* Cox.

1905. *Palaeohelicina* Wagner, id. ib., p. 435. Logotype, here selected, *Helicina fischeriana* Montrouzier.

Wagner introduced *Orobophana,* and as a "Formenkreis" separated the Australian forms about *diversicolor* under that name. A few pages later he separated *Palaeohelicina,* but the next year he transferred the *diversicolor* series to *Palaeohelicina,* but gave as a synonym the earlier *Ceratopoma* of Möllendorff. Bourne commented that he found difficulty in distinguishing these groups, so that the earlier name is here used correctly for the combined series, while it is possible that the Australian series may constitute a recognisable unit of sub-ordinate value.

CERATOPOMA DRAYTONENSIS Pfeiffer, 1857.

1857. *Helicina draytonensis* Pfeiffer, Proc. Zool. Soc. (Lond.), 1856, p. 392, May 8, 1857. Drayton Range, North Australia (Stutchbury). Figd. Sowerby, Thes. Conch., Vol. iii., p. 286, pl. 271 (Helic., pl. vi.), figs. 199-200, 1866.

1866. *Helicina diversicolor* Cox, Proc. Zool. Soc. (Lond.), 1866, p. 375, September 5. Pine Mt., Ipswich, Queensland (Masters). Figd. Cox, Mon. Austr. Land Shells, p. 105, pl. xvii., fig. 9, May, 1868.
South Queensland.

CERATOPOMA GLADSTONENSIS Cox, 1864.

1864. *Helicina gladstonensis* Cox, Cat. Austr. Land Shells, p. 34, Gladstone, Port Curtis, Queensland (Blomfield). Figd. Cox, Mon. Austr. Land Shells, p. 107, pl. xvii., fig. 11, May, 1868.
South Queensland (Port Curtis district).

CERATOPOMA JANA Cox, 1872.

1872. *Helicina jana* Cox, Proc. Zool. Soc. (Lond.), 1871, p. 645, pl. lii., fig. 3, May 2, 1872. Port Macquarie, New South Wales.
Northern New South Wales.

CERATOPOMA MACLEAYI Brazier, 1876

1876. *Helicina macleayi* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 112, July. Barnard Island No. 3, North East Australia.
North Queensland.

[1855. *Helicina turbinella* Pfeiffer, Proc. Zool. Soc. (Lond.), 1855, p. 103, July 23. Sidney.
No Helicinid shell lives at Sydney, and this has been rejected as exotic; if it be from New South Wales it might be *jana* Cox, but this identity has never been claimed.]

[1868. *Helicina fulgurata* Cox, Mon. Austr. Land Shells, p. 107, pl. xvii., figs. 10, a, b, May. "Rocky Isle, near Cape Flattery, Queensland". Locality wrong, the species being *fulgora* Gould, from the Fiji Islands.]

[1874. *Helicina suprafasciata* Sowerby, Conch. Icon. (Reeve), Vol. xix., pl. xxxiii., sp. 300, February. Australia (Brenchley). Not Australian, probably New Hebrides.]

[1899. *Helicina crassidens* Tate, Trans. Roy. Soc. South Austr., Vol. xxiii., p. 247, pl. vi., fig. 6, December. "Balaklava River, Wakefield, South Australia". Locality erroneous, is an American species.]

Family CYCLOPHORIDAE.

Only three species, one of them belonging to a widely spread form, penetrate into Northern Queensland.

Genus Leptopoma Pfeiffer, 1847.

1847. *Leptopoma* Pfeiffer, Zeitsch. für Malak., 1847, p. 47, March. Logotype, Kobelt, Illustr. Conchylienbuch, p. 194, 1878, *Leptopoma vitreum* Lesson s. *nitidum* Sowerby.

1855. *Dermatocera* H. and A. Adams, Gen. Rec. Moll., Vol. ii., p. 282, Nov. Logotype, *Leptopoma vitreum* Lesson.

Leptopoma nitidum Sowerby, 1843.

[1843. *Cyclostoma nitidum* Sowerby, Thes. Conch., Vol. i., p. 133, pl. xxix., figs. 225-227, ante June 23. Is. of Guimaras and Zebu, Philippine Islands.]

Leptopoma nitidum ultra *subsp. nov.*

Smaller and comparatively taller than the typical form.
North Queensland.

The well known *vitreum* is invalid, Lesson's *Cyclostoma vitrea* (Voy. Coquille, Zool., Vol. ii., pt. i., p. 346, 1830) being anticipated by Draparnaud (Tabl. Moll. France, 1801, p. 41 (Sherborn)).

Genus Ditropisena Iredale, 1933.

1933. *Ditropisena* Iredale, Rec. Austr. Mus., Vol. xix., p. 57, August 2. Orthotype, *Cyclophorus macleayi* Brazier.

Ditropisena macleayi Brazier, 1877.

1877. *Cyclophorus* (*Ditropis*) *macleayi* Brazier, Proc. Linn. Soc. N.S.W., Vol. ii., p. 122, July. New name for

1876. *Cyclophorus* (*Ditropis*) *beddomei* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 113, July. Cape York, North East Australia. Figd. Hedley, Proc. Linn. Soc. N.S.W., Vol. xxvi., p. 706, pl. xxxiv., figs. 15-17, 1902. North Queensland (Cape York district).

Ditropisena whitei Brazier, 1875.

1875. *Cyclophorus* (*Ditropis*) *whitei* Brazier, Proc. Zool. Soc. (Lond.), 1874, p. 669, pl. 83, figs. 5-7, April 1, 1875. Fitzroy Island, North East Australia.
North Queensland (Fitzroy Island).

[Two species were described nearly one hundred years ago from West Australia, but no members of this family have since been found there and the locality appears to be erroneous; may be Indian as Dr. Bacon collected there.

Cyclophorus liricinctus Benson, 1853.

1853. *Cyclostoma liricinctum* Benson, Ann. Mag. Nat. Hist., Ser. ii., Vol. xi., p. 106, February. West Australia (Bacon). Figd. Reeve, Conch. Icon., Vol. xiii., Cyclophorus, Vol. xx., sp. 100, August, 1861 (type figured).
? West Australia.

Cyclophorus orbiculatus Benson, 1853.

1853. *Cyclostoma orbiculatum* Benson, Ann. Mag. Nat. Hist., Ser. ii., Vol. xi., p. 106, February. West Australia (Bacon). Figd. Reeve, Conch. Icon., Vol. xiii., Cyclophorus, Vol. xx., sp. 101, August, 1861 (type figured).
? West Australia.]

Family Pupinidae.

The members of this family need careful revision and the following data merely represent obvious facts and do not take into account much novel material. Kobelt's Monograph in Das Tierreich is very unsatisfactory, the association of species being unnatural. *Pupina* was introduced by Vignard (Ann. Sci. Nat. Paris, Vol. xviii., p. 439, pl. 11, c, December, 1829) for a New Guinea shell, which he named *P. keradrini* (*keraudrenii* correctly on plate). It was a small glassy shell with a circular mouth showing two canals, pupoid in shape, glossy and imperforate.

Genus Signepupina *nov.*

Type, *Pupinella macgillivrayi* Cox.

Medium Pupinid shells, glossy, imperforate, the anterior canal narrow, short, lateral joined by strong callus across body whorl to narrow posterior canal, which vertically ascends the body whorl, the edges not flanged.

Signepupina macgillivrayi Cox, 1864.

1864. *Pupinella macgillivrayi* Cox, Cat. Austr. Land Shells, p. 32. Port Denison, Queensland (Wall). Figd. Cox, Mon. Austr. Land Shells, p. 100, pl. xvi., fig. 7, May, 1868.

1906. *Pupina clara* Fulton, Ann. Mag. Nat. Hist., Ser. vii., Vol. xvii., p. 244, pl. ix., fig. 2, February 1. Port Denison, Queensland.

Mid-Queensland (Port Denison district).

Signepupina meridionalis Pfeiffer, 1864.

1864. *Pupina meridionalis* Pfeiffer, Proc. Zool. Soc. (Lond.), 1863, p. 526, April 20, 1864. North Australia.

North Queensland.

Signepupina bilinguis Pfeiffer, 1851.

1851. *Pupina bilinguis* Pfeiffer, Proc. Zool. Soc. (Lond.), 1850, p. 97, February 24, 1851. East Australia = North Queensland, Cape York. Figd. Cox, Mon. Austr. Land Shells, p. 100, pl. xvi., figs. 6, a, b, May, 1868.

1876. *Pupina nitida* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 136, July Barrow Is., North Queensland. Figd. Hedley, Proc. Linn. Soc. N.S.W., Vol. xxvii., p. 20, pl. iii., fig. 37, 1902.

North Queensland (Cape York district).

Signepupina robusta Cox, 1868.

1868. *Pupina robusta* Cox, Mon. Austr. Land Shells, p. 101, pl. xvi., figs. 13, a, b, May. Warro, Port Curtis, Queensland (Blackman).

South Queensland (Port Curtis district).

Signepupina ventrosa Dohrn, 1862.

1862. *Pupina ventrosa* Dohrn, Proc. Zool. Soc. (Lond.), 1862, p. 183, September 15. Cape York, Australia (Macgillivray), in error = Endeavour River, Queensland. Figd. Cox, Mon. Austr. Land Shells, p. 102, pl. xvi., fig. 14, May, 1868.

North Queensland (Cooktown district).

Signepupina subpolita Fulton, 1906.

1906. *Pupina subpolita* Fulton, Ann. Mag. Nat. Hist., Ser. vii., Vol. xvii., p. 245, pl. ix., fig. 4, February 1. Richmond River, New South Wales (S.W. Jackson).

Northern New South Wales.

SIGNEPUPINA PINETICOLA Cox, 1866.

1866. *Pupina pineticola* Cox, Proc. Zool. Soc. (Lond.), 1866, p. 375, September 5. Pine Mt., Lismore, New South Wales (Macgillivray). Figd. Cox, Mon. Austr. Land Shells, p. 102, pl. xvi., fig. 8, May, 1868.
Northern New South Wales.

SIGNEPUPINA PFEIFFERI Dohrn, 1862.

1862. *Pupina pfeifferi* Dohrn, Proc. Zool. Soc. (Lond.), 1862, p. 183, September 15. Cape Flattery, N. Queensland (Macgillivray). Figd. Cox, Mon. Austr. Land Shells, p. 103, pl. xvi., fig. 9, May, 1868.

1864. *Pupina carlottae* Cox, Cat. Austr. Land Shells, p. 31, ex Macgillivray MS., nom. nud. Cape Direction, N. Queensland.
North Queensland.

SIGNEPUPINA STRANGEI Pfeiffer, 1854.

1854. *Pupina strangei* Pfeiffer, Malak. Blatter, Bd. 1, p. 90, dated April. Moreton Bay, Australia (Strange). Figd. Cox, Mon. Austr. Land Shells, p. 103, pl. xx., fig. 16, May, 1868, from painting of type by Angas. Refigd. Hedley, Proc. Linn. Soc. N.S.W., Vol. xxxvii., p. 268, pl. x., fig. 61, 1912.
South Queensland (Moreton Bay district).

SIGNEPUPINA TENUIS Hedley, 1912.

1912. *Pupina tenuis* Hedley, Proc. Linn. Soc. N.S.W., Vol. xxxvii., p. 268, pl. x., fig. 62, December 13. West of Gladstone, Port Curtis, Queensland (S.W. Jackson).
South Queensland (Port Curtis district).

SIGNEPUPINA MODESTA Fulton, 1906.

1906. *Pupina pineticola* var. *modesta* Fulton, Ann. Mag. Nat. Hist., Ser. vii., Vol. xvii., p. 244, pl. ix., fig. 1, February 1. Queensland = Port Curtis.
South Queensland (Port Curtis district).

Subgenus DOLOPUPINA *nov.*
Type, *Pupina wilcoxi* Cox.

Small glossy imperforate Pupinid shells with anterior and posterior canals narrow and not connected by a callus across the body whorl.

SIGNEPUPINA (DOLOPUPINA) WILCOXI Cox, 1864.

1864. *Pupina wilcoxi* Cox, Cat. Austr. Land Shells, p. 32. Clarence River, New South Wales (Wilcox). Figd. Cox, Mon. Austr. Land Shells, p. 101, pl. xvi., fig. 15, May, 1868.
Northern New South Wales.

Subgenus PARPUPINA *nov.*
Type, *Pupina crossei* Brazier.

Small glossy imperforate Pupinid shells, without body callus connecting canals, but with edges of canals crassate, especially those of the posterior one, the upper edge developing into a vertical flange.

SIGNEPUPINA (PARPUPINA) CROSSEI Brazier, 1876.

1876. *Pupina crossei* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 111, July. Palm Is., North Queensland. Figd. Hedley, Proc. Linn. Soc. N.S.W., Vol. xxvii., p. 20, pl. iii., fig. 38, 1912.
Mid-Queensland (Palm Is.).

Genus Lopupina *nov.*
Type, *Pupina bidentata* Beddome.

Glossy imperforate Pupinid shells with heavy body callus connecting canals, the anterior one situated lower down than usual with edges developed into flanges which run as strong ridges up the back of the body whorl; the posterior canal edges also run vertically up the front of the body whorl, the lower edge of the mouth thickened and somewhat sinuate, thereby cramping the aperture.

Lopupina bidentata Beddome, 1897.

1897. *Pupina bidentata* Beddome, Proc. Linn. Soc. N.S.W., Vol. xxi., p. 814, figs. 1-4 in text, May 31. Near Cairns, Queensland.
North Queensland (Cairns district).

Lopupina thomsoni Forbes, 1851.

1851. *Pupina thomsoni* Forbes, Narr. Voy. Rattlesnake (Macgillivray), Vol. ii., p. 381, pl. iii., figs. 2, a, b, "1852" = mid-December, 1851. Fitzroy Is., N. Queensland.
North Queensland (Fitzroy Is.).

This island form is quite distinct from the preceding, being smaller with the body canals less pronounced, and the mouth less cramped. A similar shell has been seen from Dunk Island, and may occur on other islands.

Genus Diplopupina *nov.*
Type, *Pupina coxeni* Brazier.

Glossy imperforate Pupinid shells, with strong body callus, the posterior canal horizontal and short in front view, but canal elongate and ascending body whorl from side view; anterior canal horizontal, median, and then ascending to join body whorl, the outer lip duplicate.

Diplopupina coxeni Brazier, 1875.

1875. *Pupina coxeni* Brazier, Proc. Zool. Soc. (Lond.), 1875, p. 34, pl. iv., fig. 9, June 1. Mt. Dryander, Port Denison, Queensland.
Mid-Queensland (Port Denison district).

Genus Estopupina *nov.*
Type, *Pupina costata* Hedley & Musson.

Elongate striate non-glossy umbilicate Pupinellid shells with no posterior canal and only very narrow anterior canal which is horizontal, the mouth almost circular and free. Differs from all other Australian Pupinid shells in having only one canal, but it seems that *Pupinella* also lacks the posterior canal, although that generic name has been commonly used for bicanaliculate species.

Estopupina costata Hedley & Musson, 1892.

1892. *Pupina costata* Hedley & Musson, Proc. Linn. Soc. N.S.W., Ser. ii., Vol. vi., p. 559, fig. in text, May 23. Near Gympie, Queensland.
South Queensland (Gympie district).

Genus Necopupina *nov.*
Type, *Pupinella densecostata* Fulton.

Elongate, striate, non-glossy, rimate Pupinid shells with two canals, both short and narrow, horizontal, and neither attingent to body whorl.

These have been regarded as *Pupinella,* which differs in many ways, but especially in lacking a posterior canal. Kobelt classed these with some glossy non-umbilicate species, very unlike, under the typical subgenus *Pupinella,* a very erroneous location.

NECOPUPINA DENSECOSTATA Fulton, 1906.

1906. *Pupinella densecostata* Fulton, Ann. Mag. Nat. Hist., Ser. vii., Vol. xvii., p. 245, pl. ix., fig. 7, February 1. Port Curtis, Queensland.
South Queensland (Port Curtis district).

NECOPUPINA SIMPLEX Fulton, 1906.

1906. *Pupinella simplex* Fulton, Ann. Mag. Nat. Hist., Ser. vii., Vol. xvii., p. 245, pl. ix., fig. 3, February 1. Port Curtis, Queensland.
South Queensland (Port Curtis district).

NECOPUPINA PLANILABRIS Pfeiffer, 1864.

1864. *Pupina planilabris* Pfeiffer, Proc. Zool. Soc. (Lond.), 1863, p. 526, April 20, 1864. North Australia = Port Curtis.
1864. *Pupina coxi* Morelet, Journ. de Conch., Vol. xii., p. 289, July 1. Port Curtis, Queensland.
1864. *Pupinella whartoni* Cox, Cat. Austr. Land Shells, p. 32. Port Denison, Queensland. Figd. Cox, Mon. Austr. Land Shells, p. 99, pl. xvi., figs. 11, a, b, May, 1868.
South and mid-Queensland (Port Curtis to Port Denison).

Genus AMBIPUPINA *nov.*
Type, *Pupina pettardi* Crosse.

Elongate striate non-glossy narrowly rimate Pupinid shells, the canals longer than in *Necopupina,* and expanded, the posterior developing with flange-like processes; the anterior canal similarly flanged and with a median internal ridge dividing the aperture into two, the outer lip also duplicate.

AMBIPUPINA PETTARDI Crosse, 1874.

1874. *Pupina pettardi* Crosse, Journ. de Conch., Vol. xxii., p. 370, October 1. Cooktown, Endeavour River, Queensland (W. F. Pettard, i.e., Petterd). Figd. Crosse, Journ. de Conch., Vol. xxiii., p. 141, pl. vi., figs. 5, 5a, April, 1875.
1875. *Pupina macleayi* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 5, April 27. Endeavour River, Queensland.
North Queensland (Cooktown district).

Genus HEDLEYA Cox, 1892.

1892. *Hedleya* Cox, Proc. Linn. Soc. N.S.W., Ser. ii., Vol. vi., p. 568, May 23. Orthotype, *Hedleya macleayi* Cox.

HEDLEYA MACLEAYI Cox, 1892.

1892. *Hedleya macleayi* Cox, Proc. Linn. Soc. N.S.W., Ser. ii., Vol. vi., p. 568, pl. xxi., figs. 2, 5, 8, 10, May 23. Cairns, North Queensland (W. W. Froggatt).
North Queensland (Cairns district).

HEDLEYA UMBILICATA Odhner, 1917.

1917. *Hedleya umbilicata* Odhner, Kungl. Svensk. Vetensk. Handl., Bd. 52, No. 16, p. 75, pl. 3, fig. 77, September 19. Evelyne, North Queensland.
North Queensland (Atherton Tableland).

Genus SUAVOCALLIA Iredale, 1933.

1933. *Suavocallia* Iredale, Rec. Austr. Mus., Vol. xix., p. 57, August 2. Orthotype, *Callia splendens* Dohrn.

SUAVOCALLIA SPLENDENS Dohrn, 1862.

1862. *Callia splendens* Dohrn, Proc. Zool. Soc. (Lond.), 1862, p. 183, September. Lizard Is., Queensland (Macgillivray). Figd. Cox, Mon. Austr. Land Shells, p. 104, pl. xvii., fig. 8, May, 1868.
North Queensland.

Subclass PULMONATA.

Thiele continues the division into Orders Basommatophora and Stylommatophora, and all our land molluscs fall into the latter division. This was subdivided into fourteen "Stirps" and these groups into families. The association of our families into "Stirps", as given by Thiele, appears very unnatural, so it is not here followed. The following sequence of families is after Thiele, as he has not altered the earlier arrangements to any great degree, but there still seems room for improvement. Such amendments cannot be made until the forms are systematically grouped in species, genera and families, and the numerous novelties described. How little we really know about the Australian land mollusca can be seen from this list, which probably does not represent one half of the existing forms. When we ascend to the subtleties of differentiation of European and American authorities the number may be easily multiplied tenfold, as none of our forms appears to have an extended range without differentiation.

Order STYLOMMATOPHORA.

Family ELASMATINIDAE.

This family has long been known as the Tornatellinidae, but recent investigation of the type species of *Tornatellina,* from the Island of Juan Fernandez, has indicated that the animal characters differ from those of the commonly accepted species, and hence the name must be restricted to the Juan Fernandez type. At present there appears to be doubt as to the logical successor, as there seems to be several claimants. Some have preferred Pacificellidae, others have advocated Auriculellidae, while still others have retained Tornatellinidae, although this course was obviously incorrect if the anatomical data be accepted.

Apparently the earliest name that is included in the presently constituted family is *Elasmatina,* which dates from 1843. On this basis the family name would be Elasmatinidae, the name here used. As these molluscs have been comparatively recently monographed by Pilsbry, the few Australian species are arranged in accordance with his conclusions. There are, however, more species to be named and more study is necessary to understand the local species.

Genus ELASMIAS Pilsbry, 1910.

1910. *Elasmias* Pilsbry, Nautilus, Vol. xxiii., p. 122, March. Orthotype, *Tornatellina aperta* Pease.

ELASMIAS EUCHARIS Brazier, 1876.

1876. *Tornatellina eucharis* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 110, July. Barnard Is., No. 3, North Queensland. Figd. Hedley, Proc. Linn. Soc. N.S.W., Vol. xxvi., p. 705, pl. 34, fig. 12, 1912.
North Queensland.

ELASMIAS WAKEFIELDIAE COX, 1868.

1868. *Achatinella wakefieldiae* Cox, Mon. Austr. Land Shells, p. 78, May. Grafton, Clarence River, New South Wales (Wakefield). Figd. Hedley, Rec. Austr. Mus., Vol. iii., p. 153, pl. xxviii., fig. 14, December 11, 1899.
New South Wales.

Genus TORNATELLINOPS Pilsbry, 1915.

1915. *Tornatellinops* Pilsbry, Man. Conch. (Tryon), Ser. ii., Vol. xxiii. (pt. 91), p. 169, December 1. Orthotype, *Tornatellina novoseelandica* Pfeiffer.

TORNATELLINOPS MASTERSI Brazier, 1876.

1876. *Tornatellina mastersi* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 108, July. Darnley Is., Torres Straits.
1876. *Tornatellina petterdi* id., ib., p. 109, ibid.
1876. *Tornatellina grenvillei* id., ib., p. 109, Home. Is. off Cape Grenville, North Queensland. Figd. Hedley, Proc. Linn. Soc. N.S.W., Vol. xxvi., p. 705, pl. xxxiv., figs. 13-14, 1902.
North Queensland (from Cape Grenville to Torres Straits).

TORNATELLINOPS JACKSONENSIS COX, 1864.

1864. *Bulimus jacksonensis* Cox, Cat. Austr. Land Shells, p. 25. Darling Point, Sydney, N.S.W. Figd. Cox, Mon. Austr. Land Shells, p. 77, pl. xii., fig. 15, May, 1868.
New South Wales.

Family DIPLOMMATINIDAE.

Very few species have yet been found, but it is probable that more will turn up as they are inconspicuous. Here again existing Monographs prove very inadequate, and are of little use in valuing affinities.

Genus ECLOGARINIA Iredale, 1933.

1933. *Eclogarinia* Iredale, Rec. Austr. Mus., Vol. xix., p. 56, August 2. Orthotype, *Diplommatina gowllandi* Brazier.

ECLOGARINIA GOWLLANDI Brazier, 1875.

1875. *Diplommatina gowllandi* Brazier, Proc. Zool. Soc. (Lond.), 1874, p. 670, pl. 83, figs. 19-21, April 1, 1875. Fitzroy Is., North Queensland.
North Queensland (Fitzroy Is.).

Genus VELEPALAINA *nov.*
Type, *Diplommatina oreadis* Hedley.

Differs from *Cylindropalaina* (type, *Palaina chrysalis* Möllendorff), in being shorter and stouter, the body whorl more swollen and the mouth larger, more expanded than in *Macropalaina* (type, *P. pomatiaeformis* Möllendorff) and with less conical spire.

VELEPALAINA BEDDOMEI Möllendorff, 1897.

1897. *Palaina* (*Cylindropalaina*) *beddomei* Möllendorff, Nachr. deutsch. Malak. gesell., 29th Year, p. 43, May 7, ex Brazier MS. Queensland.
1900. *Diplommatina oreadis* Hedley, Proc. Linn. Soc. N.S.W., p. 512, pl. xxv., fig. 22, November 22. 20 miles from Cardwell, North Queensland (C. E. Beddome).
North Queensland (Cardwell district).

VELEPALAINA STRANGEI Benson, 1853.

1853. *Pupa* (or *Diplommatina*) *strangei* Benson, Ann. Mag. Nat. Hist., Ser. ii., Vol. xi., p. 286, April, ex Pfeiffer MS. East Australia (Strange).
1854. *Diplommatina bensoni* A. Adams, Proc. Zool. Soc. (Lond.), 1852, p. 94, May 23, 1854. Moreton Bay, Queensland (Strange). Figd. Cox, Mon. Austr. Land Shells, p. 96, pl. xvi., fig. 1, May, 1868.
1855. *Diplommatina australiae* Benson, Ann. Mag. Nat. Hist., Ser. ii., Vol. xv., p. 331, May 1. Mount Warren, Point Danger, New South Wales (Strange). Figd. Cox, Mon. Austr. Land Shells, p. 96, pl. xvii., fig. 7, May, 1868.
Northern New South Wales and South Queensland.

Family VERTIGINIDAE.

Pilsbry has monographed the small species of "Pupoid" shells from all over the world, and has found great difficulty in separating groups. The species are hereafter arranged according to Pilsbry's results, but the Australian species must be intensively collected, and studied from an ecological viewpoint. Consequently names based on Australian material are here preferentially used.

Genus AUSTRALBINULA Pilsbry, 1916.

1916. *Australbinula* Pilsbry, Man. Conch. (Tryon), Ser. ii., Vol. xxiv. (pt. 93), p. 11, December 18. Orthotype, *G(astrocopta) rossiteri.*
1917. *Australbinula* Pilsbry, Man. Conch. (Tryon), Ser. ii., Vol. xxiv. (pt. 94), pp. 155-166, July 18. Orthotype, *Gastrocopta hedleyi* Pilsbry = *rossiteri* supra.

AUSTRALBINULA HEDLEYI Pilsbry, 1917.

1917. *Gastrocopta hedleyi* Pilsbry, Man. Conch. (Tryon), Ser. ii., Vol. xxiv., p. 166, pl. 27, figs. 1-4, July 18. Narrabri, New South Wales.
New South Wales.

AUSTRALBINULA STRANGEANA *nom. nov.*

1854. *Pupa strangei* Pfeiffer, Proc. Zool. Soc. (Lond.), 1852, p. 69, May 23, 1854. Gordon (i.e., Garden) Is., Port Jackson, New South Wales (Strange). Not *Pupa strangei* Benson, 1853, *ante.* Figd. Cox, Mon. Austr. Land Shells, p. 80, pl. xiv., figs. 15, 15a, May, 1868.
New South Wales.

AUSTRALBINULA MORETONENSIS Cox, 1868.

1868. *Pupa moretonensis* Cox, Mon. Austr. Land Shells, p. 81, pl. xiv., figs. 21, 21a, May. Moreton Bay, Queensland (Masters).
South Queensland (Moreton Bay district).

AUSTRALBINULA QUEENSLANDICA Pilsbry, 1917.

1917. *Gastrocopta pediculus queenslandica* Pilsbry, Man. Conch. (Tryon), Ser. ii., Vol. xxiv. (pt. 94), p. 159, pl. 26, fig. 2, July 18. Calliungal, South Queensland.
South Queensland.

AUSTRALBINULA MUSSONI Pilsbry, 1917.

1917. *Gastrocopta mussoni* Pilsbry, Man. Conch. (Tryon), Ser. ii., Vol. xxiv. (pt. 94), p. 167, pl. 27, figs. 5-6, July 18. Calliungal, Queensland.
South Queensland.

AUSTRALBINULA MACDONNELLI Brazier, 1875.

1875. *Pupa* (*Vertigo*) *macdonnelli* Brazier, Proc. Zool. Soc. (Lond.), 1874, p. 669, pl. 83, figs. 22-23, April 1, 1875. Fitzroy Is., North Queensland.
North Queensland (Fitzroy Is.).

AUSTRALBINULA MACLEAYI Brazier, 1876.

1876. *Pupa* (*Vertigo*) *macleayi* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 110, July. Bet and Sue Islands, Torres Straits. Figd. Hedley, Proc. Linn. Soc. N.S.W., Vol. xxvii., p. 19, pl. iii., fig. 39, 1902.
North Queensland (Torres Straits Islands).

AUSTRALBINULA WALLABYENSIS Smith, 1894.

1894. *Pupa wallabyensis* Smith, Proc. Mal. Soc. (Lond.), Vol. i., p. 97, June. East Wallaby Is., Houtman's Abrolhos.
West Australia (Houtman's Abrolhos).

AUSTRALBINULA MOOREANA Smith, 1894.

1894. *Pupa mooreana* Smith, Proc. Mal. Soc. (Lond.), Vol. i., p. 97, Vol. vii., fig. 25, June. Roebuck Bay, North West Australia. Figd. Pilsbry, Man. Conch., Vol. xxvi., p. 230, pl. 24, figs. 6-7, November, 1921.
North West Australia.

AUSTRALBINULA LARAPINTA Tate, 1896.

1896. *Pupa larapinta* Tate, Rep. Horn. Sci. Exped. Centr. Austr., pt. ii., Zool., p. 205, pl. xix., fig. 19, February. Central Australia.
1917. *Gastrocopta larapinta deserti* Pilsbry, Man. Conch. (Tryon), Ser. ii., Vol. xxiv. (pt. 94), p. 170, pl. 30, figs. 1-3, July 18. Central Australia (Tempe Downs, etc.).
Central Australia.

AUSTRALBINULA TATEI Pilsbry, 1917.

1917. *Gastrocopta tatei* Pilsbry, Man. Conch. (Tryon), Ser. ii., Vol. xxiv. (pt. 94), p. 165, pl. 26, figs. 9-10; pl. 30, fig. 12, July 18. Central Australia.
Central Australia.

AUSTRALBINULA MARGARETAE Cox, 1868.

1868. *Pupa margaretae* Cox, Mon. Austr. Land Shells, p. 80, pl. xiv., fig. 20a, May. Wallaroo, South Australia (Masters).
South Australia.

AUSTRALBINULA BANNERTONENSIS Gabriel, 1930.

1930. *Bifidaria bannertonensis* Gabriel, Proc. Roy. Soc. Vict., Vol. xliii. (n.s.), pt. i., p. 64, pl. iii., figs. 9-10, September 11. Bannerton, Victoria.
Victoria.

AUSTRALBINULA ROSSITERI Brazier, 1875.

1875. *Pupa* (*Vertigo*) *rossiteri* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 18, April 27. Picton, New South Wales.
New South Wales.

Genus CYLINDROVERTILLA Boettger, 1880.

1880. *Cylindrovertilla* Boettger, Conch. Mitth. (Martens), Bd. 1, heft 4, pp. 61-62, July. Logotype, Pilsbry, Man. Conch. (Tryon), Ser. ii., Vol. xxvi., p. 43, December 23, 1920, *Pupa fabreana* Crosse.

CYLINDROVERTILLA FABREANA Crosse, 1872.

[1872. *Pupa fabreana* Crosse, Journ. de Conch., Vol. xx., p. 359, October; Vol. xxii., p. 392, pl. 12, fig. 6, October, 1874. Noumea, New Caledonia.]

CYLINDROVERTILLA FABREANA BOYNENSIS *subsp. nov.*

1920. *Cylindrovertilla fabreana* Pilsbry, Man. Conch. (Tryon), Ser. ii., Vol. xxvi., p. 48, pl. 5, figs. 12, 13, December 23. Boyne Is., Port Curtis, Queensland (C. T. Musson).

Differs from the typical form in being more striated, the angular lamellae smaller and more sinuous, etc., etc.

CYLINDROVERTILLA HEDLEYI Pilsbry, 1920.

1920. *Cylindrovertilla hedleyi* Pilsbry, Man. Conch. (Tryon), Ser. ii., Vol. xxvi., p. 46, pl. 5, figs. 4-10, December 23. Calliungal, Queensland. South Queensland.

Subgenus WALLIVERTILLA *nov.*
Type, *Pupa kingi* Cox.

While the typical *Cylindrovertilla* has only one palatal fold, the present subgenus has two palatal folds, the upper fold, however, being the stronger.

CYLINDROVERTILLA (WALLIVERTILLA) KINGI Cox, 1864.

1864. *Pupa kingi* Cox, Cat. Austr. Land Shells, p. 28, Parramatta, New South Wales (R. L. King). Figd. Cox, Mon. Austr. Land Shells, p. 79, pl. xiv., figs. 17, 17c, May, 1868.

1864. *Pupa mastersi* Cox, Cat. Austr. Land Shells, p. 29. Wollongong, New South Wales (W. (= G.) Masters).
New South Wales.

Genus THEMAPUPA Iredale, 1930.

1930. *Themapupa* Iredale, Vict. Naturalist, Vol. 47, p. 120, November. Haplotype, *Pupa beltiana* Tate.

THEMAPUPA BELTIANA Tate, 1894.

1894. *Pupa beltiana* Tate, Trans. Roy. Soc. South Austr., Vol. xviii., p. 191, November. Central Australia. Figd. Tate, Rep. Horn Sci. Exped. Centr. Austr., pt. ii., Zool., p. 204, pl. xviii., fig. 15, February, 1896, as dextral *contraria* Smith.
Central Australia.

THEMAPUPA EREMICOLA Tate, 1894.

1894. *Pupa eremicola* Tate, Trans. Roy. Soc. South Austr., Vol. xviii., p. 191, November. Central Australia. Figd. Tate, Rep. Horn. Sci. Exped. Centr. Austr., pt. ii., Zool., p. 204, pl. xix., fig. 17, February, 1896, as sinistral *contraria* Smith.
Central Australia.

THEMAPUPA CONTRARIA Smith, 1894.

1894. *Pupa contraria* Smith, Proc. Mal. Soc. (Lond.), Vol. i., p. 96, June. East Wallaby Is., Houtman's Abrolhos, West Australia.
Western Australia.

THEMAPUPA LEPIDULA A. Adams & Angas, 1864.

1864. *Buliminus (Chondrula) lepidula* A. Adams & Angas, Proc. Zool. Soc. (Lond.), 1864, p. 38, June 24. Shark's Bay, West Australia. Figd.

Cox, Mon. Austr. Land Shells, p. 69, pl. xix., fig. 14, May, 1868, from a painting by Angas of the type.
Western Australia.

THEMAPUPA ISCHNA Tate, 1894.

1894. *Pupa ischna* Tate, Trans. Roy. Soc. South Austr., Vol. xviii., p. 191, November. Central Australia. Figd. Tate, Rep. Horn. Sci. Exped. Centr. Austr., pt. ii., Zool., p. 204, pl. xix., fig. 16, February, 1896. Alice Springs and Palm Creek.
Central Australia.

THEMAPUPA MYOPORINAE Tate, 1880.

1880. *Bulimus myoporinae* Tate, Trans. Proc. Roy. Soc. South Austr., Vol. iii., p. 104, new name for
1879. *Bulimus sinistrorsus* Tate, Trans. Roy. Soc. Adelaide, South Austr., p. 134, pl. v., fig. 4. Peelunibie, Head of the Bight, South Australia. Not *Bulimus sinistrorsus* Serres, Ann. Soc. Ag. Lyon, iii., 1841, 484. South Australia.

THEMAPUPA ADELAIDAE Angas, 1864.

1864. *Buliminus* (*Chondrula*) *adelaidae* Angas, Proc. Zool. Soc. (Lond.), 1863, p. 522, April 20, 1864, ex A. Adams & Angas MS. South Australia. Figd. Cox, Mon. Austr. Land Shells, p. 69, pl. xiii., fig. 5, May, 1868.
1864. *Pupa ramsayi* Cox, Cat. Austr. Land Shells, p. 28. Point Lowly, South Australia.
South Australia.

THEMAPUPA PACIFICA Pfeiffer, 1846.

1846. *Pupa pacifica* Pfeiffer, Proc. Zool. Soc. (Lond.), 1846, p. 31, May. Sir Charles Hardy's Is., Pacific Ocean (= Queensland) (B. W. Tucker).
North Queensland.

Genus GLYPTOPUPOIDES Pilsbry, 1926.

1926. *Glyptopupoides* Pilsbry, Man. Conch. (Tryon), Ser. ii., Vol. xxvii., p. 252, March. Orthotype, *Pupoides hedleyi* Pilsbry.

GLYPTOPUPOIDES HEDLEYI Pilsbry, 1926.

1926. *Pupoides hedleyi* Pilsbry, Man. Conch. (Tryon), Ser. ii., Vol. xxvii., p. 252, pl. 31, fig. 15, March. Bundaberg, Queensland.
South Queensland.

Genus OMEGAPILLA *nov.*
Type, *Pupa nelsoni* Cox.

Referred by Pilsbry to *Primipupilla*, an Asiatic group, from which it differs in being larger, sinistral, the lamellae differing in form and position.

OMEGAPILLA NELSONI Cox, 1864.

1864. *Pupa nelsoni* Cox, Cat. Austr. Land Shells, p. 29. Nelson's Bay, Sydney, N.S.W. (Rev. R. L. King). Figd. Cox, Mon. Austr. Land Shells, p. 79, pl. xiv., figs. 19, 19a, May, 1868.
New South Wales.

OMEGAPILLA FICULNEA Tate, 1894.

1894. *Pupa ficulnea* Tate, Trans. Roy. Soc. South Austr., Vol. xviii., p. 191, November. Central Australia. Figd. Tate, Rep. Horn. Sci. Exped.

Centr. Austr., Vol. ii., Zool., p. 205, pl. 19, figs. 18, a, b., February, 1896.
Palm Creek.
Central Australia.

OMEGAPILLA AUSTRALIS Angas, 1864.

1864. *Vertigo australis* Angas, Proc. Zool. Soc. (Lond.), 1863, p. 522, April 20, 1864, ex A. Adams & Angas MS. Rapid Bay, South Australia. Fig. Cox, Mon. Austr. Land Shells, p. 79, pl. xx., fig. 15, May, 1868, from a painting of the type by Angas.

1867. *Pupa lincolnensis* Cox, Proc. Zool. Soc. (Lond.), 1867, p. 39, May, 25. Port Lincoln, South Australia (Masters). Figd. Cox, Mon. Austr. Land Shells, p. 80, pl. xiv., fig. 16, May, 1868.
South Australia.

OMEGAPILLA TASMANICA Johnston, 1883.

1883. *Pupa tasmanica* Johnston, Papers Proc. Roy. Soc. Tasm., 1882, p. 144, pl., as synonym of *lincolnensis* Angas, but Tasmanian specimens figured and described. Tasmania.
Tasmania.

Genus SOMNIOPUPA *nov.*
Type, *Pupa scotti* Brazier.

A dextral form of small size with peculiar armature of the mouth as described by Pilsbry at the citation below.

SOMNIOPUPA SCOTTI Brazier, 1875.

1875. *Pupa* (*Vertigo*) *scotti* Brazier, Proc. Zool. Soc. (Lond.), 1874, p. 669, pl. 83, figs. 24-26, April 1, 1875. Fitzroy Is., North Queensland. Refigd. Hedley, in Man. Conch. (Tryon), Ser. ii., Vol. xxvi., p. 222, pl. 23, fig. 22, November, 1921, from unique specimen.
North Queensland (Fitzroy Is.).

Genus GYLIOTRACHELA Tomlin, 1930.

1930. *Gyliotrachela* Tomlin, Proc. Mal. Soc. (Lond.), Vol. xix., p. 24, March 13, new name for

1917. *Gyliauchen* Pilsbry, Man. Conch. (Tryon), Ser. ii., Vol. xxiv. (pt. 94), pp. 173-174, July 18. Logotype, Pilsbry, *loc. cit.*, p. 210. *Hypselostoma hungerfordiana* Möllendorff. Not *Gyliauchen* Nicoll, Parasitology, Vol. viii., p. 37, 1915.

GYLIOTRACHELA AUSTRALIS Odhner, 1917.

1917. *Hypselostoma australis* Odhner, Kungl. Svensk. Vetensk. Handl., Bd. 52, No. 16, p. 98, pl. 3, figs. 107-109, September 19. Chillagoe Caves, North Queensland (subfossil).
North Queensland (Chillagoe Caves district, *living*).

Genus IMPUTEGLA *nov.*
Type, *Pupisoma circumlitum* Hedley.

Differs in form and lack of apertural teeth from the type of *Pupisoma* (*lignicola*), and resembling *Ptychopatula* (type *caeca*) from Trinidad.

IMPUTEGLA CIRCUMLITA Hedley, 1897.

1897. *Pupisoma circumlitum* Hedley, Rec. Austr. Mus., Vol. iii., p. 44, pl. xi., figs. 1, 2, 3, August 5. Bundaberg, Queensland.
South Queensland. New South Wales.

IMPUTEGLA PORTI Brazier, 1876.

1876. *Helix* (*Conulus* ?) *porti* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 104, July. Albany Is., North Queensland.
North Queensland (Cape York district).

[Note.—*Pupa anodonta* Hedley & Musson (Proc. Linn. Soc. N.S.W., Ser. ii., Vol. vi., p. 588, fig. in text, May 23, 1892), described from the North Pine River, Queensland, has been determined as a fresh water shell previously described as *Hydrobia petterdi* Smith (Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 270, pl. vii., fig. 23, July, 1881), and *Bithynia richmondiana* Petterd (Journ. Conch. (Leeds), Vol. iv., p. 159, January, 1884, figd. by Hedley, Proc. Linn. Soc. N.S.W., 1904, pl. viii., fig. 7), from the Richmond River, New South Wales. It is unlike any Australian fresh water group, and Hedley has referred it to the New Caledonian genus, *Heterocyclus,* but it seems to be nearer the other New Caledonian genus, *Hemistomia.* It does not agree with the former in form, being narrow and elongate, *Heterocyclus* being short and broad. It is more like *Hemistomia* in form, but differs in the rounder whorls and free mouth. It is apparently an endemic group which may be called *Fluvidona.*]

Family SUBULINIDAE.

An alien member, *Subulina octona* Bruguière, is common along the coast, but there are endemic members of this family living in Australia, but the occurrence in Central Australia contributes a puzzling factor to add to the number of *Larapintine* mollusca, suggesting in this case northern origin.

Genus EREMOPEAS Pilsbry, 1906.

1906. *Eremopeas* Pilsbry, Man. Conch. (Tryon), Ser. ii., Vol. xviii., (pt. 70), p. 115, April 10. Orthotype, *Stenogyra interioris* Tate.

EREMOPEAS INTERIORIS Tate, 1894.

1894. *Stenogyra interioris* Tate, Trans. Roy. Soc. South Austr., Vol. xviii., p. 191, November. Central Australia. Figd. Tate, Rep. Horn Sci. Exped. Centr. Austr., pt. ii., Zool., p. 203, pl. xviii., fig. 14, February, 1896.
Central Australia.

EREMOPEAS TUCKERI Pfeiffer, 1846.

1846. *Bulimus tuckeri* Pfeiffer, Proc. Zool. Soc. (Lond.), 1846, p. 30, May. Sir Charles Hardy's Islands, Pacific Ocean = North Queensland.
1864. *Bulimus walli* Cox, Cat. Austr. Land Shells, p. 24. Kalka, Rockhampton, Queensland (W. S. Wall, jr.). Figd. Cox, Mon. Austr. Land Shells, p. 69, pl. xiii., fig. 9, May, 1868.
Queensland.

Family COELOCIONTIDAE.

This family seems necessary for this quaint form only known from mid-Queensland, and referred by Pilsbry to the family Megaspiridae of Brazil!!

Genus COELOCION Pilsbry, 1904.

1904. *Coelocion* Pilsbry, Man. Conch. (Tryon), Ser. ii., Vol. xvi., p. 190, January 8. Haplotype, *Balea australis* Forbes.

COELOCION AUSTRALIS Forbes, 1851.

1851. *Balea australis* Forbes, Narr. Voy. Rattlesnake (Macgillivray), Vol. ii.,

p. 380, pl. ii., figs. 9 a-b, "1852" = mid-December, 1851. Port Molle, Queensland.

1868. *Coeliaxis exigua* H. Adams & Angas, Proc. Zool. Soc. (Lond.), 1867, p. 907, pl. xliii., figs. 16-17, April 3, 1868. "Solomon Archipelago", error = Port Molle, Queensland.
Mid-Queensland.

Family Succineidae.

The species of this family are conchologically so alike that it is difficult to determine them. Yet anatomically they apparently show valid differences, so that Quick (Proc. Mal. Soc. (Lond.), Vol. xx., pp. 295-318, November 15, 1933) has separated the few British species.

The Australian specimens dissected by him proved unlike the typical *Succinea,* but nearer a form which is conchologically dissimilar. There may be three or four different groups represented in the Australian fauna, so that it will be necessary to examine them anatomically before they can be correctly arranged.

Genus Austrosuccinea *nov.*

Type, *Succinea australis* Ferussac.

According to Quick, Victorian specimens resemble *arenaria* in jaw, radula and genitalia, and of *arenaria* he wrote "differs so widely from the other British species that it will not fit into either of their sections, and from its jaw it cannot be placed in *Oxyloma,* so another sectional name is required for this type". The Australian type differs entirely conchologically from *arenaria,* being more like *elegans,* as figured by Quick.

Austrosuccinea australis Ferussac, 1821.

1821. *Helix austalis* (sic) Ferussac, Tabl. Syst. Limaçons, pt. ii., p. 31, January; 2nd print, p. 27, "June" = May 12; pl. xi., fig. 11, published in 1819, probably with name. Kangaroo Island and Isles St. Pierre and St. François.

1855. *Succinea strigata* Pfeiffer, Proc. Zool. Soc. (Lond.), 1854, p. 297, May 8, 1855. "Port Clarence, Behring's Straits", error = "general in South Australia", Cf. Proc. Zool. Soc. (Lond.), 1863, p. 522, 1864. Figd. Cox, Mon. Austr. Land Shells, p. 88, pl. xv., fig. 1, May, 1868.

1864. *Succinea rhodostoma* Cox, Cat. Austr. Land Shells, p. 27. Point Lowly, South Australia.
South Australia. Victoria.

Austrosuccinea legrandi Legrand, 1871.

1871. *Succinea legrandi* Legrand, Coll. Mon. Tasm. Shells, 2nd ed., *Succinea,* sp. 2, ex Cox MS., dated August, 1871, September. Kangaroo Point, Tasmania (Masters, Petterd, W. L.).

1879. *Succinea australis* var. *queenboroughensis* Petterd, Mon. Land Shells Tasm., p. 49, April. Queenborough, Tasmania (C. E. Beddome).
Tasmania.

Austrosuccinea scalarina Pfeiffer, 1861.

1861. *Succinea scalarina* Pfeiffer, Proc. Zool. Soc. (Lond.), 1861, p. 28, May 1. King George's Sound, South West Australia. Figd. Cox, Mon. Austr. Land Shells, p. 89, pl. xx., fig. 19, May, 1868, from painting of type of Angas. Refigd. Smith, Proc. Mal. Soc. (Lond.), Vol. i., p. 97, pl. vii., fig. 24, June.
South West Australia.

AUSTROSUCCINEA MENKEANA Pfeiffer, 1850.

1850. *Succinea menkeana* Pfeiffer, Zeitsch. für Malak., 6th Year, 1849, No. 7, p. 110, January, 1850 (Sherborn). New Holland (L. Preiss) = Hay district, South West Australia. Figd. Pfeiffer, Syst. Conch. Cab. (Mart. & Chemn.), Bd. 1, Abth xi., p. 45, pl. 4, figs. 36, 37, 38, 1854.
South West Australia.

AUSTROSUCCINEA STRIGILLATA A. Adams & Angas, 1864.

1864. *Succinea strigillata* A. Adams & Angas, Proc. Zool. Soc. (Lond.), p. 38, June 24. Shark's Bay, West Australia. Figd. Cox, Mon. Austr. Land Shells, p. 89, pl. xv., fig. 5, May, 1868.
Mid-West Australia.

AUSTROSUCCINEA TAMARENSIS Petterd, 1879.

1879. *Succinea australis* var. *tamarensis* Petterd, Mon. Land Shells Tasm., p. 49, April. Tamar River, Launceston, North Tasmania. Figd. Petterd & Hedley, Rec. Austr. Mus., Vol. vii., p. 284, pl. lxxxii., fig. 1, 1909.
North Tasmania.

AUSTROSUCCINEA COXI Finlay, 1927.

1927. *Succinea coxi* Finlay, Trans. New Zeal. Inst., Vol. 57, p. 521, January 19. New name for
1868. *Succinea aperta* Cox, Mon. Austr. Land Shells, p. 90, pl. xvii., fig. 6, May. King George's Sound, West Australia (Masters). Not *S. aperta* Lea, Trans. Amer. Phil. Soc., n.s., Vol. vi., p. 101, 1838.
South West Australia.

AUSTROSUCCINEA INTERIORIS Tate, 1894.

1894. *Succinea interioris* Tate, Trans. Roy. Soc. South Austr., Vol. xviii., p. 191, November. Central Australia. Figd. Tate, Rep. Horn Sci. Exped. Centr. Austr., pt. ii., Zool., p. 207, pl. xix., fig. 21, February, 1896. Palm Creek, Central Australia.
Central Australia.

AUSTROSUCCINEA NORTONI Cox, 1864.

1864. *Succinea nortoni* Cox, Cat. Austr. Land Shells, p. 27. Norton's Basin, Nepean River, New South Wales. Figd. Cox, Mon. Austr. Land Shells, p. 90, pl. xv., fig. 4, May, 1868.
New South Wales.

AUSTROSUCCINEA MACGILLIVRAYI Cox, 1864.

1864. *Succinea macgillivrayi* Cox, Cat. Austr. Land Shells, p. 27. Mount Henry, Mulgoa, New South Wales. Figd. Cox, Mon. Austr. Land Shells, p. 90, pl. xv., fig. 6, May, 1868.
New South Wales.

Genus ARBORCINEA *nov.*
Type, *Succinea eucalypti* Cox.

This curious little group deserves distinction as the shells are small, with spire short, body whorl swollen, and have a strange habit of clustering under bark with their shells sealed by an epiphragm. They appear to be strictly arboreal, while the *Austrosuccinea* group is terrestrial, another factor of importance, which should be accompanied by anatomical differentiation.

ARBORCINEA EUCALYPTI Cox, 1864.

1864. *Succinea eucalypti* Cox, Cat. Austr. Land Shells, pp. 38-27. County of Cumberland, New South Wales. Figd. Cox, Mon. Austr. Land Shells p. 90, pl. xv., figs. 3 a-b, May, 1868.
New South Wales. South Queensland.

ARBORCINEA ARBOREA Angas, 1864.

1864. *Succinea arborea* Angas, Proc. Zool. Soc. (Lond.), 1863, p. 523, April 20, 1864, ex A. Adams & Angas MS. Burnside Hills, near Adelaide, South Australia. Figd. Cox, Mon. Austr. Land Shells, p. 89, pl. xx., fig. 20, May, 1868, from a painting of the type by Angas.
South Australia.

ARBORCINEA BREVISSIMA Thiele, 1930.

1930. *Succinea brevissima* Thiele, Die Fauna Südwest Australiens, Bd. 5, lief. 8, p. 587, pl. iv., fig. 66. Collie, South West Australia.
South West Australia.

Family BOTHRIEMBRYONTIDAE.

This family is one of the most extraordinary features of the otherwise very peculiar Australian Land Molluscan fauna as practically restricted to the south-west corner of the Continent a great variety of forms has developed. These will be fully dealt with in another place, so that the recorded knowledge only is here proffered. It must be emphasised, as this association may be revised, as extralimital workers, such as Pilsbry and Kobelt gave names to material with imperfect data, and it has not been easy to correct the mistakes. Thus Pilsbry's material from Cox was labelled King George's Sound because Cox had determined the shells as a species known from that locality, and not because the shells had been collected at that locality. Kobelt simply recorded Australia or New Holland, and such a locality is valueless and the names might rightly be discarded. Still more recently Thiele has recorded Central Australian species from Perth, an absurd association.

Genus BOTHRIEMBRYON Pilsbry, 1894.

1894. *Bothriembryon* Pilsbry, Nautilus, Vol. viii., p. 36, July (new name for West Australian *Liparus*). Orthotype, *Bulimus melo* Quoy & Gaimard.
1861. *Liparus* Martens, Die Heliceen (Albers), 2nd ed., p. 229. Orthotype, *Bulimus inflatus* Lamarck. Not *Liparus* Albers, Die Heliceen, 1st ed., p. 172, 1850.
1933. *Hartogembryon* Iredale, Rec. Austr. Mus., Vol. xix., p. 41, August 2. Orthotype, *Bulimus onslowi* Cox.
1933. *Larapintembryon* Iredale, Rec. Austr. Mus., Vol. xix., p. 41, August 2. Orthotype, *Liparus spenceri* Tate.
1933. *Satagembryon* Iredale, Rec. Austr. Mus., Vol. xix., p. 41, August 2. Orthotype, *Buliminus gratwicki* Cox.

BOTHRIEMBRYON MELO Quoy & Gaimard, 1832.

1832. *Helix melo* Quoy & Gaimard, Voy. Astrol., Zool., Vol. ii., p. 109, pl. 9, figs. 4-7. Bald Head, King George's Sound, West Australia.
1832. *Helix melones* id., ib., in synonymy, ex Ferussac, Tabl. Syst. Limaçons, Prodr., p. 58, January; p. 54, June, 1821 (*Helix* (*Cochlogena*) *melones*, nom. nud.).
1838. *Bulimus ovum* Deshayes, Regne Animal (Cuvier), Disciples ed., pl. 23, fig. 1, ex Quoy MS. Alternative name for *melo* Quoy & Gaimard.

1843. *Bulimus physodes* Menke, Moll. Nov. Holl. Spec., p. 7, April. Hay, West Australia.
1901. *Bothriembryon physalis* Kobelt, Syst. Conch. Cab. (Mart. & Chemn.), ed. Kuster, Bd. 1, Abth. 13 (2), p. 778 (dated July 28), error pro *physodes* Menke.
South West Australia (King George's Sound).

BOTHRIEMBRYON RHODOSTOMUS Gray, 1834.

1834. *Bulimus rhodostomus* Gray, Proc. Zool. Soc. (Lond.), 1834, p. 67, November 25. New Holland.
1900. *Bothriembryon inflatus* var. *castaneus* Pilsbry, Man. Conch. (Tryon), Ser. ii., Vol. xiii., p. 5, pl. i., figs. 11, 18, April 23, ex Deshayes MS.; does not occur, Lamarck, Vol. vii., p. 245. King George Sound, West Australia.
1900. *Bothriembryon inflatus* var. *maculiferus* Pilsbry, Man. Conch. (Tryon), Ser. ii., Vol. xiii., p. 5, pl. i., figs. 12-14, April 23. King George's Sound, West Australia.
1901. *Bothriembryon martensi* Kobelt, Syst. Conch. Cab. (Mart. & Chemn.), ed. Kuster, Bd. 1, Abth. 13 (2), p. 764, pl. 112, figs. 3-4 (dated June 19). New Holland.
South West Australia (Islands of Recherche Archipelago).

BOTHRIEMBRYON BULLA Menke, 1843.

1843. *Bulimus bulla* Menke, Moll. Nov. Holl. Spec., p. 7, April. Darling Range, West Australia.
1854. *Bulimus baconi* Benson, Ann. Mag. Nat. Hist., Ser. ii., Vol. xiii., p. 99, February 1. Darling Range, West Australia. Figd. Cox, Mon. Austr. Land Shells, p. 73, pl. xix., fig. 13, May, 1868, from a painting of the type by Angas. Refigd. Smith, Proc. Mal. Soc. (Lond.), Vol. i., p. 95, pl. vii., fig. 32, 1894 (type).
1900. *Bothriembryon inflatus* var. *conispira* Pilsbry, Man. Conch. (Tryon), Ser. ii., Vol. xiii., p. 5, pl. i., figs. 15-17, April 23. "King George's Sound, W.A.", error = Perth.
1902. *Bothriembryon durus* Kobelt, Syst. Conch. Cab. (Mart. & Chemn.), ed. Kuster, Bd. 1, Abth. 13 (2), p. 930, pl. 131, figs. 1-2 (dated April 8). Australia.
Western Australia (Perth district).

BOTHRIEMBRYON INDUTUS Menke, 1843.

1843. *Bulimus indutus* Menke, Moll. Nov. Holl. Spec., p. 6, April. Darling Ranges, West Australia.
1877. *Bulimus ponsonbii* Angas, Proc. Zool. Soc. (Lond.), 1877, p. 170, pl. xxvi., fig. 1, August 1. Western Australia (J. Gould).
Western Australia (Darling Ranges).

BOTHRIEMBRYON COSTULATUS Lamarck, 1822.

1822. *Helix costulata* Lamarck, Hist. Anim. s. Vert., Vol. vi., pt. ii., p. 122, April, as synonym, ex "Daudeb., No. 405" (*Helix* (*Cochlogena*) *costulata* Ferussac, Tabl. Syst., Limaçons, pt. ii., p. 58, January; p. 54, June, 1821, *nom. nud.* Shark's Bay (West Austr.).
1822. *Bulimus inflatus* Lamarck, Hist. Anim. s. Vert., Vol. vii., pt. ii., p. 122, April. Nouvelle Hollande = Shark's Bay, Mid-West Australia. Figd. Recueil Coq. Lamarck, pl. 28, fig. 1, 1841. Not *Bulimus inflatus* Olivier, Voy. Othoman., Vol. ii., p. 356, 1801.

1864. *Bulimus onslowi* Cox, Cat. Austr. Land Shells, p. 24. Dirk Hartog Is., West Australia (Onslow). Figd. Cox, Mon. Austr. Land Shells, p. 74, pl. xiii., fig. 13, May, 1868.

Mid-West Australia (Shark's Bay).

BOTHRIEMBRYON MINOR Pilsbry, 1900.

1900. *Bothriembryon onslowi* var. *minor* Pilsbry, Man. Conch. (Tryon), Ser. ii., Vol. xiii., p. 12, pl. iii., figs. 45, 46, 47, April 23, for

1894. *Bulimus (Liparus) onslowi* Smith, Proc. Mal. Soc. (Lond.), Vol. i., p. 95, pl. vii., fig. 29, June. Dirk Hartog Is. (J. J. Walker).

1901. *Bothriembryon melo* var. *hartogensis* Kobelt, Syst. Conch. Cab. (Mart. & Chemn.), ed. Kuster, Bd. 1, Abth. 13, p. 770, pl. 112, fig. 15 (dated June 19). Dirk Hartog's Is., West Australia.

Mid-West Australia (Dirk Hartog's Island).

BOTHRIEMBRYON DUX Pfeiffer, 1861.

1861. *Bulimus dux* Pfeiffer, Proc. Zool. Soc. (Lond.), 1861, p. 24, May 1. King George's Sound, South West Australia. Figd. Cox, Mon. Austr. Land Shells, p. 71, pl. xiii., fig. 4, pl. xviii., fig. 16, May, 1868.
South West Australia.

BOTHRIEMBRYON BARRETTI Iredale, 1930.

1930. *Bothriembryon barretti* Iredale, Vict. Naturalist, Vol. xlvii., pp. 119-120, fig. in text, November. Nullarbor Plain, South Australia (C. Barrett).

1879. *Bulimus indutus* var. *pallidus* Tate, Trans. Proc. Roy. Soc. Adelaide, South Austr., 1878-79, p. 134. Bunda Plateau, Nullarbor Plain, South Australia. Not *Bulimus pallidus* C. B. Adams, Proc. Bost. Soc. N.H., Vol. ii., p. 12, 1845.
South and West Australia (Nullarbor Plain).

BOTHRIEMBRYON FUSCUS Thiele, 1930.

1930. *Bothriembryon fuscus* Thiele, Die Fauna Südwest Australiens, Bd. v., lief. 8, p. 588, pl. iv., fig. 68. Torbay, South West Australia.
South West Australia (Torbay district).

BOTHRIEMBRYON KINGII Gray, 1825.

1825. *Bulimus kingii* Gray, Annals Philos. (Thomson), Vol. xxv. (Ser ii., Vol. ix.), p. 414, June. New Holland (Capt. King) = Bald Head, King George's Sound.

1826. *Helix bulimus* King, Narr. Survey Coast Australia, Vol. i., p. 12, "1827" = April 15, 1826. Near Bald Head, King George's Sound, South West Australia.

1828. *Helix kingii* Wood, Suppl. Index Test., p. 22, pl. vii., *Helix*, fig. 27. New Holland. Brit. Mus., type figured.

1832. *Helix trilineata* Quoy & Gaimard, Voy. Astrol. Zool., Vol. ii., p. 107, pl. ix., figs. 1-3. Bald Head, King George's Sound, South West Australia.

1848. *Bulimus trilineatus* Reeve, Conch. Icon., Vol. v., pl. xlviii., sp. & fig. 310, November, as of Q. & G. New Holland.

1849. *Bulimus trilineatus* Reeve, Conch. Icon., Vol. v., pl. lix., sp. & fig. 397, January, as of Q. & G. Port George, New Holland.

1864. (*Bulimus*) *quoyi* Cox, Cat. Austr. Land Shells, p. 23, new name for Reeve's fig. 397, not Reeve's fig. 310.

1900. *Bothriembryon physoides* var. *humilis* Pilsbry, Man. Conch. (Tryon), Ser. ii., Vol. xiii., p. 10, pl. ii., figs. 33-34, April 23. King George's Sound, West Australia.
South West Australia (King George's Sound).

BOTHRIEMBRYON SAYI Pfeiffer, 1847.

1847. *Bulimus sayi* Pfeiffer, Proc. Zool. Soc. (Lond.), 1846, p. 114, January 26, 1847. Locality unknown = Cape Freycinet, West Australia. Figd. Reeve, Conch. Icon., Vol. v., pl. lxv., sp. 458, May, 1849.

1900. *Bothriembryon kingii* var. *solidus* Pilsbry, Man. Conch. (Tryon), Ser. ii., Vol. xiii., p. 9, pl. ii., fig. 28, April 23. West Australia = Margaret River.
Western Australia (Cape Freycinet district).

BOTHRIEMBRYON NATURALISTARUM Kobelt, 1901.

1901. *Bothriembryon kingii* var. *naturalistarum* Kobelt, Syst. Conch. Cab. (Mart. & Chemn.), ed. Kuster, Bd. i., Abth. 13, p. 781, pl. 113, figs. 22-23 (dated July 28). Cape Naturaliste, West Australia.
Western Australia (Cape Naturaliste district).

BOTHRIEMBRYON LEEUWINENSIS Smith, 1894.

1894. *Bulimus* (*Liparus*) *leeuwinensis* Smith, Proc. Mal. Soc. (Lond.), Vol. i., p. 94, pl. vii., fig. 27, June. Cape Leeuwin, South West Australia.
Western Australia (Cape Leeuwin district).

BOTHRIEMBRYON MAXWELLI Kobelt, 1901.

1901. *Bothriembryon maxwelli* Kobelt, Syst. Conch. Cab. (Mart. & Chemn.), ed. Kuster, Bd. i., Abth. 13, p. 781, pl. 112, fig. 17 (dated June 19), ex Brazier MS. West Australia.
South West Australia.

BOTHRIEMBRYON BRAZIERI Angas, 1871.

1871. *Bulimus* (*Liparus*) *brazieri* Angas, Proc. Zool. Soc. (Lond.), 1871, p. 19, pl. i., fig. 28, June 12. Sinclair's (error for Stirling), Range, King George's Sound, W.A.
Western Australia (Stirling Ranges).

BOTHRIEMBRYON GRATWICKI Cox, 1899.

1899. *Buliminus gratwicki* Cox, Proc. Linn. Soc. N.S.W., Vol. xxiv., p. 435, fig. in text, December 9. East of Israelite Bay, South West Australia.
South West Australia (Israelite Bay district).

BOTHRIEMBRYON SPENCERI Tate, 1894.

1894. *Liparus spenceri* Tate, Trans. Roy. Soc. South Austr., Vol. xviii., p. 192, November. Central Australia. Figd. Tate, Rep. Horn. Sci. Exped. Centr. Aust., pt. ii., Zool., p. 202, pl. xviii., fig. 13, February, 1896. Palm Creek.
Central Australia.

BOTHRIEMBRYON ANGASIANUS Pfeiffer, 1864.

1864. *Bulimus angasianus* Pfeiffer, Proc. Zool. Soc. (Lond.), 1863, p. 528, April 20, 1864, ex Angas *loc. cit.*, at p. 522, n.n. Port Lincoln, South

Australia. Figd. Cox, Mon. Austr. Land Shells, p. 70, pl. xiii., fig. 2, May, 1868.

South Australia (Eyre Peninsula).

BOTHRIEMBRYON MASTERSI Cox, 1867.

1867. *Bulimus mastersi* Cox, Proc. Zool. Soc. (Lond.), 1867, p. 39,, May 25. Port Lincoln, South Australia (Masters). Figd. Cox, Mon. Austr. Land Shells, p. 77, pl. xiii., fig. 14, May, 1868.

South Australia (Eyre Peninsula).

Genus TASMANEMBRYON Iredale, 1933.

1933. *Tasmanembryon* Iredale, Rec. Austr. Mus., Vol. xix., p. 41, August 2. Orthotype, *Bulimus tasmanicus* Pfeiffer.

TASMANEMBRYON TASMANICUS Pfeiffer, 1853.

1853. *Bulimus tasmanicus* Pfeiffer, Proc. Zool. Soc. (Lond.), 1851, p. 260, December 7, 1853. Van Diemen's Land.

1900. *Bothriembryon gunni* var. *brachysoma* Pilsbry, Man. Conch. (Tryon), Ser. ii., Vol. xiii., p. 18, pl. iii., fig. 53, April 23. Tasmania. Tasmania.

Note.—*Bulinus gunnii* Sowerby (Phys. Descr. New South Wales (Strzelecki), p. 298, pl. xix., fig. 5 (6), 1845) was given to a fossil from Tasmania, based on a cast only from the yellow limestone of Hobart Town and is of uncertain status.

Family LAOMIDAE.

Thiele has allowed a "Stirps Zonitacea", and in it a Family, Endodontidae, with eight subfamilies, Laominae, Rotadiscinae, Helicodiscinae, Stenopylinae, Endodontinae, Amphidoxinae, Megomphicinae and Discinae. As usual the taxonomy is at fault, as both *Discus* and *Laoma* are earlier in date than *Endodonta*. The family Discidae will not enter into this discussion, being restricted to the Northern Hemisphere, while the Laomidae is apparently a very distinct group entitled to separate rank. None of our shells are at all like the typical *Endodonta,* and the family name Charopidae is here preferred for the Australian forms, the type of *Charopa* being a conchologically similar Neozelanic shell. *Amphidoxa* is a South American form, and it has been conclusively shown that our species are anatomically dissimilar from similar South American shells. Consequently the family Flammulinidae is here utilised, the type of *Flammulina* again being a Neozelanic land shell. The groupings here given are provisional, as these small shells need very intensive study before any stable classification can be prepared.

Genus PARALAOMA Iredale, 1913.

1913. *Paralaoma* Iredale, Proc. Mal. Soc. (Lond.), Vol. x., p. 380, September. Haplotype, *Paralaoma raoulensis* Iredale.

PARALAOMA MORTI Cox, 1864.

1864. *Helix morti* Cox, Cat. Austr. Land Shells, p. 22. Darling Point, Sydney, New South Wales. Figd. Cox, Mon. Austr. Land Shells, p. 21, pl. xi., fig. 13, May, 1868.

1864. *Helix paradoxa* Cox, Cat. Austr. Land Shells, p. 21. Stroud Road,

Campbelltown, N.S.W. (King). Not *Helix paradoxa* Pfeiffer, Abbild. Conch., i., p. 153, 1844.
Mid New South Wales. Victoria.

PARALAOMA HOBARTI Cox, 1868.

1868. *Helix hobarti* Cox, Mon. Austr. Land Shells, p. 22 (not pl. xii., fig. 11), May. Hobart Town, Tasmania (Masters).
1868. *Helix similis* Cox, Mon. Austr. Land Shells, p. 23, pl. xii., fig. 12, May. Mount Wellington, Tasmania. Not *H. similis* Thomae, Jahrb. Var. Nat. Nassau, Vol. ii., p. 143, 1845.
1871. *Helix* (*Patula*) *stellata* Brazier, Proc. Zool. Soc. (Lond.), 1870, p. 662, April, 1871.
1871. *Helix* (*Discus*) *derelicta* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., sp. 11, ex Cox MS., June. Both new names for *similis* Cox.
South Tasmania.

PARALAOMA HALLI Legrand, 1871.

1871. *Helix* (*Rhyssota*) *halli* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., sp. 34, p. 7, pl. ii., fig. 9, June, ex Cox MS. Brown's River, Tasmania.
South Tasmania. Victoria.

PARALAOMA MUCOIDES Tenison-Woods, 1878.

1878. *Helix mucoides* Tenison-Woods, Proc. Linn. Soc. N.S.W., Vol. ii., p. 125, pl. xii., figs. 5-5a, December. Victoria.
Victoria.

PARALAOMA ARENICOLA Tate, 1878.

1878. *Helix arenicola* Tate, Proc. Linn. Soc. N.S.W., Vol. ii., p. 291, June. Holdfast Bay, Yorke's Peninsula, South Australia.
South Australia.

PARALAOMA RETINODES Tate, 1894.

1894. *Charopa retinodes* Tate, Trans. Roy. Soc. South Austr., Vol. xviii., p. 192, November. Central Australia. Figd. Tate, Rep. Horn. Sci. Exped. Cent. Austr., pt. ii., Zool., p. 187, pl. xvii., fig. 2, February, 1896. Reedy Creek, George Gill's Ridge.
Central Australia.

PARALAOMA SITIENS Legrand, 1871.

1871. *Helix* (*Discus*) *sitiens* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., sp. 60, June, ex Cox MS., new name for *H. hobarti* Cox, Mon. Austr. Land Shells, pl. xii., fig. 11, May, 1868. Hobart, Tasmania.
South Tasmania.

PARALAOMA TASMANIAE Cox, 1868.

1868. *Helix tasmaniae* Cox, Mon. Austr. Land Shells, p. 22, pl. xii., fig. 4, May. Mount Wellington, Tasmania (Masters).
South Tasmania.

PARALAOMA MURPHYI Cox, 1864.

1864. *Helix murphyi* Cox, Cat. Austr. Land Shells, p. 37. Wollongong, New South Wales (Masters).
South New South Wales.

PARALAOMA DISCORS Petterd, 1902.

1902. *Helix discors* Petterd, Proc. Roy. Soc. Tasm., 1900-01, p. 2, June, 1902. Maria Is., South Tasmania.
South Tasmania (Maria Is.).

Genus EXCELLAOMA *nov.*

Type, *Helix retipora* Cox.

Large Paralaomid shells with very narrow umbilicus, almost imperforate, columella reflected, protoconch obsoletely spirally striate, adult regularly striate.

EXCELLAOMA RETIPORA Cox, 1867.

1867. *Helix retipora* Cox, Proc. Zool. Soc. (Lond.), 1867, p. 39, May 25. Flinder's Range, South Australia (Masters). Figd. Cox, Mon. Austr. Land Shells, p. 21, pl. vii., figs. 8-8a, May, 1868.
South Australia.

EXCELLAOMA MELBOURNENSIS Cox, 1868.

1868. *Helix melbournensis* Cox, Mon. Austr. Land Shells, p. 22, pl. xii., fig. 10, May. Melbourne, Victoria (Masters).
Victoria.

EXCELLAOMA PULLEINEI Tate, 1899.

1899. *Flammulina pulleinei* Tate, Trans. Roy. Soc. South Austr., Vol. xxiii., p. 247, pl. vi., figs. 1a-c. Carrieton, South Australia (R. H. Pulleine).
South Australia.

Genus LAOMAVIX Iredale, 1933.

1933. *Laomavix* Iredale, Rec. Austr. Mus., Vol. xix., p. 53, August 2. Orthotype, *Helix minima* Cox.

LAOMAVIX COLLISI Brazier, 1877.

1877. *Helix* (*Pitys*) *collisi* Brazier, Papers Proc. Roy. Soc. Tasm., 1876, p. 168, February 27, new name for
1868. *Helix minima* Cox, Mon. Austr. Land Shells, p. 10, pl. xii., fig. 8, May. Mount Wellington, Tasmania (Masters in A.M.). Not *Helix minima* Schlotheim, Min. Tasch., p. 340, 1818.
1879. *Helix henryana* Petterd, Mon. Land Shells Tasm., p. 21, April. Domain, Hobart Town, Tasmania.
South Tasmania.

LAOMAVIX FURNEAUXENSIS Petterd, 1879.

1879. *Helix furneauxensis* Petterd, Mon. Land Shells Tasm., p. 21, April. Furneaux Group, Bass Straits.
Bass Straits (Furneaux Group). Victoria.

Genus MISELAOMA Iredale, 1933.

1933. *Miselaoma* Iredale, Rec. Austr. Mus., Vol. xix., p. 53, August 2. Orthotype, *Helix weldii* Tenison-Woods.

MISELAOMA WELDII Tenison-Woods, 1877.

1877. *Helix weldii* Tenison-Woods, Papers Proc. Roy. Soc. Tasm., 1876, p. 33, February 27. Stanley, Circular Head, Tasmania. Figd. Petterd & Hedley, Rec. Austr. Mus., Vol. vii., p. 293, pl. 83, figs. 8-10, 1909.
Tasmania.

MISELAOMA SINISTRA Gabriel, 1930.

1930. *Laoma sinistra* Gabriel, Proc. Roy. Soc. Victoria, Vol. xliii. (n.s.), pt. i., p. 81, pl. ii., fig. 8, September 11. Tarraville, Victoria.
Victoria.

Genus PASMADITTA Iredale, 1933.

1933. *Pasmaditta* Iredale, Rec. Austr. Mus., Vol. xix., p. 53, August 2. Orthotype, *Helix jungermanniae* Petterd.

PASMADITTA JUNGERMANNIAE Petterd, 1879.

1879. *Helix jungermanniae* Petterd, Mon. Land Shells Tasm., p. 17, April. Cataract, near Launceston, Tasmania. Figd. Petterd & Hedley, Rec. Austr. Mus., Vol. vii., p. 296, pl. lxxxv., figs. 26-28, 1909.
North Tasmania.

Genus PLANILAOMA *nov.*

Type, *Helix luckmanii* Brazier.

Flattened Laomid shells, broader than high, umbilicus deep and narrow, mouth wide for this series, protoconch smooth, sculpture of adult whorls fine striation.

PLANILAOMA LUCKMANII Brazier, 1877.

1877. *Helix* (*Pitys*) *luckmanii* Brazier, Papers Proc. Roy. Soc. Tasm., 1876, p. 168, February 27, 1877, new name for
1871. *Helix* (*Charopa*) *neglecta* Brazier, Proc. Zool. Soc. (Lond.), 1870, p. 660, April 1, 1871. Hobart Town, Tasmania. Not *H. neglecta* Draparnaud, H. N. Moll. France, p. 108, 1805. Figd. Petterd & Hedley, Rec. Austr. Mus., Vol. viii., p. 296, pl. 82, figs. 5-7, 1909.
South Tasmania.

Genus TROCHOLAOMA *nov.*

Type, *Helix spiceri* Petterd.

Conical many whorled Laomid shells, periphery rounded, sculpture very fine striation, mouth small, umbilicus deep and narrow.

TROCHOLAOMA SPICERI Petterd, 1879.

1879. *Helix spiceri* Petterd, Mon. Land Shells Tasm., p. 23, April. New Norfolk, Tasmania. Figd. Petterd & Hedley, Rec. Austr. Mus., Vol. vii., p. 295, p. 87, figs. 47-50, 1909.
Tasmania.

TROCHOLAOMA TRUCANINI Petterd, 1879.

1879. *Helix trucanini* Petterd, Mon. Land Shells Tasm., p. 19, April. Launceston, Tasmania.
1894. (*Laoma*) *pipaensis* Suter, Ann. Mag. Nat. Hist., Ser. vi., Vol. xiii., p. 64, January, *nom. nud.*
1909. *Laoma pipaensis* Petterd & Hedley, Rec. Austr. Mus., Vol. vii., p. 295, as synonym of *trucanini*. Figd. Petterd & Hedley, Rec. Austr. Mus., Vol. vii., p. 295, pl. 87, figs. 44-46, August 30, 1909.
North Tasmania.

TROCHOLAOMA PARVISSIMA Legrand, 1871.

1871. *Helix* (*Conulus*) *parvissima* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., sp. 39, p. 6, pl. ii., fig. 1, June, ex Cox MS. Brown's River, Tasmania.
Tasmania. Victoria.

TROCHOLAOMA NINGUICOLA *sp. nov.*

Recalling the preceding but larger and comparatively less elevated, the umbilicus, however, narrower, and the sculpture more pronounced; recorded under the preceding name but easily differentiated. Kosciusko, New South Wales.

Southern New South Wales.

Genus MAGILAOMA *nov.*

Type, *M. parpictilis sp. nov.*

MAGILAOMA PARPICTILIS *sp. nov.*

Similar to *Helix penolensis* Cox, from South Australia, but with coarser sculpture, the fine sculpture being subordinate and the base coarsely sculptured, the keel stronger, the umbilicus narrower, the shell altogether larger and comparatively broader. Circular Head, North West Tasmania. Figd. as *Laoma pictilis* by Petterd & Hedley, Rec. Austr. Mus., Vol. vii., p. 294, pl. 86, figs. 35-37, August 30, 1909, and as *L. penolensis* by May, Illustr. Index Tasm. Shells, pl. xliii., fig. 5, 1923.

North West Tasmania.

MAGILAOMA PENOLENSIS COX, 1868.

1868. *Helix penolensis* Cox, Proc. Zool. Soc. (Lond.), 1867, p. 724, April 3, 1868. Penola, South Australia (Woods). Figd. Cox, Mon. Austr. Land Shells, p. 8, pl. xi., fig. 12, May, 1868.

1878. *Helix pictilis* Tate, Proc. Linn. Soc. N.S.W., Vol. ii., p. 290, June. Cape Northumberland Cliffs, South Australia.

South Australia. Victoria.

Genus TURBOLAOMA *nov.*

Type, *Laoma turbinuloidea* Gabriel.

This species differs in its few very rounded whorls with deep sutures, very fine sculpture, thin shell, rather rounded mouth, deep narrow umbilicus, columella reflected, and may not even be related to the Laomid shells proper.

TURBOLAOMA TURBINULOIDEA Gabriel, 1930.

1930. *Laoma turbinuloidea* Gabriel, Proc. Roy. Soc. Vict., Vol. xliii. (n.s.), p. 81, pl. ii., fig. 7, September 11. Bairnsdale, Victoria (T. Worcester). Victoria.

Genus PEDICAMISTA Iredale, 1933.

1933. *Pedicamista* Iredale, Rec. Austr. Mus., Vol. xix., p. 53, August 2. Orthotype, *Helix coesus* Cox.

PEDICAMISTA COESA Legrand, 1871.

1871. *Helix* (*Charopa*) *coesus* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., sp. 21, p. 3, pl. i., fig. 4, June, ex Cox MS. Recherche Bay, Tasmania.

1871. *Helix* (*Discus*) *occultus* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., sp. 23, p. 4, pl. i., fig. 6, June, ex Cox MS. Near Southport, Tasmania.

South Tasmania.

Family FLAMMULINIDAE.

This Neozelanic group is well represented in Tasmania and rarely in Eastern Australia. The exact limits of variation are at present unknown in the genera, while the specific differentiation is a matter for further

study. The earlier Tasmanian conchologists separated many species generally from field knowledge, and many of these have been since lumped, probably incorrectly. Here, a middle course has been adopted, a few geographical species being allowed, but probably later many of the rejected forms will be reinstated. In Tasmania there are four districts which apparently show valid differences in these molluscs. The Southern, whence most of the species have been described; the Northern, where a number of local species are easily recognisable from their very different form, but here some are restricted to the North East, others to the North West; the Western, where again the mid-west appears to show somewhat different forms from the south-west; and the Central with its high altitudes which is the least known.

Genus Oreokera Iredale, 1933.

1933. *Oreokera* Iredale, Rec. Austr. Mus., Vol. xix., p. 54, August 2. Orthotype, *Flammulina cumulus* Odhner.

Oreokera cumulus Odhner, 1917.

1917. *Flammulina cumulus* Odhner, Kungl. Svenska. Vetensk. Handl., Bd. 52, No. 16, p. 84, pl. iii., figs. 89-91, September 19. Bellenden Ker Mt. (4,000 ft.), North Queensland.
North Queensland.

Oreokera corticicola Cox, 1866.

1866. *Helix corticicola* Cox, Proc. Zool. Soc. (Lond.), 1866, p. 374, September 5. Lismore, New South Wales (Macgillivray). Figd. Cox, Mon. Austr. Land Shells, p. 19, pl. vii., figs. 7-7a, May, 1868. Refigd. Hedley, Proc. Linn. Soc. N.S.W., Vol. xxxvii., p. 264, pl. viii., figs. 46-48, 1912.
Northern New South Wales. South Queensland.

Genus Thryasona Iredale, 1933.

1933. *Thryasona* Iredale, Rec. Austr. Mus., Vol. xix., p. 54, August 2. Orthotype, *Helix diemenensis* Cox.

Thryasona diemenensis Cox, 1868.

1868. *Helix diemenensis* Cox, Proc. Zool. Soc. (Lond.), 1867, p. 723, April 3, 1868. Tasmania (Legrande) = Mt. Wellington. Figd. Cox, Mon. Austr. Land Shells, p. 20, pl. vii., figs. 6-6a, May, 1868.
1868. *Helix wellingtonensis* Cox, Proc. Zool. Soc. (Lond.), 1867, p. 723, April 3, 1868. Mt. Wellington, Tasmania. Figd. Cox, Mon. Austr. Land Shells, p. 29, pl. vii., figs. 5-5a, May, 1868.
1871. *Helix* (*Discus*) *atkinsoni* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., sp. 62, pl. ii., fig. 12, June. Brown's River, Tasmania (Hall).
1874. *Helix* (*Charopa*) *midsoni* Legrand, Coll. Mon. Tasm. Land Shells, slip in 2nd ed., dated December, 1874; new name for preceding, not *H. atkinsoni* Theobald, Journ. As. Soc. Bengal, 1859.
South Tasmania.

Thryasona daveyensis Legrand, 1871.

1871. *Helix* (*Discus*) *daveyensis* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., sp. 35, p. 8, pl. ii., fig. 4, June, ex Cox MS. Port Davey, Tasmania (W.L.).
South West Australia.

THRYASONA THOMPSONI Legrand, 1871.

1871. *Helix* (*Charopa*) *thompsoni* Legrand, Coll. Mon. Tasm. Land Shells, 2nd ed., sp. 73, September. Cape Barren Is., Bass's Straits (C. Gould).

1871. *Helix* (*Charopa*) *camillae* Legrand, Coll. Mon. Tasm. Land Shells, 2nd ed., sp. 74, September. Islands in Bass's Straits (C. Gould).
Tasmania (Islands in Bass's Straits). Victoria.

THRYASONA ELENESCENS Cox & Hedley, 1912.

1912. *Flammulina elenescens* Cox & Hedley, Mem. Nat. Mus. Melb., No. 4, p. 12, pl. iii., figs. 16-18, February. Merri Creek, Victoria (Tenison-Woods).
Victoria.

THRYASONA MARCHIANAE Legrand, 1871.

1871. *Helix* (*Discus*) *marchianae* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., sp. 25, p. 5, pl. i., fig. 7, June, ex Cox MS. Recherche Bay, Tasmania (W.L.).

1871. *Helix* (*Discus*) *fuscoradiata* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., sp. 61, pl. ii., fig. 2, June, ex Cox MS. Brown's River, Tasmania (Hall).
South Tasmania.

Genus FLAMMULOPS *nov.*

Type, *Flammulina excelsior* Hedley.

A flammulate shell approaching the typical Neozelanic *Flammulina*, subvitriniform, very thin, protoconch of half a whorl, obsoletely spirally lirate, succeeding sculpture, fine radials, mouth very open, imperforate.

FLAMMULOPS EXCELSIOR Hedley, 1896.

1896. *Flammulina excelsior* Hedley, Rec. Austr. Mus., Vol. ii., p. 103, pl. xxiii., figs. 2, 3, 4, January. Mt. Kosciusko, New South Wales, 5,700 feet.
Southern New South Wales. Victoria.

Genus MULATHENA Iredale, 1933.

1933. *Mulathena* Iredale, Rec. Austr. Mus., Vol. xix., p. 53, August 2. Orthotype, *Helix fordei* Brazier.

MULATHENA FORDEI Brazier, 1871.

1871. *Helix* (*Hemiplecta*) *fordei* Brazier, Proc. Zool. Soc. (Lond.), 1870, p. 662, April, 1871. Mt. Wellington, Tasmania.

1871. *Helix* (*Planispira*) *allporti* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., sp. 18, p. 1, pl. i., fig. 2, June. Recherche Bay, Tasmania.

1871. *Helix petterdi* Legrand, id., ib., ex Cox MS. as synonym.

1871. *Helix* (*Camaena*) *medianus* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., sp. 19, p. 1, pl. i., fig. 1, June, ex Cox MS. Recherche Bay, Tasmania.

1871. *Helix* (*Planispira*) *austrinus* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., sp. 22, p. 4, pl. i., fig. 3, June, ex Cox MS. South Cape, Tasmania.

1871. *Helix* (*Charopa*) *helice* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., sp. 20, p. 9, June, ex Cox MS. Southport, Tasmania.

1871. *Helix* (*Paryphanta*) *tabescens* Legrand, Coll. Mon. Tasm. Land Shells,

2nd ed., sp. 77, September, ex Cox MS. Mount Wellington, Tasmania (Petterd).
South Tasmania.

MULATHENA TRANQUILLA Legrand, 1871.

1871. *Helix* (*Microcystis*) *tranquilla* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., sp. 37, p. 6, pl. ii., fig. 3, June, ex Cox MS. Port Davey, Tasmania.
1871. *Helix* (*Rhyssota*) *mixta* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., sp. 38, p. 7, pl. ii., fig. 11, June, ex Cox MS. Port Davey, Tasmania.
1871. *Helix* (*Rhyssota*) *trajectura* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., sp. 36, p. 8, pl. ii., fig. 6, June, ex Cox MS. Port Davey, Tasmania.
South West Tasmania.

MULATHENA MCOYI Petterd, 1879.

1879. *H.* (= *Helix fordei* var.) *mcoyi* Petterd, Mon. Land Shells Tasm., p. 14, April. Dandenong Range, Victoria. Figd. Cox & Hedley, Mem. Nat. Mus. Melb., No. 4, p. 8, pl. ii., figs. 13-18, February, 1912 (type).
1879. *Helix fernshawensis* Petterd, Journ. Conch. (Leeds), Vol. ii., p. 355, December. Fernshaw, Victoria.
Victoria.

Genus STENACAPHA Iredale, 1933.

1933. *Stenacapha* Iredale, Rec. Austr. Mus., Vol. xix., p. 53, August 2. Orthotype, *Helix savesi* Petterd.

STENACAPHA SAVESI Petterd, 1879.

1879. *Helix savesi* Petterd, Mon. Land Shells Tasm., p. 12, April. Table Cape, Tasmania.
North Tasmania (Table Cape district).

STENACAPHA KINGI Brazier, 1871.

1871. *Helix* (*Aerope*) *kingi* Brazier, Proc. Zool. Soc. (Lond.), 1870, p. 662, April 1, 1871. Ringarooma, North Tasmania.
1871. *Helix* (*Videna*) *ducani* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., sp. 56, June, ex Cox MS. Leven, North West Tasmania (C. Gould).
1871. *Helix* (*Charopa*) *spoliata* Legrand, Coll. Mon. Tasm. Land Shells, 2nd ed., sp. 75, September, ex Cox MS. North Coast Tasmania (Petterd).
North Tasmania.

STENACAPHA HAMILTONI Cox, 1868.

1868. *Helix hamiltoni* Cox, Proc. Zool. Soc. (Lond.), 1867, p. 722, April 3, 1868. Mt. Wellington, Tasmania. Figd. Cox, Mon. Austr. Land Shells, p. 32, pl. vii., fig. 2, May, 1868.
1871. *Helix* (*Patula*) *stephensi* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., p. 4, pl. ii., fig. 8, June, ex Cox MS. Mt. Wellington, Tasmania.
1871. *Helix* (*Discus*) *coepta* Legrand, ib., 1st ed., sp. 4, p. 9, pl. ii., fig. 13, June, ex Cox MS. Brown's River, Tasmania (Hall).
1871. *Helix* (*Planispira*) *plexus* Legrand, ib., 1st ed., sp. 28, p. 9, pl. i., fig. 10, June, ex Cox MS. Tasmania.
1871. *Helix* (*Videna*) *pascoei* Legrand, ib., 2nd ed., sp. 65, September, ex Brazier MS. Mt. Wellington, Tasmania.

1871. *Helix* (*Videna*) *milligani* Legrand, ib., 2nd ed., sp. 69, September, ex Brazier MS. Mt. Wellington, Tasmania.
1871. *Helix* (*Videna*) *floodi* Legrand, ib., 2nd ed., sp. 70, September, ex Brazier MS. Mt. Wellington, Tasmania.
1871. *Helix* (*Charopa*) *irvinae* Legrand, ib., 2nd ed., sp. 71, September, ex Cox MS. Piper's River, Tasmania (Mr. Ogilvie).
1871. *Helix* (*Charopa*) *scrupulus* Legrand, ib., 2nd ed., sp. 76, September, ex Cox MS. Mt. Wellington, Tasmania.
South Tasmania.

STENACAPHA LANGLEYANA Brazier, 1875.

1875. *Helix* (*Rhytida*) *langleyana* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 18, April 27. Macquarie Harbour, West Tasmania.
West Tasmania.

STENACAPHA WYNYARDENSIS Petterd, 1879.

1879. *Helix wynyardensis* Petterd, Mon. Land Shells Tasm., p. 8, April. Table Cape, Tasmania.
North Tasmania.

Genus HEDLEYOCONCHA Pilsbry, 1893.

1893. *Hedleyoconcha* Pilsbry, Man. Conch. (Tryon), Ser. ii., Vol. ix., p. 18, November 16. Orthotype, *Helix delta* Pfeiffer.

HEDLEYOCONCHA DELTA Pfeiffer, 1857.

1857. *Helix delta* Pfeiffer, Proc. Zool. Soc. (Lond.), 1856, p. 386, May 8. Drayton Range, North Australia (Stutchbury).
Mid Queensland.

HEDLEYOCONCHA SCANDENS Cox, 1872.

1872. *Helix scandens* Cox, Proc. Zool. Soc. (Lond.), 1871, p. 645, pl. 52, fig. 5, May 2, 1872. Port Macquarie, New South Wales.
1864. *Helix conoidea* Cox, Cat. Austr. Land Shells, p. 21. Cabbage Tree Is., Port Stephens, N.S.W. (R. L. King). Fig. Cox, Mon. Austr. Land Shells, p. 63, pl. iv., fig. 13, May, 1868. Not *Helix conoidea* Draparnaud, Tab. Moll. France, p. 69, 1801.
1866. *Helix fenestrata* Cox, Proc. Zool. Soc. (Lond.), 1866, p. 374, September 5. Pine Mt., Lismore, New South Wales (Macgillivray). Not *Helix fenestrata* Sowerby, Proc. Zool. Soc. (Lond.), 1841, p. 137.
New South Wales.

Genus DELINITESTA Iredale, 1933.

1933. *Delinitesta* Iredale, Rec. Austr. Mus., Vol. xix., p. 54, August 2. Orthotype, *Helix gayndahensis* Brazier.

DELINITESTA GAYNDAHENSIS Brazier, 1875.

1875. *Helix* (*Thalassia*) *gayndahensis* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 2, April 27. Gayndah, Queensland. Figd. Hedley, Proc. Linn. Soc. N.S.W., Vol. xxv., p. 16, pl. ii., figs. 17-19, 1901.
South Queensland.

Note.—The relationships of this extraordinary species are not clear, and the suggestion that it be placed alongside the Flammulinid species is accepted with doubt.

Genus QUERIDOMUS *nov.*
Type, *Helix grenvillei* Brazier.

Imperforate, thin, subglobose, decorated with spiral rows of bristly hairs, problematically related to this family.

QUERIDOMUS GRENVILLEI Brazier, 1876.

1876. *Helix* (*Conulus* ?) *grenvillei* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 104, July. Home Is., off Cape Grenville, N.E. Australia. Figd. Hedley, Proc. Linn. Soc. N.S.W., Vol. xxvii., p. 21, pl. iii., fig. 46, 1902. North Australia (Home Islands).

Family CHAROPIDAE.

Hedley separated some Charopid-looking species as referable to *Flammulina* on account of the fact that the protoconch was spirally lirate, but this feature is not here regarded as of family value. The form, texture and sculpture appear to be the features that easily distinguish the groups, the distinction being confirmed by anatomical characters. Charopids are generally recognisable by their tight coiling in practically the same plane, though some are a little elevated, the mouth is semicircular, narrow, the height more than the breadth, sometimes the aperture bears internal lamellae. No Flammulinid yet known shows any toothing and these have the mouth more open, broader than high, always descending from a few whorled shell. The texture and sculpture are different, the shell being thin and more or less glassy, the sculpture weak, not regular and strong as in the Charopids.

Genus GYROCOCHLEA Hedley, 1924.

1924. *Gyrocochlea* Hedley, Austr. Zool., Vol. iii., p. 215, May 9. Orthotype, *Helix vinitincta* Cox.

GYROCOCHLEA VINITINCTA Cox, 1868.

1868. *Helix vinitincta* Cox, Mon. Austr. Land Shells, p. 18, pl. i., figs. 6-6a, May. Upper Richmond River, New South Wales (Macgillivray). Northern New South Wales.

GYROCOCHLEA CONCINNA Hedley, 1924.

1924. *Gyrocochlea concinna* Hedley, Austr. Zool., Vol. iii., p. 215, pl. xxix., figs. 1-3, May 9. Cardwell scrubs, North Queensland. North Queensland.

GYROCOCHLEA CONFERTA Hedley, 1924.

1924. *Gyrocochlea conferta* Hedley, Austr. Zool., Vol. iii., p. 215, pl. xxix., figs. 4-6, May 9. Port Stephens, New South Wales (Rev. R. L. King). New South Wales.

GYROCOCHLEA CONVOLUTA Hedley, 1924.

1924. *Gyrocochlea convoluta* Hedley, Austr. Zool., Vol. iii., p. 216, pl. xxix., figs. 7-9, May 9. Beaudesert, Queensland (Dr. R. L. Pulleine). South Queensland.

GYROCOCHLEA EURYTHMA Hedley, 1924.

1924. *Gyrocochlea eurythma* Hedley, Austr. Zool., Vol. iii., p. 216, pl. xxix., figs. 10-12, May 9. Northern Rivers, New South Wales (Petterd). Northern New South Wales.

GYROCOCHLEA IMPRESSA Hedley, 1924.

1924. *Gyrocochlea impressa* Hedley, Austr. Zool., Vol. iii., p. 216, pl. xxx., figs. 13-15, May 9. Kurrajong, New South Wales (C. T. Musson).
New South Wales.

GYROCOCHLEA PLANORBIS Hedley, 1924.

1924. *Gyrocochlea planorbis* Hedley, Austr. Zool., Vol. iii., p. 217, pl. xxx., figs. 19-21, May 9. Port Stephens, New South Wales (Rev. R. L. King).
New South Wales.

GYROCOCHLEA OMICRON Pfeiffer, 1851.

1851. *Helix omicron* Pfeiffer, Zeitschr. für Malak., 1851, No. 8, p. 128 (after September). Australia = Northern New South Wales (Cox).
1854. *Helix ammonitoides* Reeve, Conch. Icon., Vol. vii., *Helix,* pl. 181, sp. 1246, June, new name for above.
Northern New South Wales.

GYROCOCHLEA PRAVA Hedley, 1924.

1924. *Gyrocochlea prava* Hedley, Austr. Zool., Vol. iii., p. 217, pl. xxx., figs. 22-24, May 9. Upper Tweed River, New South Wales (Petterd).
Northern New South Wales.

GYROCOCHLEA RECAVA Hedley, 1924.

1912. *Endodonta recava* Hedley, Proc. Linn. Soc. N.S.W., Vol. xxxvii., p. 267, pl. x., figs. 58-60, December 13. Finch Hatton, 50 miles W. of Mackay, Queensland (S. W. Jackson).
Mid Queensland.

GYROCOCHLEA AUSTERA Hedley, 1912.

1912. *Endodonta austera* Hedley, Proc. Linn. Soc. N.S.W., Vol. xxxvii., p. 266, pl. ix., figs. 52-54, December 13. Logan Village, Queensland.
South Queensland.

GYROCOCHLEA CINNAMEA Hedley, 1912.

1912. *Endodonta cinnamea* Hedley, Proc. Linn. Soc. N.S.W., Vol. xxxvii., p. 267, pl. ix., figs. 55-56; pl. x., fig. 57, December 13. Coolabunia, near Kingaroy, Queensland.
South Queensland.

GYROCOCHLEA IULOIDEA Forbes, 1851.

1851. *Helix iuloidea* Forbes, Narr. Voy. Rattlesnake (Macgillivray), Vol. ii., p. 379, pl. ii., fig. 4, "1852" = mid December, 1851. Port Molle, Queensland.
Mid Queensland.

GYROCOCHLEA CURTISIANA Hedley, 1912.

1912. *Endodonta iuloidea* var. *curtisiana* Hedley, Proc. Linn. Soc. N.S.W., Vol. xxxvii., p. 264, pl. ix., figs. 49-51, December 13. Port Curtis, Queensland.
South Queensland.

GYROCOCHLEA STROUDENSIS Cox, 1864.

1864. *Helix stroudensis* Cox, Cat. Austr. Land Shells, p. 20. Stroud, Port Stephens, New South Wales (Rev. R. L. King). Figd. Cox, Mon.

Austr. Land Shells, p. 20, pl. xi., fig. 1, May, 1868. Refigd. Hedley, Austr. Zool., Vol. iii., p. 217, pl. xxxi., figs. 25-27, May 9, 1924.
Mid New South Wales.

Note.—All these small "Endodontids" must be examined under a compound microscope, and the protoconch varies, so that in the present series some appear to be smooth, but with a high power the protoconch can be observed to be finely spirally lirate but crossed by fine radials, thus making it microscopically reticulate. In others there will be seen to be a fine spiral striation only, not lirate as in some groups.

Genus ELSOTHERA Iredale, 1933.

1933. *Elsothera* Iredale, Rec. Austr. Mus., Vol. xix., p. 53, August 2. Orthotype, *Helix sericatula* Pfeiffer.

ELSOTHERA SERICATULA Pfeiffer, 1850.

1850. *Helix sericatula* Pfeiffer, Proc. Zool. Soc. (Lond.), 1849, p. 127, between January and June, 1850. Port Jackson, New South Wales (Strange). Figd. Reeve, Conch. Icon., Vol. vii., pl. 132, sp. 812, October, 1852. Cox, Mon. Austr. Land Shells, p. 12, pl. xii., fig. 6, May, 1868.
New South Wales. Victoria.

ELSOTHERA LIMULA Legrand, 1871.

1871. *Helix* (*Charopa*) *limula* Legrand, Coll. Mon. Tasm. Land Shells, 2nd ed., sp. 72, September, ex Cox MS. Piper's River, Tasmania.
Tasmania.

ELSOTHERA FUNEREA Cox, 1868.

1868. *Helix funerea* Cox, Mon. Austr. Land Shells, p. 16, pl. iii., fig. 1, May. Mudgee, New South Wales.
New South Wales. South Queensland.

ELSOTHERA INUSTA Cox, 1868.

1868. *Helix inusta* Cox, Mon. Austr. Land Shells, p. 13, pl. x., fig. 3, May, new name for

1866. *Helix nautilodea* Cox, Journ. de Conch., Vol. xiv., p. 47, January 1. Proc. Zool. Soc. (Lond.), 1865, p. 696, April 24, 1866 (*nautilodes*). Clarence River, New South Wales (Macgillivray). Not *Helix nautilodes* Ferussac, Hist. Nat. Moll., Vol. i., p. 191, 1850.
Northern New South Wales.

ELSOTHERA MURRAYANA Pfeiffer, 1864.

1864. *Helix murrayana* Pfeiffer, Proc. Zool. Soc. (Lond.), 1863, p. 527 (ex Angas, *loc. cit.*, p. 521, *nom. nud.*), April 20, 1864. Murray Cliffs, South Australia (Angas). Figd. Cox, Mon. Austr. Land Shells, p. 14, pl. xix., fig. 10, May, 1868, from a painting of the type by Angas.
South Australia.

ELSOTHERA SUBMURRAYANA Cox & Hedley, 1912.

1912. *Endodonta murrayana* var. *submurrayana* Cox & Hedley, Mem. Nat. Mus. Melb., No. 4, p. 9, pl. i., figs. 6-8, February, ex Tate MS. Geelong, Victoria (T. S. Hall).
Victoria.

ELSOTHERA RICEI Brazier, 1871.

1871. *Helix* (*Charopa*) *ricei* Brazier, Proc. Zool. Soc. (Lond.), 1870, p. 660, April 1, 1871. Mt. Wellington, Tasmania.

1871. *Helix* (*Charopa*) *rotella* id., ib. Mt. Wellington, Tasmania.
1871. *Helix* (*Charopa*) *onslowi,* id. ib. Mt. Wellington, Tasmania. Figd. Petterd & Hedley, Rec. Austr. Mus., Vol. vii., p. 291, pl. 83, figs. 11-13, 1909 (Maria Island, specimen in Tas. Mus.).
Tasmania.

ELSOTHERA BIRETRACTA Mousson, 1869.

1869. *Patula biretracta* Mousson, Journ. de Conch., Vol. xvii., p. 57, pl. iv., fig. 1, January 1. Wollongong, New South Wales (Graeffe, Rietman).
New South Wales.

ELSOTHERA RETEPOROIDES Tate, 1887.

1887. *Helix reteporoides* Tate, Trans. Roy. Soc. South Austr., Vol. ix., 1886, p. 62, pl. v., figs. 14a-c, March, 1887 (separates distributed December 29, 1886). Black Hill, near Adelaide, S.A.
South Australia.

Genus DISCOCHAROPA Iredale, 1913.

1913. *Discocharopa* Iredale, Proc. Mal. Soc. (Lond.), Vol. x., p. 379, September. Orthotype, *Charopa exquisita* Iredale.

DISCOCHAROPA CONCINNA Hedley, 1901.

1901. *Endodonta concinna* Hedley, Proc. Linn. Soc. N.S.W., Vol. xxv., p. 729, pl. xlviii., figs. 1-3, May 20. Bundaberg, Queensland.
South Queensland.

DISCOCHAROPA PLANORBULINA Tate, 1896.

1896. *Endodonta* (*Charopa*) *planorbulina* Tate, Rep. Horn. Sci. Exped. Centr. Austr., pt. ii., Zool., p. 187, pl. xvii., fig. 3, February. Palm Creek, Krichauff Range, Central Australia.
Central Australia.

DISCOCHAROPA VIGENS Legrand, 1871.

1871. *Helix* (*Discus*) *vigens* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., sp. 30, p. 2, pl. i., fig. 12, June, ex Cox MS. Mount Wellington, Tasmania.
Tasmania.

DISCOCHAROPA BASSI Legrand, 1871.

1871. *Helix* (*Charopa*) *bassi* Legrand, Coll. Mon. Tasm. Land Shells, 2nd ed., sp. 50, September, 1871, ex Brazier MS., new name for
1871. *Helix* (*Charopa*) *ammonitoides* Brazier, Proc. Zool. Soc. (Lond.), 1870, p. 661, April 1, 1871. Mount Nelson, Tasmania. Not *Helix ammonitoides* Reeve, 1854, ante, cf. *omicron*. Figd. Petterd & Hedley, Rec. Austr. Mus., Vol. vii., p. 289, fig. 16, 1909.
Tasmania.

DISCOCHAROPA LOTTAH Petterd, 1879.

1879. *Helix lottah* Petterd, Mon. Land Shells Tasm., p. 37, April. Cataract Hill, near Launceston, Tasmania.
North Tasmania.

DISCOCHAROPA MIMOSA Petterd, 1879.

1879. *Helix mimosa* Petterd, Mon. Land Shells Tasm., p. 33, April. Launceston, Tasmania. Figd. Petterd & Hedley, Rec. Austr. Mus., Vol. vii., p. 291, pl. 86, figs. 32-34, 1909.
North Tasmania.

Genus Allocharopa *nov.*

Type, *Helix brazieri* Cox.

Simple Charopid shells with flattened upper surface and wide umbilicus, regularly striate, not so flat as *Discocharopa,* with protoconch radially ribbed as remainder of shell.

Allocharopa brazieri Cox, 1868.

1868. *Helix brazieri* Cox, Mon. Austr. Land Shells, p. 14, pl. xi., fig. 18, May. Cooks' River, Sydney, New South Wales.
Mid New South Wales.

Allocharopa legrandi Cox, 1868.

1868. *Helix legrandi* Cox, Mon. Austr. Land Shells, p. 23, pl. xii., fig. 7, May. Mt. Wellington, Tasmania (Masters).
South Tasmania.

Allocharopa kershawi Petterd, 1879.

1879. *Helix kershawi* Petterd, Mon. Land Shells Tasm., p. 28, April. Launceston, Tasmania.
North Tasmania.

Allocharopa tarravillensis Gabriel, 1930.

1930. *Charopa tarravillensis* Gabriel, Proc. Roy. Soc. Vict., Vol. xliii., pt. i. (n.s.), p. 77, pl. ii., figs. 5-6, September 11. Tarraville, Victoria.
Victoria.

Allocharopa erskinensis Gabriel, 1930.

1930. *Charopa erskinensis* Gabriel, Proc. Roy. Soc. Vict., Vol. xliii., pt. i., p. 76, pl. ii., figs. 1-2, September 11. Erskine River, Lorne, Victoria.
Victoria.

Allocharopa belli Cox, 1864.

1864. *Helix belli* Cox, Cat. Austr. Land Shells, p. 22, Darling Point, Sydney, New South Wales (Bell). Figd. Cox, Mon. Austr. Land Shells, p. 17, pl. vi., fig. 3, May, 1868.
Mid New South Wales.

Genus Pernagera Iredale, 1933.

1933. *Pernagera* Iredale, Rec. Austr. Mus., Vol. xix., p. 53, August 2. Orthotype, *Helix albanensis* Cox.

Pernagera albanensis Cox, 1868.

1868. *Helix albanensis* Cox, Proc. Zool. Soc. (Lond.), 1867, p. 723, April 3, 1868. King George's Sound, West Australia (Masters). Figd. Cox, Mon. Austr. Land Shells, p. 15, pl. iv., fig. 2, May, 1868.
South West Australia.

Pernagera stanleyensis Petterd, 1879.

1879. *Helix stanleyensis* Petterd, Mon. Land Shells Tasm., p. 32, April. Circular Head, Tasmania.
1879. *Helix petterdiana* Taylor, Journ. Conch. (Leeds), Vol. ii., p. 287, September. Circular Head, Tasmania.
1879. *Helix petterdiana* var. *albida,* id., ib., colour only.
North West Tasmania. Victoria.

PERNAGERA EASTBOURNENSIS Hedley, 1892.

1892. *Charopa eastbournensis* Hedley, Proc. Linn. Soc. N.S.W., Ser. 2, Vol. vii., p. 163, pl. ii., figs. 5-6, 7-8, September 1, ex Beddome & Petterd MS. Eastbourne, Tasmania.
North East Tasmania.

PERNAGERA OFFICERI Legrand, 1871.

1871. *Helix (Discus) officeri* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., sp. 57, June, ex Cox MS. North West Bay, North East Coast (Midson).
North East Tasmania.

PERNAGERA KINGSTONENSIS Legrand, 1871.

1871. *Helix (Discus) kingstonensis* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., sp. 40, p. 3, pl. ii., fig. 5, June, ex Cox MS. Brown's River, Tasmania.
1871. *Helix gouldiana* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., sp. 32, June, *nom. nud.* River Snug (Sproule).
1871. *Helix (Discus) juliformis* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., sp. 32, p. 3, pl. i., fig. 14, June, for *gouldii* preoccupied. Not *Helix juliformis* Lowe, Ann. Mag. Nat. Hist., Ser. ii., Vol. ix., p. 118, February, 1852.
1871. *Helix (Discus) macdonaldi* Legrand, Coll. Mon. Tasm. Land Shells, 2nd ed., sp. 32, pl. i., fig. 14, September, new name for *Helix juliformis*. River Snug, S.E. Tasmania.
1871. *Helix gouldi* Legrand, id., ib., in synonymy of *macdonaldi*. Not *Helix gouldi* Pfeiffer, Proc. Zool. Soc. (Lond.), 1845, 124, February, 1846.
South East Tasmania.

PERNAGERA ARCHITECTONICA Legrand, 1871.

1871. *Helix (Pitys) architectonica* Legrand, Coll. Mon. Tasm. Land Shells, 2nd ed., sp. 64, September, ex Brazier MS. Hobart Town, Tasmania.
1871. *Helix (Discus) spectra* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., sp. 55, June, ex Cox MS. Brown's River, Tasmania. Not *Helix spectrum* Reeve, Conch. Icon., Vol. vii., pl. 202, sp. 1424, 1854.
1871. *Helix (Pitys) assimilis* Legrand, Coll. Mon. Tasm. Land Shells, 2nd ed., sp. 66, September, ex Brazier MS. Hobart, Tasmania. Not *Nanina assimilis* H. Adams, Proc. Zool. Soc. (Lond.), 1866, p. 316.
1877. *Helix (Pitys) gunnii* Brazier, Papers Proc. Roy. Soc. Tasm., 1876, p. 168, February 27, 1877, new name for preceding. Not *Helix gunnii* Gray, Zeitschr. für Malak., 1850, 86. Figd. Petterd & Hedley, Rec. Austr. Mus., Vol. vii., p. 289, pl. 85, figs. 29-31, 1909.
South East Tasmania.

PERNAGERA TAMARENSIS Petterd, 1879.

1879. *Helix tamarensis* Petterd, Mon. Land Shells Tasm., p. 30, April. Launceston, Tasmania.
1879. *Helix rosaceae,* id., ib., as synonym.
1879. *Helix rosacea* Petterd, Journ. Conch. (Leeds), Vol. iii., p. 213, July; same descr. Figd. Hedley, Proc. Linn. Soc. N.S.W., Vol. xxvii., p. 605, pl. 31, figs. 18-20, 1903. North East Tasmania.
Victoria. South New South Wales. North East Tasmania.

PERNAGERA GATLIFFI Gabriel, 1930.

1930. *Charopa gatliffi* Gabriel, Proc. Roy. Soc. Vict., Vol. xliii., (n.s.), p. 76, pl. ii., figs. 3-4, September 11. Splitters' Falls, Lorne, Victoria. Victoria.

Genus KANNAROPA *nov.*

Type, *Helix subrugosa* Legrand.

Resembling *Dentherona* but lacking the apertural tooth, and showing a depression near the aperture on the last whorl, the sculpture being bold.

KANNAROPA SUBRUGOSA Legrand, 1871.

1871. *Helix (Pitys) subrugosa* Legrand, Coll. Mon. Tasm. Land Shells, 2nd ed., sp. 68, September, ex Brazier MS. Hobart Town, Tasmania.

1879. *Helix kannariae* Petterd, Mon. Land Shells Tasm., p. 35, April, ex Beddome MS., as synonym of *H. subrugosa.* Blue Tier, Tasmania. South Tasmania.

Genus EGILOMEN *nov.*

Type, *Helix cochlidium* Cox.

Small flat Charopid shells with very wide umbilicus, protoconch smooth, mouth small, unarmed, lip thin, sculpture of fine and coarse ribs.

EGILOMEN COCHLIDIUM Cox, 1868.

1868. *Helix cochlidium* Cox, Mon. Austr. Land Shells, p. 13, pl. viii., fig. 1, May. Clarence River, New South Wales (Macgillivray). Northern New South Wales.

EGILOMEN LIRATUM Cox, 1864.

1864. *Helix lirata* Cox, Cat. Austr. Land Shells, p. 38. Rushcutter's Bay, Sydney, New South Wales (Macgillivray). Figd. Cox, Mon. Austr. Land Shells, p. 15, pl. xi., fig. 3, May, 1868. Mid New South Wales.

EGILOMEN BARRENENSE Petterd, 1879.

1879. *Helix barrenensis* Petterd, Mon. Land Shells Tasm., p. 38, April. Furneaux Group, Bass Straits. Figd. Petterd & Hedley, Rec. Austr. Mus., Vol. vii., p. 287, pl. 87, figs. 41-43, 1909. Tasmania (Islands of Bass Straits).

EGILOMEN PEXUM Cox, 1868.

1868. *Helix pexa* Cox, Mon. Austr. Land Shells, p. 13, pl. viii., fig. 2, May. Near Parramatta, New South Wales. Mid New South Wales.

EGILOMEN SATURNI Cox, 1864.

1864. *Helix saturni* Cox, Cat. Austr. Land Shells, p. 35. Darling Point, Sydney, New South Wales. New name for

1864. *Helix costulata* Cox, Ann. Mag. Nat. Hist., Ser. iii., Vol. xiv., p. 184, September, ex Cat. Austr. Land Shells, p. 5, 1864, *nom. nud.* Darling Point, Sydney, New South Wales. Not *Helix costulata* "Ferussac" Lamarck, 1822, *ante.* Mid New South Wales.

Genus EGILODONTA *nov.*

Type, *Charopa bairnsdalensis* Gabriel.

Topotypical specimens, kindly sent me by Mr. Gabriel, are similarly sculptured to the preceding, but the mouth shows a long entering palatal

lamella and another shorter basal one, a feature not noticed in the original description.

EGILODONTA BAIRNSDALENSIS Gabriel, 1930.

1930. *Charopa bairnsdalensis* Gabriel, Proc. Roy. Soc. Vict., Vol. xliii. (n.s.), p. 78, pl. ii., figs. 11-12, September 11. Bairnsdale, Victoria (Worcester).
Victoria.

Genus DENTHERONA Iredale, 1933.

1933. *Dentherona* Iredale, Rec. Austr. Mus., Vol. xix., p. 53, August 2. Orthotype, *Helix dispar* Brazier.

DENTHEROMA DISPAR Brazier, 1871.

1871. *Helix* (? *Charopa*) *dispar* Brazier, Proc. Zool. Soc. (Lond.), 1870, p. 661, April 1, 1871. Mt. Wellington, Tasmania. Figd. Petterd & Hedley, Rec. Austr. Mus., Vol. vii., p. 290, pl. 84, figs. 17-19, 1909.
Tasmania.

Genus RHOPHODON Hedley, 1924.

1924. *Rhophodon* Hedley, Austr. Zool., Vol. iii., p. 219, May 9. Orthotype, *R. peregrinus* Hedley.

RHOPHODON PEREGRINUS Hedley, 1924.

1924. *Rhophodon peregrinus* Hedley, Austr. Zool., Vol. iii., p. 220, pl. xxxii., figs. 38-40, May 9. Tweed River, New South Wales (Petterd).
Northern New South Wales.

RHOPHODON CONSOBRINUS Hedley, 1924.

1924. *Rhophodon consobrinus* Hedley, Austr. Zool., Vol. iii., p. 220, pl. xxxi., figs. 32-34, May 9. Richmond River, New South Wales (W. T. Petterd).
Northern New South Wales.

RHOPHODON CONTORTUS Hedley, 1924.

1924. *Rhophodon contortus* Hedley, Austr. Zool., Vol. iii., p. 220, pl. xxxii., figs. 35-37, May 9. Sherwood, Macleay River, New South Wales (C. Laseron).
New South Wales.

Genus SETOMEDEA Iredale, 1933.

1933. *Setomedea* Iredale, Rec. Austr. Mus., Vol. xix., p. 53, August 2. Orthotype, *Suteria seticostata* Hedley.

SETOMEDEA SETICOSTATA Hedley, 1924.

1924. *Suteria seticostata* Hedley, Austr. Zool., Vol. iii., p. 221, pl. xxxii., figs. 41-44, May 9. Dorrigo, New South Wales (S. W. Jackson).
Northern New South Wales.

SETOMEDEA ACULEATA Hedley, 1899.

1899. *Endodonta aculeata* Hedley, Rec. Austr. Mus., Vol. iii., p. 151, pl. xxviii., figs. 1-3, December 11. Wollongong, New South Wales.
Mid New South Wales.

Genus GEMINOROPA Iredale, 1933.

1933. *Geminoropa* Iredale, Rec. Austr. Mus., Vol. xix., p. 53, August 2. Orthotype, *Helix antialba* Beddome.

GEMINOROPA ANTIALBA Petterd, 1879.

1879. *Helix antialba* Petterd, Mon. Land Shells Tasm., p. 41, April, ex Beddome MS. Gad's Hill and Mt. Bischoff, Tasmania. Figd. Hedley, Proc. Linn. Soc. N.S.W., Ser. 2, Vol. vii., p. 166, pl. i., figs. 5-8, 1892.

1892. *Charopa antialba* var. *alba* Hedley, Proc. Linn. Soc. N.S.W., Ser 2, Vol. vii., p. 167. Same locality.

Tasmania.

GEMINOROPA HOOKERIANA Petterd, 1879.

1879. *Helix hookeriana* Petterd, Mon. Land Shells, Tasm., p. 38, April, ex Johnston MS. Surrey Hills, North West Tasmania. Figd. Hedley, Proc. Linn. Soc. N.S.W., Vol. xxviii., p. 182, pl. viii., figs. 1-3, 1904. North West Tasmania.

Genus OREOMAVA Iredale, 1933.

1933. *Oreomava* Iredale, Rec. Austr. Mus., Vol. xix., p. 54, August 2. Orthotype, *Helix otwayensis* Petterd.

OREOMAVA OTWAYENSIS Petterd, 1879.

1879. *Helix otwayensis* Petterd, Mon. Land Shells Tasm., p. 39, April. Cape Otway scrubs, Victoria. Figd. Hedley, Proc. Linn. Soc. N.S.W., Vol. xxvii., p. 605, pl. xxix., figs. 10-12, 1903.

Victoria.

OREOMAVA JOHNSTONI Iredale, 1933.

1933. *Oreomava johnstoni* Iredale, Rec. Austr. Mus., Vol. xix., p. 54, August 2, new name for

1879. *Helix otwayensis* var. *alpina* Petterd, Mon. Land Shells Tasm., p. 39, April, ex R. M. Johnston MS. Surrey Hills, North West Tasmania. Figd. Petterd & Hedley, Rec. Austr. Mus., Vol. vii., p. 300, pl. 85, figs. 23-25, 1909.

Tasmania.

OREOMAVA CANNFLUVIATILUS Gabriel, 1929.

1929. *Allodiscus cannfluviatilus* Gabriel, Vict. Naturalist, Vol. xlvi., p. 133, figs. 1, 2, 3, text, October 10. Cann River, Victoria.

Victoria (Gippsland).

Genus PILLOMENA Iredale, 1933.

1933. *Pillomena* Iredale, Rec. Austr. Mus., Vol. xix., p. 54, August 2. Orthotype, *Flammulina meraca* Cox & Hedley.

PILLOMENA MERACA Cox & Hedley, 1912.

1912. *Flammulina meraca* Cox & Hedley, Mem. Nat. Mus. Melb., No. 4, p. 13, pl. iii., figs. 19-21. Dandenong Range, Victoria (Kershaw).

1884. *Helix garthii* Tate, Trans. Roy. Soc. South Austr., Vol. iv., p. 75, ex Petterd MS., *nom. nud.* Fernshaw, Victoria.

Victoria.

PILLOMENA DANDENONGENSIS Petterd, 1879.

1879. *Helix dandenongensis* Petterd, Journ. Conch. (Leeds), Vol. ii., p. 355, December. Dandenong Ranges, Victoria.

1872. *Helix* (*Charopa*) *subdepressa* Brazier, Proc. Zool. Soc. (Lond.), 1871, p. 641, May 2, 1872. Snowy River, Gippsland, Victoria. Not *Helix subdepressa* Orbigny, Prod. Palaeont., Vol. iii., p. 1, 1852. Figd.

Hedley, Proc. Linn. Soc. N.S.W., Vol. xxvii., p. 605, pl. 31, figs. 13-15, 1903.
Victoria.

PILLOMENA NIVEA Hedley, 1896.

1896. *Endodonta nivea* Hedley, Rec. Austr. Mus., Vol. ii., p. 102, pl. xxiii., figs. 5-7, January. Mt. Kosciusko, New South Wales, 4,500 ft.
Southern New South Wales.

PILLOMENA AEMULA Tate, 1894.

1894. *Charopa aemula* Tate, Trans. Roy .Soc. South Austr., Vol. xviii., p. 192, November. Central Australia. Figd. Tate, Rep. Horn. Sci. Exped. Centr. Austr., pt. ii., Zool., p. 186, pl. xvii.,, fig. 2, February, 1896.
Penny Springs, George Gill's Range.
Central Australia.

PILLOMENA SCINDOCATARACTA Gabriel, 1930.

1930. *Charopa scindocataracta* Gabriel, Proc. Roy. Soc. Vict., Vol. xliii. (n.s.), p. 77, pl. ii., figs. 9-10, September 11. Splitters' Falls, Lorne, Victoria.
Victoria.

Genus LUINODISCUS *nov.*
Type, *Helix cuprea* Cox.

Small flattened Charopid shells, spire not sunken, umbilicus wide, mouth small, thin, sculpture of regular fine radials, protoconch spirally lirate.

LUINODISCUS CUPREUS Cox, 1868.

1868. *Helix cuprea* Cox, Mon. Austr. Land Shells, p. 22, pl. xii., fig. 9, May. King George's Sound, West Australia (Masters).
1875. *Helix* (*Charopa*) *nupera* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 18, April 27. King George's Sound, West Australia.
South West Australia.

LUINODISCUS HEDLEYI Thiele, 1930.

1930. *Charopa hedleyi* Thiele, Die Fauna Sudwest Australiens, Bd. 5, lief. 8, p. 587, pl. iv., fig. 6. Brunswick, S.W.A.
South West Australia.

LUINODISCUS TUMIDUS Odhner, 1917.

1917. *Endodonta* (*Charopa*) *tumida* Odhner, Kungl. Svensk. Vetensk. Handl., Bd. 52, No. 16, p. 72, pl. 3, figs. 72-74, September 19. Noonkanbah, Fitzroy River, North West Australia.
North West Australia.

LUINODISCUS ? CYGNEUS Benson, 1853.

1853. *Helix cygnea* Benson, Ann. Mag. Nat. Hist., Ser. ii., Vol. vi., p. 30, January 1. Perth, West Australia (Dr. J. F. Bacon). Figd. Reeve, Conch. Icon., Vol. vii., *Helix,* pl. 174, sp. 1182, October 1853. Copied Cox, Mon. Austr. Land Shells, p. 16, pl. xii., fig. 3, May, 1868.
West Australia.

LUINODISCUS ? SUBLESTUS Benson, 1853.

1853. *Helix sublesta* Benson, Ann. Mag. Nat. Hist., Ser. ii., Vol. vi., p. 30, January 1. Freemantle, West Australia (Dr. J. F. Bacon). Figd. Reeve, Conch. Icon., Vol. iii., *Helix,* pl. 174, sp. 1177, October, 1853.

Copied Cox, Mon. Austr. Land Shells, p. 16, pl. xi., fig. 10, May, 1868. West Australia.

Genus DUPUCHAROPA *nov.*
Type, *Helix millestriata* Smith.

Medium size Charopid shells with depressed spire, narrow deep umbilicus, and sculpture of fine radials with fine spiral striation throughout.

DUPUCHAROPA MILLESTRIATA Smith, 1874.

1874. *Helix millestriata* Smith, Zool. Voy. Erebus & Terror, Moll., p. 2, pl. 4, fig. 5. Dupuch's Is., West Australia.
Mid West Australia.

Genus BISCHOFFENA *nov.*
Type, *Helix bischoffensis* Petterd.

Small subglobose Charopid shells, practically imperforate, protoconch spirally lirate, succeeding sculpture almost reticulate, very fine radials crossed by microscopic spirals. Topotypes show two internal lamellae on outer lip.

BISCHOFFENA BISCHOFFENSIS Petterd, 1879.

1879. *Helix bischoffensis* Petterd, Mon. Land Shells Tasm., p. 39, April, ex Beddome MS. Mt. Bischoff, N.W. Tasmania.
1880. *Helix bischoffensis* Beddome, Papers Proc. Roy. Soc. Tasm., 1879, p. 23, July 21, 1880. Same specimens. Figd. Hedley, Proc. Linn. Soc. N.S.W., Ser. ii., Vol. vii., p. 167, pl. i., figs. 1-4, 1892.
North West Tasmania.

Genus ROBLINELLA *nov.*
Type, *Helix roblini* Petterd.

A series of Charopid shells was placed in the subgenus *Allodiscus* of the genus *Flammulina* on account of their spirally striated nuclear whorls, but in every other respect they are of general Charopid facies. These are flattened species with wide umbilicus, radial sculpture and the protoconch spirally striate or lirate, sometimes of large size as in the type species.

ROBLINELLA ROBLINI Petterd, 1879.

1879. *Helix roblini* Petterd, Mon. Land Shells Tasm., p. 38, April. Near Launceston, Tasmania. Figd. Petterd & Hedley, Rec. Austr. Mus., Vol. vii., p. 300, pl. 84, figs. 20-22, 1909.
North East Tasmania.

ROBLINELLA GADENSIS Petterd, 1879.

1879. *Helix gadensis* Petterd, Mon. Land Shells Tasm., p. 29, April, ex Beddome MS. Gad's Hill, N.W. Tasmania.
1880. *Helix gadensis* Beddome, Papers Proc. Roy. Soc. Tasm., 1879, p. 23, July 21, 1880. Same specimens. Figd. Hedley, Proc. Linn. Soc. N.S.W., Ser. ii., Vol. vii., p. 168, pl. ii., figs. 1-4, 1892.
North West Tasmania.

ROBLINELLA CURACOAE Brazier, 1871.

1871. *Helix* (*Charopa*) *curacoae* Brazier, Proc. Zool. Soc. (Lond.), 1870, p. 659, April, 1871. Mt. Wellington, Tasmania.
1871. *Helix* (*Discus*) *ramsgatensis* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., sp. 33, p. 2, pl. i., fig. 13, September, ex Cox MS. Recherche Bay, Tasmania (Legrand). Figd. Petterd & Hedley, Rec. Austr. Mus., Vol. vii., p. 300, pl. 83, figs. 14-16, 1909.
Tasmania.

ROBLINELLA MATHINNAE Petterd, 1879.

1879. *Helix mathinnae* Petterd, Mon. Land Shells Tasm., p. 26, April. Launceston, Tasmania. Figd. Hedley, Proc. Linn. Soc. N.S.W., Vol. xxviii., p. 182, pl. viii., figs. 4-6, 1904.
North Tasmania.

ROBLINELLA AGNEWI Legrand, 1871.

1871. *Helix* (*Discus*) *agnewi* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., sp. 27, p. 5, pl. i., fig. 8, June, ex Cox MS. Mt. Wellington, Tasmania (Petterd).
1871. *Helix* (*Pitys*) *petterdi* Legrand, Coll. Mon. Tasm. Land Shells, 2nd ed., sp. 67, September, ex Brazier MS. Huon Road, Hobart, Tasmania.
1871. *Helix* (*Pitys*) *peroni,* id., ib., white var. only.
South Tasmania.

ROBLINELLA INTERMEDIA Odhner, 1917.

1917. *Endodonta* (*Charopa*) *intermedia* Odhner, Kungl. Svensk. Vetensk. Handl., Bd. 52, No. 16, p. 85, pl. 3, figs. 92-93, September 19. Cedar Creek, Queensland.
North Queensland.

Genus TORRESIROPA Iredale, 1933.

1933. *Torresiropa* Iredale, Rec. Austr. Mus., Vol. xix., p. 54, August 2. Orthotype, *Helix spaldingi* Brazier.

TORRESIROPA SPALDINGI Brazier, 1876.

1876. *Helix* (*Patula*) *spaldingi* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 103, July. Cape York, Albany, I. etc., Torres Strait. Figd. Hedley, Proc. Linn. Soc. N.S.W., Vol. xxvii., p. 705, pl. 34, figs. 9-11, 1902 (Bet. Is.).
North Queensland.

TORRESIROPA MELLA Iredale, 1933.

1933. *Torresiropa mella* Iredale, Rec. Austr. Mus., Vol. xix., p. 54, August 2, new name for
1880. *Helix* (*Patula*) *spaldingi* var. *carinata* Brazier, Proc. Linn. Soc. N.S.W., Vol. iv., p. 393, May. Thursday Is., Torres Strait. Figd. Hedley, Proc. Linn. Soc. N.S.W., Vol. xxvii., p. 705, pl. 34, fig. 8, 1902
North Queensland (Islands of Torres Strait).

Genus THESKELOMENSOR Iredale, 1933.

1933. *Theskelomensor* Iredale, Rec. Austr. Mus., Vol. xix., p. 54, August 2. Orthotype, *Helix lizardensis* Pfeiffer.

THESKELOMENSOR LIZARDENSIS Pfeiffer, 1863.

1863. *Helix lizardensis* Pfeiffer, Proc. Zool. Soc. (Lond.), 1862, p. 269, April 10, 1863. Lizard Is., Queensland (Macgillivray). Figd. Cox, Mon. Austr. Land Shells, p. 33, pl. iv., fig. 1, May, 1868.
North Queensland (Lizard Island).

Note—.As pointed out when I introduced this genus the shell is quite unlike that of any "Endodontid" in Australia, but recalls rather the Trochomorphas of the Pacific Islands.

(To be continued.)

THE SPECIES OF *CHIASTOSELLA* (BRYOZOA).

By Leo. W. Stach, B.Sc., F.R.M.S.

(Plate xviii.)

INTRODUCTION.

The species of *Chiastosella* Canu and Bassler, 1934, form a characteristic group from Tertiary to Recent times in southern Australia. Much confusion, however, has been brought about by the misleading figures of the genotype. A search was made in the Macgillivray collection (preserved in the National Museum, Melbourne) for the holotype of *"Schizoporella" daedala* (the genotype), so that accurate comparison with other species could be made.

Five slides labelled *"Schizoporella daedala"* in Macgillivray's handwriting were found, one of them also bearing the name *"insignis"*. This specimen proved to be the holotype, since it is also the only specimen bearing ovicells, which are shown in Macgillivray's figures (1882, 1887). The ectocyst and a large amount of loose granular material mask the calcified structures of the holotype and consequently a small fragment was incinerated in order to reveal the zooecial detail.

The examination of a large series of specimens of *Chiastosella* from the author's collection, the Macgillivray and Maplestone collections in the National Museum (Melbourne) and the South Australian Museum collections has indicated the necessity for the present revision.

The failure to appreciate the variation within both fossil and Recent species which can be brought about by varying degrees of calcification according to the age of the zooecia, the effects of abrasion and the mode of preservation, must inevitably cause endless confusion in the application of the Bryozoa for age determination in Cainozoic deposits. Such "species" erected on growth variations and mode of preservation can give an entirely erroneous conception of the proportion of fossil to Recent species at any particular locality and consequently a valuable source of information on Cainozoic stratigraphy is liable to be neglected.

Key to the Species.

1. Ovicell with grooved crescentic distal border .. .. 2.
   Ovicell lacking grooved distal border .. .. 3.
2. Frontal with median longitudinal ridge .. .. *C. conservata* (Waters).
   Frontal with smooth-rimmed tremopores .. .. 4.
3. Small avicularia surmounting globular bosses .. *C. watersi, sp. nov.*
   Large rounded avicularia with serrated rims .. *C. gabrieli, sp. nov.*
4. About 12 rows of pores in border of ovicell. *C. daedala* (Macgillivray).
   About 18 rows of pores in border of ovicell . *C. porosa* Canu & Bassler.

SYSTEMATIC DESCRIPTION.

Family Schizoporellidae Bassler, 1935.

Subfamily Schizoporellinae Canu & Bassler, 1917.

Genus Chiastosella Canu & Bassler, 1934.

Chiastosella Bassler, 1934, 407.

Type (by original designation): *Chiastosella* (*"Schizoporella"*) *daedala* (Macgillivray, 1887).

Observations.—The study of the species which obviously belong to this group has shown the necessity for certain emendations of the generic diagnosis. All the species are characterized by the hyperstomial ovicell opening above the level of the aperture. The central portion of the ovicell is usually sparsely porous, while the distal margin usually bears a crescentic depression with radiating rows of small pores. Canu and Bassler state that the sinus of the aperture is rectangular. In the genotype it is definitely subcircular, while in the other species its form varies. A single row only of aerolar pores may occur in *Chiastosella.*

Other constant features are the presence of spines on the distal margin of the peristome and the laterally-directed avicularia on the frontal proximal to the aperture. The zoarium in all the species known is unilaminate and either free or encrusting.

CHIASTOSELLA DAEDALA (Macgillivray, 1887).

(Plate xviii., figs. 1, 2.)

Schizoporella insignis Macgillivray (*non* Hincks, 1881), 1883, 132, pl. ii., fig. 11. Hincks, 1884, 281.

Schizoporella conservata Hincks (*non* Waters, 1881), 1882, 165, pl. vii., fig. 2. Stach, 1935, 343, pl. xii., fig. 4.

Schizoporella daedala Macgillivray, 1887, *a,* 180; *idem,* 1887, *b,* 211; *idem,* 1887, *c,* 146, pl. cxxxviii., fig. 4. Jelly, 1889, 225.

Schizoporella vercoi Livingstone, 1928, 117, figs. 32, 33.

Chiastosella daedala (Macgillivray), Bassler, 1934, 407. Not *Schizoporella daedala* Macgillivray, 1895, 84, pl. xi., fig. 15; Maplestone, 1904, 207 = *C. porosa* Canu & Bassler, 1935.

Description.—Zoarium unilaminate, foliaceous; dull-brown in colour when dry. Zooecia rhomboid in outline, usually broader than long.

The aperture, set within a shallow, smooth, subcircular peristome, is semicircular. The transversely oval sinus, limited by inwardly directed cardelles, equals in diameter about one-quarter that of the aperture. A narrow serrated plate, arising in the proximal corners of the aperture below the level of the cardelles, extends along the proximal rim on each side almost to the sinus. The operculum is strengthened by a median banded narrow sclerite, crescentic in outline and with a central unthickened area. The distal margin of the peristome bears four unjointed short spines articulated to circular spine bases.

The frontal is pierced by a varying number of tremopores (14-32) according to the size and number of avicularia on the zooecia. Areolation is often obscure, but, when distinct, a single row of areolar pores is developed. In older zooecia many of the tremopores become closed by calcification.

Large acute avicularia with entire rims occur on one side of the zooecia directed laterally below the level of the proximal rim. A corresponding large avicularium occasionally is developed on the opposite side of the zooecium. Small avicularia of similar type may appear on the proximal region of the frontal.

The triangular ovicell, not raised above the level of the frontal of the distal zooecium, is surrounded distally by a bordered depression containing eleven or twelve radiating rows of two or three small pores. The triangular smooth area distal to the peristome bears two to four large tremopores.

Dimensions.—Zooecium, length, 0.9 mm.; breadth, 1.0; aperture, diameter, 0.30; ovicell, height, 0.40; breadth, 0.55.

Type Material.—Holotype: One zoarial fragment (Nat. Mus., Coll. No. 64,105). Paratypes: Nat. Mus. Coll. Nos. 64,102-04.

Distribution.—Recent: Port Phillip Heads (Victoria); off Beachport at 40 fathoms (South Australia).

Lower Pliocene: Upper beds at Macdonald's on Muddy Creek, Hamilton (Victoria).

Observations.—The inadequate figures and description of this species caused Livingstone (1928) to describe this form as a new species under the name of *Schizoporella vercoi.* His discovery of the intra-apertural serrated plate and an examination of his types confirm its placing with the present species.

CHIASTOSELLA GABRIELI, *sp. nov.*

(Plate xviii., figs. 3, 4.)

Description.—Zoarium unilaminate, white in colour when dry and with the ectocyst intact. Zooecia very large in comparison with the other species, elongate rectangular in outline and more than twice as long as broad.

The large aperture, without peristome, is semicircular, the slightly concave proximal rim being indented by a broad shallow median sinus equalling in diameter about one-fifth that of the aperture. The operculum bears no sclerite. Above the distal rim of the aperture three slender spines, and rarely a fourth, are developed.

The frontal, pierced by a large number of small tremopores, is strongly tuberculate. The lateral and proximal margins of the frontal are deeply areolated, the bounding ridges being strongly salient.

Elongate rounded avicularia of moderate size, and with the outer extremities of their salient rims sharply serrated, occur some distance below the level of the proximal rim directed laterally on one side of the zooecium; rarely an avicularium is present on each side of the zooecium, but often they are absent altogether.

The large longitudinally semi-elliptical ovicell, scarcely projecting above the level of the frontal of the distal zooecium, is deeply areolated, the central portion being tuberculate and pierced by numerous small tremopores. A single spine occurs on each side of the aperture of zooecia bearing ovicells.

Dimensions.—Zooecium, length, 1.30 mm.; breadth, 0.75; aperture, diameter, 0.35; ovicell, height, 0.55; breadth, 0.60.

Type Material.—Holotype: Zoarial fragment (Nat. Mus. Coll. No. 64,101). Paratype: Nat. Mus. Coll. No. 69,639.

Distribution.—Recent: Western Port (Victoria).

Observations.—Specimens of this form, dredged by the late J. Gabriel after whom the species is named, were found in the Macgillivray collection labelled as *"Schizoporella daedala."* They differ from the genoholotype in the large elongate form of the zooecia, the marked areolation, the three spines of the distal rim of the aperture, the rounded serrated character of the avicularia and the lack of the intra-apertural serrated plate.

CHIASTOSELLA WATERSI, *sp. nov.*

(Plate xviii., fig. 5.)

Schizoporella conservata Waters, 1887 (*non* Waters, 1881), 65, pl. vii., fig. 21.

Description.—Zoarium unilaminate, encrusting, pale brown when dry. Zooecia longitudinally elliptical in outline, the width being less than half the length.

The small, high, semi-elliptical aperture has a straight proximal rim with a narrow, rectangular median sinus equalling in width about one-sixth that of the aperture. Above the distal rim of the aperture four spines are developed.

The frontal is pierced by a small number (10 to 16) of scattered tremopores separated by low, smooth, rounded ridges which pass outward into the interareolar ridges. A single row of small distinct shallow areolae borders the proximal and lateral margins of the zooecia.

Short, acute, small avicularia occur at the summits of small globular bosses, situated on one side of the zooecium some distance below the level of the proximal rim and directed laterally. Usually only one avicularium is found on each zooecium, but occasionally two are present.

The longitudinally elliptical ovicell, with a narrow salient border, has a marginal row of distinct areolae surrounding a central smooth area.

Dimensions.—Zooecium, length, 0.80 mm.; breadth, 0.55; aperture, diameter, 0.15; ovicell, height, 0.35; breadth, 0.30.

Distribution.—Recent: New Zealand.

Cainozoic: Napier (New Zealand).

Observations.—Three slides labelled *"Schizoporella conservata,* New Zealand" (Nat. Mus. Coll. Nos. 65,866-68) were found in the Macgillivray collection. In the form of the ovicell this species resembles *C. gabrieli, sp. nov.,* in its lack of the border of radiating pores, which feature is common to the three remaining species of the genus. It differs markedly from *C. gabrieli* in having a high aperture with a narrow rectangular sinus and the avicularia mounted on squat mamilliform processes. This latter character, in the absence of the ovicell, readily distinguishes this form from those species having an ovicell with a border of radiating pores.

Chiastosella conservata (Waters, 1881).
(Plate xviii., figs. 6, 7.)

Schizoporella conservata Waters, 1881, 340, pl. xviii., fig. 81; *idem,* 1882, 273, pl. vii., fig. 1. Maplestone, 1904, 207.

Chiastosella lamellata Canu & Bassler, 1935, 25, pl. vi., fig. 8.

Chiastosella gibbera Canu & Bassler, 1935, 25, pl. vi., fig. 2.

Not *Schizoporella conservata* Waters, 1887, 65, pl. vii., fig. 21 = *C. watersi, sp. nov.*

Not *Schizoporella conservata* Hincks, 1882, 165, pl. vii., fig. 2; Stach, 1935, 343, pl. xii., fig. 4 = *C. daedala* (Macgillivray).

Description.—Zoarium unilaminate. Zooecia longitudinally elongate, the greatest width being at the middle level of the zooecium.

The small, semi-elliptical, high aperture has a straight proximal rim with a narrow rectangular sinus, equalling in width about one-sixth that of the aperture, overhung by a short projection from the distal extremity of the longitudinal median ridge of the frontal. Above the distal rim of the aperture five or six spine traces occur.

The frontal is pierced by a small number (10 to 15) of tremopores separated by low rounded ridges which pass outward into the interareolar ridges and unite along the longitudinal axis of the frontal to form a pronounced median ridge increasing in height distally until it partly overhangs the sinus of the aperture. Small, shallow areolae border the lateral and proximal margins of the zooecia.

The elongate, very narrow, acute, curved avicularia are developed near the middle level of the zooecium on one or both sides and are directed laterally. The distal portions of the lateral margins of the avicularia are remarkably salient.

The large, oval, salient ovicells have a crescentic, shallow, grooved distal border with about eighteen radiating rows of about three pores. The smooth central area, depressed near the crescentic border, is pierced by three or four tremopores. A spine occurs on each side of the aperture at its middle level where the ovicell joins with the zooecium.

Dimensions.—Zooecium, length, 0.80 mm.; breadth, 0.30; aperture, diameter, 0.12; ovicell, height, 0.35; breadth, 0.40.

Distribution.—Lower Miocene: Victoria: Upper Moorabool River; Mitchell River at Bairnsdale; Clifton Bank, Muddy Creek, Hamilton. South Australia: Mount Gambier.

Observations.—The description given above refers to well-preserved material, slight abrasion resulting in the elimination of the median salient longitudinal ridge on the frontal and the loss of the salient rim and the apparent decrease in size of the avicularia as has apparently taken place in the specimen of *"C. lamellata"* figured by Canu and Bassler.

These authors state that *"C. lamellata"* has four or five spines and *"C. gibbera"* four spines above the aperture. An examination of their figures shows that in the former specimen five to six spines are indicated, while in the four zooecia of the latter form, traces of five spines are discernible. Measurements of the apertures of these two figured forms taken directly from the figures and brought up to the scale of Waters' (1881) figure agree closely with each other and with a large range of Lower Miocene specimens in the Macgillivray collection.

The zooecia figured as *"C. gibbera"* appear to be of different aspect from those of *"C. lamellata"*, but the obliquity of the zooecia and the great attenuation of the avicularia is apparently due to their position near the edge of the zoarium as is illustrated by the zooecia herein figured (pl. xviii., figs. 6, 7) which are both from the same zoarial fragment.

Other minor apparent discrepancies in Canu and Bassler's descriptions of these two "species" undoubtedly have their origin in abrasion effects and variation, and these two forms are regarded as synonyms of *C. conservata* (Waters).

This species is characterized by the small dimensions of the aperture, the five or six spines of the distal rim, the attenuated, acute, salient avicularia and the median longitudinal salient ridge on the frontal, the latter feature readily distinguishing it from those species with a similar type of ovicell.

Chiastosella porosa Canu & Bassler, 1935.
(Plate xviii., fig. 8.)

Schizoporella daedala Macgillivray, 1895 (*non* Macgillivray, 1887), 84, pl. xi., fig. 15. Maplestone, 1904, 207.
Chiastosella porosa Canu & Bassler, 1935, 26, pl. vi., fig. 4.
C. grandicella Canu & Bassler, 1935, 26, pl. vi., fig. 3.
C. parviporosa Canu & Bassler, 1935, 27, pl. vi., fig. 10.

Description.—Zoarium unilaminate. Zooecia rhomboid, usually broader than long, the greatest width being near the middle level of the zooecium.

The moderately large, semicircular, low aperture has a slightly concave proximal rim with a broad semicircular sinus, equalling in width

about one-quarter that of the aperture. Above the distal rim of the aperture four spines are developed.

The frontal is pierced by a varying number of tremopores according to the degree of calcification which has taken place; the tremopores are surrounded by smooth salient ridges which pass into the ridges separating the poorly developed areolae.

Large, acute avicularia occur at the middle level of the zooecia on one or both sides, directed laterally. The distal extremities are attenuated and very salient.

The subcircular raised ovicell has a broad, crescentic, shallow, grooved border with about eighteen radiating rows of two or three pores. The smooth central area, depressed at the margins and raised in the centre, is pierced by three or four marginal tremopores.

Dimensions.—Zooecium, length, 0.70 mm.; breadth, 0.90; aperture, diameter, 0.23; ovicell, height, 0.32; breadth, 0.44.

Distribution.—Lower Miocene: Victoria: Mitchell River at Bairnsdale; upper Moorabool River; lower beds at Forsyth's on Grange Burn Creek, Hamilton; Clifton Bank, Muddy Creek, Hamilton; Flinders bryozoan limestone.

Observations.—This species is closely allied to the genotype, but differs from it in the greater number of tremopores, the more acute avicularia and the much greater number of radiating rows of pores in the crescentic distal border of the ovicell.

Canu and Bassler's figure of *"C. grandicella"* represents a well-preserved specimen of *C. porosa* in which the acute, salient tips of the avicularia and the ridges of the tremocyst are still well shown. In the specimen figured as *C. porosa,* the tips of the avicularia have been abraded and parts of the tremocyst have undergone solution or abrasion, thus giving a different aspect to the frontal. In the specimen of *"C. parviporosa"*, as in most specimens of Bryozoa from the Flinders limestone, the frontal has been subject to considerable solution, thus reducing the size of the funnel-like tremopores by the elimination of the bounding ridges, and the size of the avicularia.

Canu and Bassler give widely varying dimensions for the apertures of the three "species" mentioned above, but actual measurements taken from the figures in question coincide almost exactly. For these reasons, the forms listed above are regarded as synonyms, *C. porosa* being selected because of page priority.

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EXPLANATION OF PLATE XVIII.

(Magnification X 50.)

(All figures drawn with camera lucida.)

Fig. 1. *Chiastosella daedala* (Macgillivray). Ovicelled zooecium from holotype fragment showing form of aperture and adventitious avicularia. Nat. Mus. Coll., No. 64,105.
Fig. 2. *C. daedala.* Zooecium from holotype fragment showing operculum and form of spine. Nat. Mus. Coll., No. 64,105.
Fig. 3. *Chiastosella gabrieli, sp. nov.* Zooecium from paratype fragment. Nat. Mus. Coll., No. 69,639.
Fig. 4. *C. gabrieli.* Ovicelled zooecium from holotype fragment. Nat. Mus. Coll., No. 64,101.
Fig. 5. *Chiastosella watersi, sp. nov.* Ovicelled zooecium and distal zooecium illustrating zooecial detail. Nat. Mus. Coll., No. 65,866.
Fig. 6. *Chiastosella conservata* (Waters). Ovicelled zooecium from Lower Miocene bryozoan limestone at Mitchell River, Bairnsdale. Nat. Mus. Coll., No. 14,063.
Fig. 7. *C. conservata.* Marginal zooecium from the same zoarial fragment as the zooecium represented in fig. 6. Nat. Mus. Coll., No. 14,063.
Fig. 8. *Chiastosella porosa* Canu & Bassler. Distal zooecium and ovicell from Clifton Bank, Muddy Creek, Hamilton (Lower Miocene). Nat. Mus. Coll., No. 14,064.

A NEW SPECIES OF APHELOCHEIRUS FROM AUSTRALIA (HEMIPTERA, NAUCORIDAE).

By Robert L. Usinger.

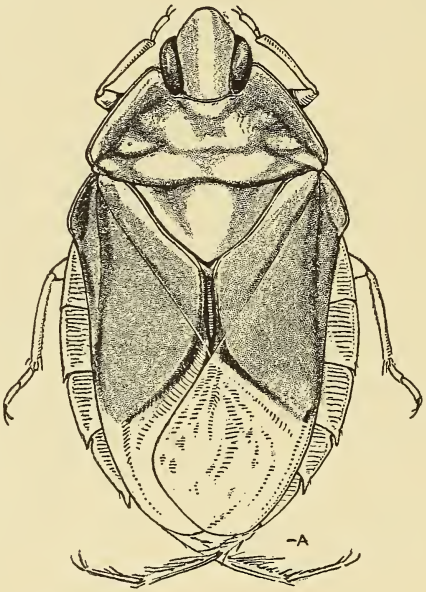
University of California, Berkeley, California.

The subfamily Aphelocheirinae is predominately palaearctic, with a few species occurring in the Oriental Region and in Africa. Both geographically and systematically the closest known relative of this first Australian species of *Aphelocheirus* is *pallens* Horvath. *Pallens* was described in 1899 from a single macropterous specimen collected by Biro in New Guinea. I am indebted to my friend Dr. J. F. Illingworth, of Honolulu, for the unique and likewise macropterous specimen described below.

Aphelocheirus australicus *sp. nov.*

Elongate-oval; head, pronotum, and scutellum polished; the body beset with scattered, very inconspicuous short hairs. Head longer than broad, 22::21; strongly produced before the eyes, the anteocular portion twice as long as postocular portion, its sides convergent and straight, broadly rounded at apex; length almost one and three-quarters as great as width of interocular space anteriorly; interocular space rather evenly divergent anteriorly, its width ratio at base and apex 10::13; disk tumid, distinctly punctate except at extreme apical margin; gula scarcely elevated. Eyes two and one half times as long as broad. Labrum scarcely broader than long, rounded apically. Rostrum attaining level of apices of intermediate coxae. Pronotum two and one half times as broad posteriorly as width of head including eyes; much shorter than head on median line, 13::22; coarsely punctate on elevated median disk, the depressed sides almost impunctate; anterior angles almost right angles, narrowly rounded; sides strongly dilated posteriorly, feebly rather evenly arcuate, the postero-lateral angles suddenly rounded, then feebly, angulately emarginate; posterior margin extending well behind level of posterior angles, distinctly roundly emarginate before middle of scutellum. Scutellum almost twice as broad as long; sub-basally transversely depressed, the depression following sinuation of hind margin of pronotum; strongly elevated behind the depression, its sides sinuate; subacute at apex. Hemelytra exceeding tip of abdomen; commissure of clavus subequal in length to scutellum; embolium strongly dilated basally, its sides feebly, evenly arcuate and then suddenly strongly rounded and converging, behind which the embolium continues, ever-narrowing, to apical third of corium, its sides straight or slightly concave; apical margin of corium sub-rectilinear, its outer apical angle produced posteriorly, then abruptly, obliquely turned forward to the margin. Connexivum broadly exposed, the postero-lateral angles progressively more acuminately produced on the hindmost segments, little more than right angles on first visible segment, distinctly, acuminately produced on fourth segment. Venter strongly elevated at middle, especially posteriorly, the fourth, fifth, and sixth segments each bearing three or four closely grouped spines at middle of their posterior borders. The lateral genital plates of seventh segment broad basally, narrowed apically, their outer margins subangular at basal fourth. Apices subtruncate, contiguous on anterior half, forming a small triangular emargination at apex of abdomen well beyond tip of subgenital plate.

Colour testaceous to fulvous, the pronotum transversely at centre and head fulvous. Pronotum within the testaceous lateral margins, anterior dilation and narrowly along inner apical margin of embolium, base of scutellum, outer apex of corium, and basal three-fourths of connexival segments, especially laterally within the yellow border, pale fuscous. Pronotum behind indistinct transverse impression and disk of scutellum in great part paler, fusco-testaceous. The rest of the hemelytra much darker fuscous, the membrane smoky, subhyaline, and obscurely spotted. Eyes black. Beneath lightly infuscated, the gula, appendages, except for tawny apex of rostrum and spines, and spiracular rosettes testaceous.



APHELOCHEIRUS AUSTRALICUS Usinger.

Size: Length, 8.75 mm.; width (connexivum), 5 mm.

Holotype, female, Cairns, North Queensland, 18, ‡‡ 125, J. F. Illingworth, in my collection deposited on loan in the type collection of the California Academy of Sciences.

Related to *pallens* Horvath in general form, prolongation of connexival angles, and long narrow head but differing from that species in the broader pronotum with postero-lateral angles feebly angulately emarginate and posterior margin more strongly, roundly emarginate at middle and the almost unicolorous embolium with rounded sides of anterior dilation.

OBITUARY.

Robin John Tillyard.

(Portrait Plate xix.)

An accident to the car in which he was being driven from Canberra to Sydney resulted in the death, on 13th January, 1937, of that brilliant scientist, Dr. Robin John Tillyard, in his 56th year.

Born in Norwich, England, in 1881, Tillyard was educated at Dover College and Queen's College, Cambridge. He left England for health reasons, and accepted a position as mathematical and science master at the Sydney Grammar School in 1904. He graduated B.Sc. at the Sydney University in 1914 and D.Sc. in 1917. In 1915 he was appointed to a Linnean Macleay Fellowship in Zoology, and two years later he was appointed lecturer in Zoology at the Sydney University. In the same year he was awarded the Crisp prize and medal by the Linnean Society of London. In 1917 he published his first book, "The Biology of Dragon Flies", which is regarded as the standard work on this group.

In 1919 he was appointed Chief of the Biological Department of the Cawthron Institute of Scientific Research, Nelson, New Zealand, and in 1927 he was made Assistant Director of the Institute. In 1928 the Council for Scientific and Industrial Research of the Commonwealth appointed Dr. Tillyard Chief of its Division of Economic Entomology at Canberra, a position he held until early in 1934, when ill-health compelled him to resign.

The greatest honour that can be awarded to a scientist, the Fellowship of the Royal Society of London, was conferred on Dr. Tillyard in 1925, and he received many other honours in recognition of his work. In January, 1931, the title of Fellow of the Royal Zoological Society of New South Wales was conferred upon him in recognition of his valuable services to Australian Zoology. He was for many years an Associate Member of the Society, and at the time of his death he was actively engaged in the preparation of "A New Classification of the Order Odonata or Dragon Flies" for publication in *The Australian Zoologist*. It is hoped that this work can be completed with the assistance of one of his former colleagues; in any case it is proposed to publish the completed part.

My personal acquaintance with Tillyard began when he was appointed Linnean Macleay Fellow in 1915. Physically frail, his mental strength was the more remarkable by contrast. His reading of papers on the Dragon Flies was always a treat to listen to, being characterised with the freshness and enthusiasm of a delighted school boy recounting his great discoveries in the field of Natural History. His description of the venation of the wings, the life histories as unfolded to him, and the graphic illustrations both on the blackboard and in narration of moving incidents attending the capture of a rare specimen, always were received with appreciation by the assembled members of the Linnean Society.

A. F. Basset Hull.

REVIEWS.

Three Notable "Wonder" Books.

(a) *Insect Wonders of Australia,* by Keith C. McKeown, Assistant Entomologist, Australian Museum. Sydney, Angus & Robertson, Ltd. 1935, 6/-.

From his observations in the field and in the Museum collections, with choice selections from writers, ancient and modern, Mr. McKeown answers many of the questions the seeker after information is wont to ask about our Australian insects. And he answers those questions in just the way you like, chatty and colloquial is his language, illuminating and full of charm his narratives of the life history (where known) and the strange habits of the ants, wasps, butterflies, moths, grasshoppers and other inhabitants of the insect world around us. There is just a sprinkling of the scientific aspect in the use of the scientific names where the insect in question has not so far been favoured with a vernacular name. Numerous illustrations from photographs by the author and other well-known Australian entomologists form an added attraction to a book that should be particularly acceptable to school libraries.

(b) *Spider Wonders of Australia,* by the same author and publisher, Sydney, 1936, 6/-.

Mr. McKeown may fairly be regarded as the Australian Fabre, his acquaintance with the manners and customs of Arachne, her loves, hates, accomplishments and diversions, is quite on a par with that of the great French naturalist when applied to the spiders of our continent. He tells the story of each species in the same attractive detail, setting out the manner of its hunting, mating, and upbringing of its offspring in the most lucid and engaging style. The chief charm of this author lies in his skill in presenting the incidents of a spider's career in terms applicable to those occurring in the life of a human being. He seems to be able to enter into the spirit which actuates the spider, and translates its feelings and actions into every day language. Here again many photographic illustrations are provided to assist the reader in identifying the particular spider he has observed in his own garden. The venomous species are fully dealt with and illustrated, so that the reader may know which to avoid.

(c) *Wonders of The Great Barrier Reef,* by T. C. Roughley, B.Sc., F.R.Z.S., Sydney, Angus & Robertson, 1936.

This work provides a remarkable example of the high standard in colour printing attained in this State, as well as in printing and general production. So far as the literary work is concerned, Mr. Roughley is well known as the Economic Zoologist of the Technological Museum, and as the author of "The Cult of the Goldfish" and other works, both technical and popular. His clear narrative style is well adapted to the task of taking the tourist or searcher after marine wonders over the fascinating area known as the Great Barrier Reef. He anticipates every question that might be asked as to means of getting there and what can be seen or done when the inquirer has arrived. The natural beauties of sea, reef, sand-cay and elevated island are all described in narrative form; the fish, mammals, birds, reptiles, molluscs, echinoderms and other delightful inhabitants of

the region are all dealt with in popular terms. But even transcending the word pictures this region evolves are the marvellous coloured illustrations. These are the result of the author's study of colour photography, and are the pick of some 100 photographs taken over, under or through water, showing the beautiful scenery, the wonderful coral growths, and the brilliantly hued fish, crabs and other natural attractions so liberally provided for the casual visitor or earnest student of marine zoology. To one who has often visited the region and seen the lagoons and coral pools in all their beauty under varying weather conditions these softly tinted, absolutely natural reproductions are a delight to the eye. The two island views of sunrise and sunset have the artistic effect and delicate tints of perfect water colour paintings.

Budgerigars: The Standard of Perfection and Classification of Colour Varieties, compiled by T. R. Treloar and J. Hocking for The Australasian Budgerigar Council, Melbourne, 1936. 4/6.

This work is issued as a guide to breeders and keepers of Budgerigars, whether for pleasure, profit, or scientific study of the possible colour mutations to be evolved from this beautiful little bird, which in nature keeps to its own standard of colour. The book contains a general view of the Australasian Budgerigar Council, its aims and objects, together with informative articles on nearly every subject of interest in relation to the Budgerigar. As a handbook it should be invaluable to the aviculturist, and its illustrations and colour chart are excellently produced.

Bush Rambles, by A. G. Hamilton, Sydney, Angus & Robertson, Ltd., 1937. 6/-.

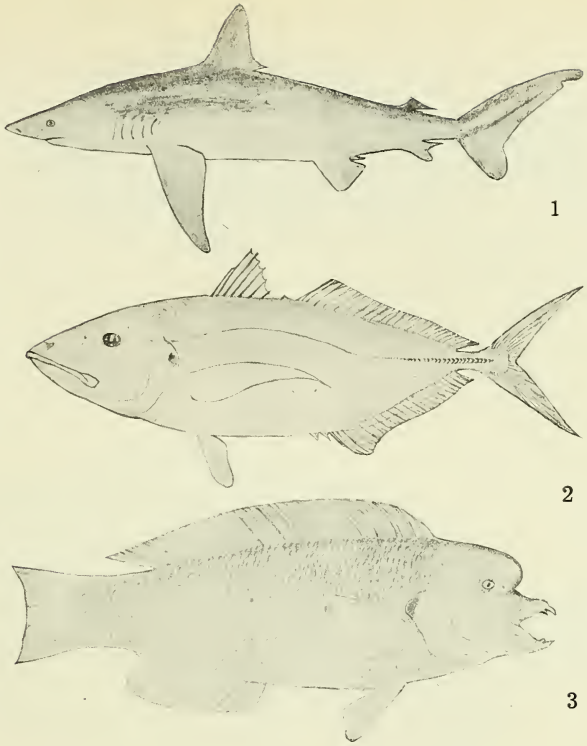
Like the fragrant scent from a pot-pourri jar comes this reprint of papers written by that veteran naturalist, A. G. Hamilton, forty and more years ago. A lover of the bush and seashore, the rivers and lakes, mountains and gullies of New South Wales, the author takes his reader on long nature trails, noting with the keen eye of the trained collector every bird, animal, insect and plant that he meets, touching each wih some remembered classical allusion, instructive or amusing incident of the occasion or of past excursions. Hamilton is a botanist first, a naturalist second, and a sincere lover of nature all the time. One reads his vivid chapter entitled, "When the wind bloweth in from the Sea" and smells the salt sea air, the iodine laden weeds, and the frequently unpleasant odours of the ocean's dead things cast up by the storms. One wanders with the writer through the lush and ferny undergrowth of the sandstone gullies and the rich volcanic subtropical forests of the Hawkesbury and Shoalhaven districts so near to the metropolis. One climbs the Blue Mountain region and sees with the eye of the author the great eucalypts and the humble shrubs, each with its attractive associations in flower, bird, and insect. For the bringing to the modern schoolboy and girl as well as their elders these fragrant memories of past wanderings the publishers deserve the thanks of all Australian nature lovers. The deep sympathy of all must be felt for the author, who can now see the beauties of the Australian bush in memory only, as he is blind.

NEW RULES.

The following Rules were made by the Council of the Royal Zoological Society on 24th February, 1937:—

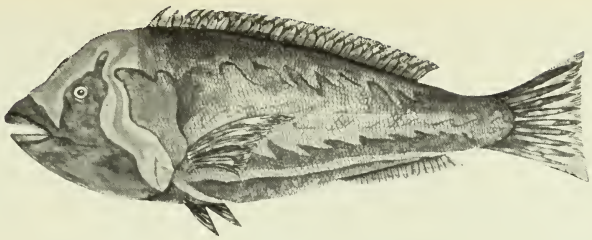
Rules Governing Awards for Notable Achievements in Zoology.

1. The Rules governing the award of Fellowship of the Society remain unaltered.
2. In the case of each Section of the Society an "Awards Sub-Committee," consisting of three members, may be appointed annually by each Section, and these members shall not necessarily be members of Council.
3. Each Awards Sub-Committee shall furnish a report to the Council annually in the month of June, stating whether any outstanding work suitable for award has been carried out. Such report shall indicate the order of merit of any achievement, placing it first, second, third, etc., on the list.
4. If considered by the Council to be of sufficient merit, a medallion may be awarded to the first on such list, and thereafter diplomas may be issued.
5. No awards shall be made to residents outside the State of New South Wales.
6. In the case of the Avicultural and Budgerigar Sections the award may be given to the member first reporting his successful breeding in captivity of any species of bird not included in the list of birds "not eligible". Any member wishing to obtain an award must send a detailed account to the Honorary Secretary of the Section within a week of young birds leaving the nest, and furnish such evidence of the facts as the Executive Committee may require. The award will be made only in cases where the young shall live to be old enough to feed themselves and to be independent of their parents. Birds must be reared by their natural parents. On notification a member of the Committee will inspect. The account of the breeding must be reasonably full so as to afford instruction to members of the Society; it should describe the plumage of the young and be of value as a permanent record of the nesting and general habits of the species, and must be forwarded within eight weeks to the Secretary of the Society for publication in the Society's journal before it is published or notified elsewhere.
7. The list of species which are "not eligible" for awards shall be declared annually in June by each Awards Sub-Committee.
8. Hybrids and subspecies of species may be included in the list for which awards may be given.



FISHES FROM MIDDLETON AND ELIZABETH REEFS. 4

G. P. Whitley, del. figs. 1-3. A. R. McCulloch, photo, fig. 4.



1

2

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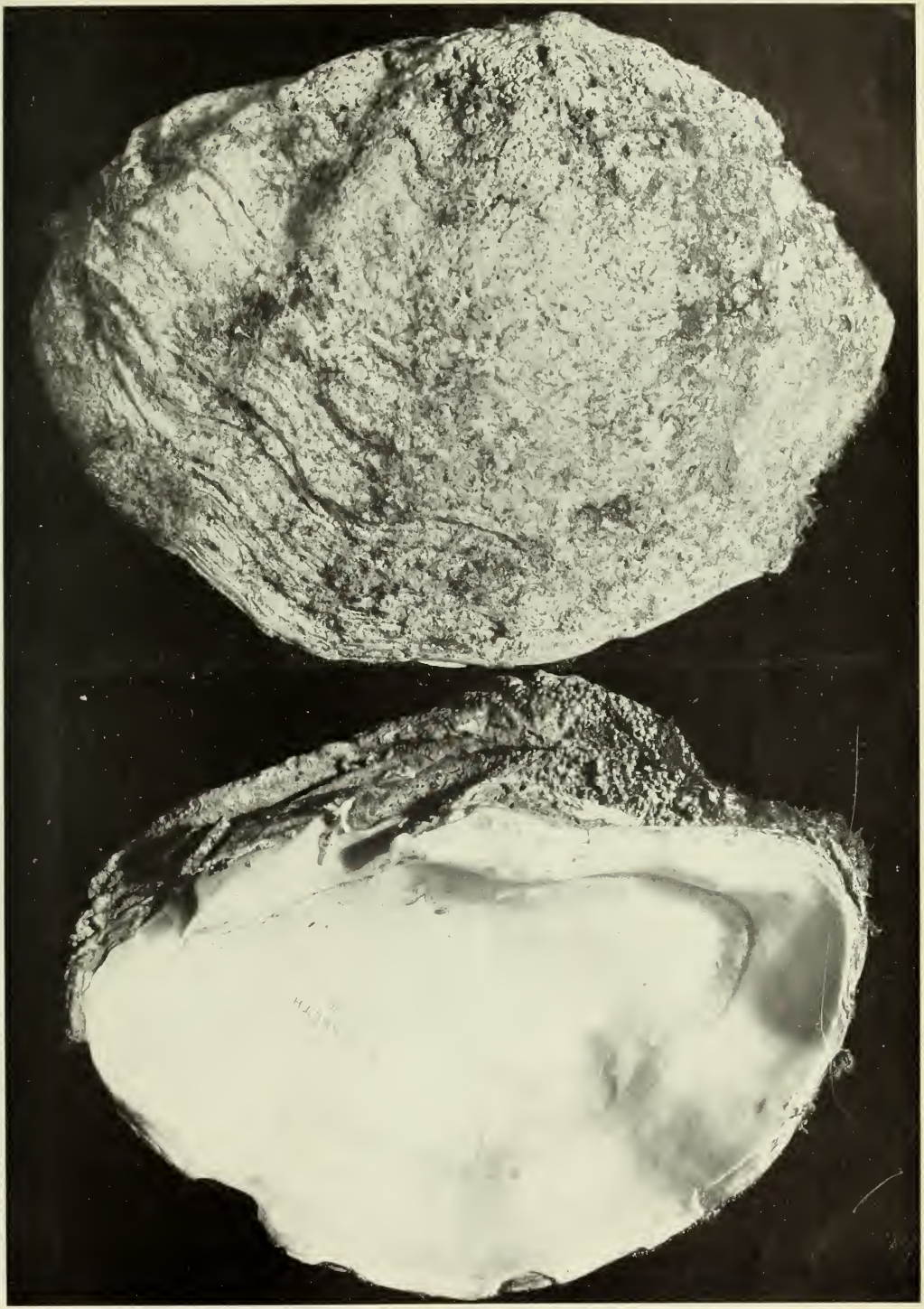
FISHES FROM MIDDLETON AND ELIZABETH REEFS.

Photo: A. Musgrave, fig. 1. H. Irwin, del. fig. 2. G. C. Clutton, photo, fig. 3.

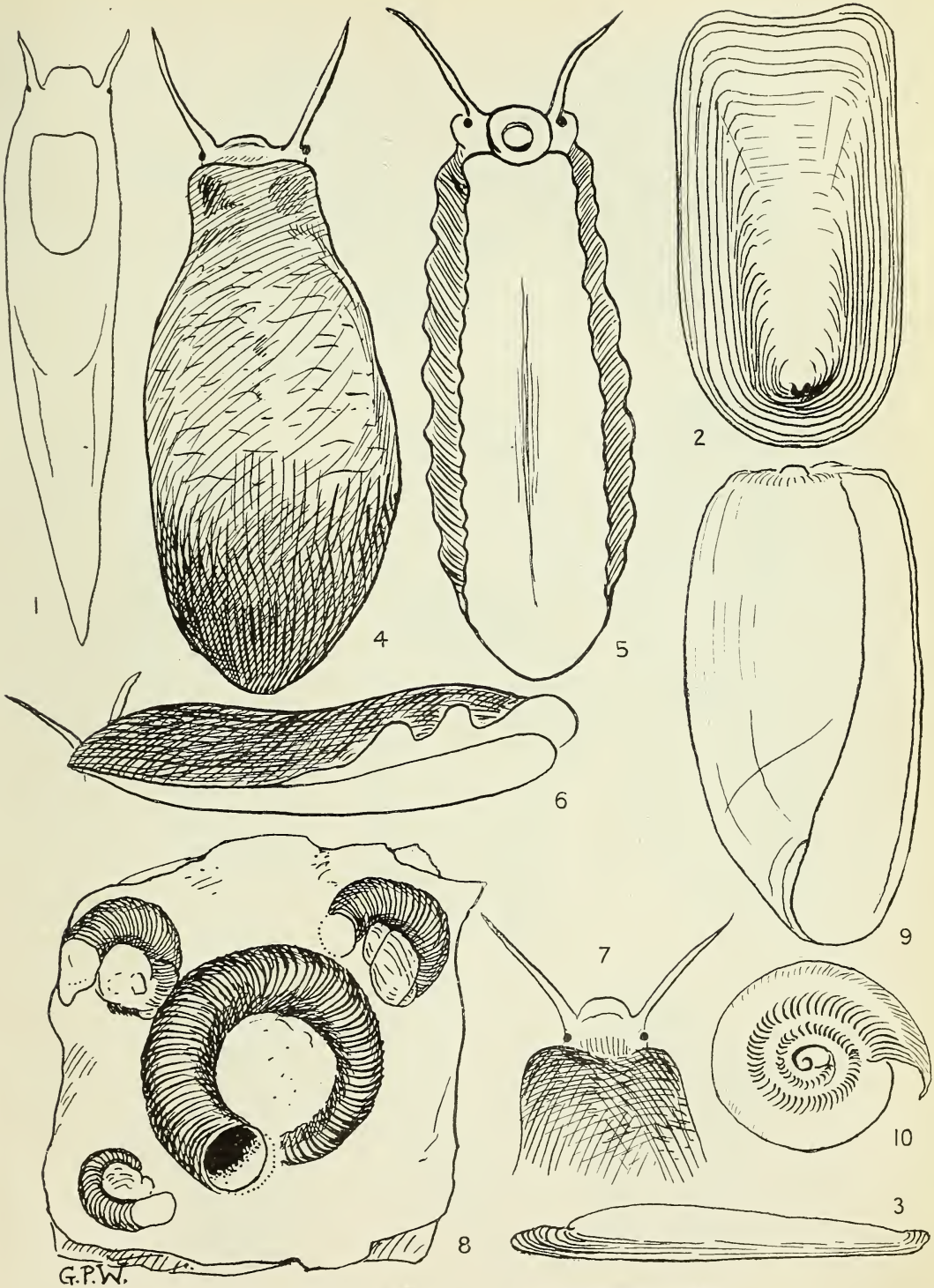


Mollusca from Middleton and Elizabeth Reefs.

Photo by G. C. Clutton.

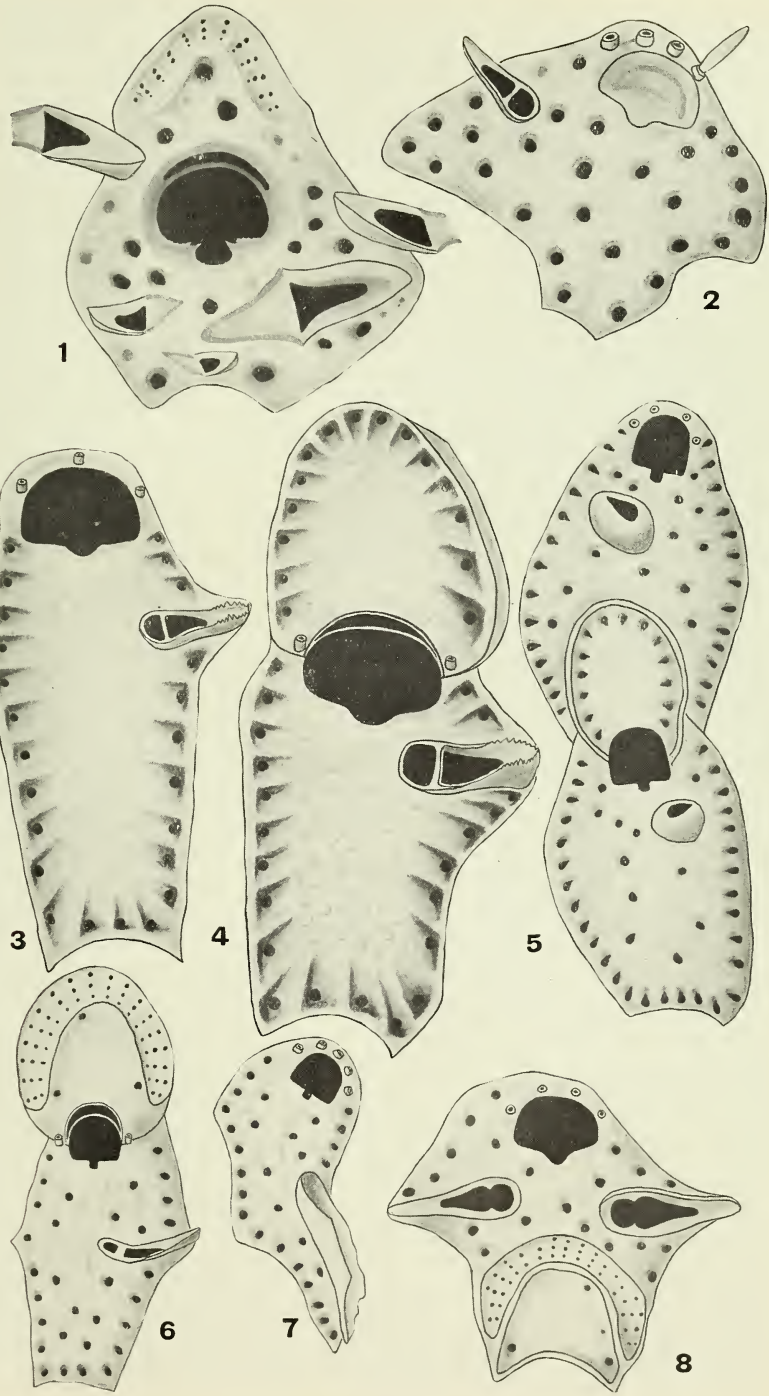
MOLLUSCA FROM MIDDLETON AND ELIZABETH REEFS.

Photo by G. C. Clutton.

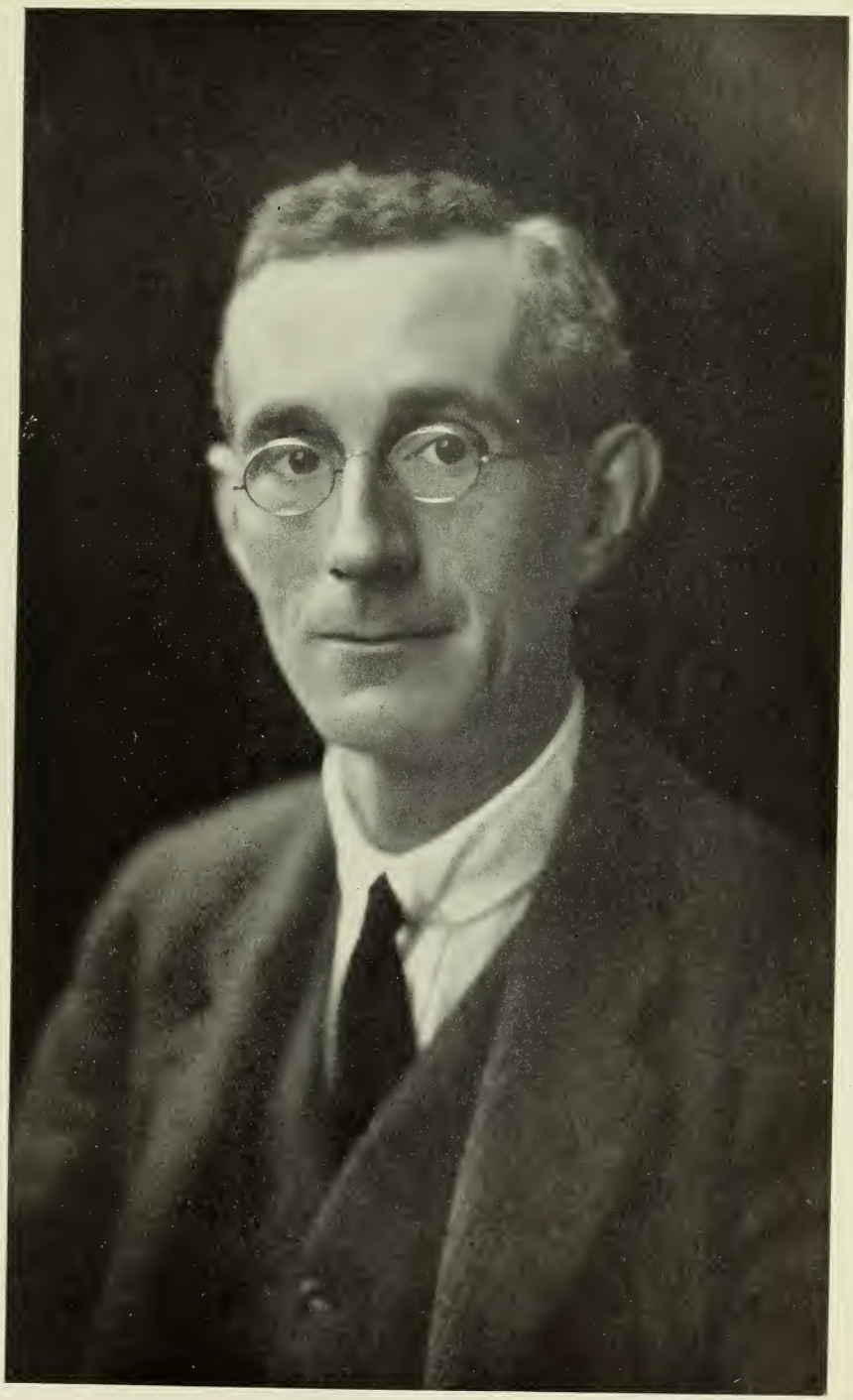


MOLLUSCA FROM MIDDLETON AND ELIZABETH REEFS.

G. P. Whitley, del.



SPECIES OF CHIASTOSELLA (BRYOZOA).



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