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No. 25

Issued 1st May, 1962

C. W. BRAZENOR.
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CONTENTS.

SIPHAMIA ZARIBAE WHITLEY (FAMILY APOGONIDAE), WITH SOME OBSERVATIONS ON ITS ECOLOGY.

R. J. Slack–Smith, Department of Zoology, University of Queensland, Brisbane.

I. Introduction.

During ecological studies at Heron Island, Great Barrier Reef (Lat. 23° 27′ Long. 151° 58′) Dr. R. Endean of the Department of Zoology, University of Queensland observed a small fish living commensally amongst the spines of the urchin *Echinothrix calmaris* (Pallas). On 24th August, 1957, the author collected 23 specimens at Heron Island from this host. They were determined to be a previously undescribed species of *Siphamia*. A description was prepared but just prior to its submission for publication, Whitley's brief description and name was received by the author (Whitley, 1959). As this account contains observations on the ecology of this species as well as an independently prepared full description and illustration, it is here submitted with appropriate alterations. This species is particularly noteworthy as it is the first record of commensalism in this genus.

The record of this species from Australia greatly enlarges the known distribution of the genus which has been previously illustrated by Smith (1955, p. 62, fig. 1). Indeed, careful faunistic studies will undoubtedly show that it is a truly tropical Indo–Pacific genus.

II. Description.

Family APOGONIDAE.

Subfamily *SIPHAMIINAE*.

Genus *SIPHAMIA* Weber.

Siphamia Weber 1909, p. 168 (Genotype *Siphamia tubifer* Weber); Fowler & Bean 1930, p. 142; Shultz et. al. 1953, p. 414–29; Smith 1955, p. 61–6.

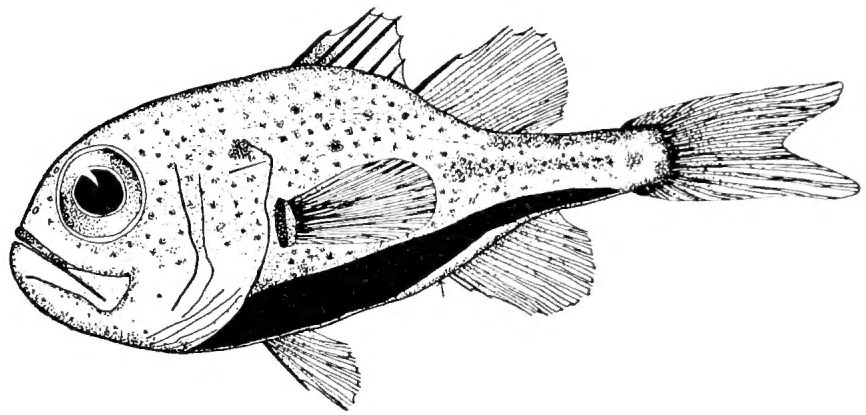

Figure 1.—*Siphamia zaribae* Whitley. 24 mm. specimen, Reg. No. A 150, National Museum of Victoria, from Heron Island, Queensland.

Shultz et. al. (1953) have revised the genus *Siphamia* and have constructed a comprehensive key to the species. This revision has been commented on by Smith (1955) who further divides this subfamily into the genera *Siphamia* Weber, *Scopelapogon* Whitley (1933) and *Adenapogon* McCulloch (1921).

The genus *Siphamia* as defined by Smith (1955) has not previously been recorded from Australia.

SIPHAMIA ZARIBAE WHITLEY.

Siphamia zaribae Whitley 1959, Aust. Zool. 12, 4, p. 323.

All material was collected from one specimen of *Echinothrix calmaris*. This was found on the outer reef flat of the northern reef at Heron Island amongst dead coral and rubble on 24th August, 1957. The fish were observed in association with this species of urchin in other outer reef-flat localities but were not collected.

D^1 VI; D^2 I, 9; fourth spine longest and thickest, second 0·3—0·5 in first, second and third about equal. A. II, 9; second spine 0·6 in first. C. vii, 15, vii; moderately forked, least length at fork about 1·5 in greatest length to caudal flexure; 1·5 in head. Least height of caudal peduncle 2·4 in greatest peduncle length. P. 15; 4·2 to 4·3 in standard length; rounded. V,I,5; second ray longest.

Greatest depth 2·2 to 2·7 in standard length; head 2·2 to 2·4, depth of head 0·9 to 1·1. Snout 4·9 to 5·5 in head; eye 2·7; 1·1 in interorbital. Maxillary reaches to about 0·6 in eye; length 1·8 to 2·0 in head; expansion 4·5 to 5·5 in head. Teeth in villiform bands in jaws, on vomers and palatines. Vomer prominent. Interorbital convex, 2·7 to 3 in head. Preopercular ridge entire; edge denticulated, teeth longest at angle. Gill rakers 1 + 1 + 5; long and slender. Tongue thick and pointed.

Scales in 20 vertical rows to caudal base, 1 or 2 more on latter; 5 predorsal; 2 rows above lateral line, 7 below; 1 or 2 rows on cheek; deciduous. Snout naked. Scales with 9 basal striae.

Lateral line indistinct, about 20 pores visible.

Peritoneal gland reaches to base of caudal in adults, not so far in juveniles (reaches just past anal base in 12·0 mm juvenile).

Colour.—Body and head densely covered with (fully or partially contracted) melanophores, the overall colour varying from complete black to grey with a black stipple. Three more or less distinct horizontal bands on tail; the first follows the posterior portion of the lateral line, the second the mid-axis of the peduncle and the third is formed by the completely black peritoneal gland on the ventral portion of the peduncle. Some smaller specimens show an indistinct spot at the caudal base.

In life, small red chromatophores are also present on the body and fins and their combination with the melanophores produces the deep red-black colouration similar to that of the host. On preservation in formalin these red chromatophores fade to very indistinct darker edged white spots. Caudal and pectorals hyaline. Basal two-thirds of first dorsal, basal third of second dorsal and anal dark black-brown. Iris dark.

S. zaribae differs from the remainder of this genus in having only 6 dorsal spines. It resembles *S. arygrogaster* in having 9 anal rays.

It is unique in having a completely black peritoneal gland.

Material: Nat. Mus. Victoria *Reg. No.* A.150, 1 specimen, 20 mm. in standard length; Nat. Mus. Victoria *Reg. No.* A.151, 7 specimens, 18·5 mm. to 9·5 mm.; Aust. Mus. Sydney *Reg. No.* IB.4129, IB.4132; 6 specimens, 18·0 mm. to 11 mm.; Queensland Mus. Brisbane *Reg. Nos.* I.8154–I.8160, 7 specimens 18 mm. to 10·5 mm.

III. Ecology.

A number of examples of commensalism of varying degrees of intimacy have been observed amongst reef fish. A loose association occurs between a number of small pomacentrids and various corals; particularly between *Pomacentrus sufflavus* Whitley and *Porites andrewsi* Vaughan and *Acropora breuggamanni* (Brook) (Slack–Smith ms). As the yellow colour of this fish blended well with the similar colour of the corals it is probable that this association is concerned with protective colouration and is not a true example of commensalism. Patton (personal communication) records that several species of *Gobiodon* occurred commensally in pairs amongst branches of the corals *Pocillopora damicornis* (Linnè) and *Porites andrewsi*. These fish were rarely observed outside the corals. Closer commensalism occurs between *Amphiprion spp.* and various large reef anemones. *A. percula* (Lacépède) is confined to *Stoichactis kenti* (Haddon and Shackleton) and *A. melonopus* Bleeker and *A. bicinctus* Ruppell to *Stoichactis haddoni* (Saville–Kent) (Saville–Kent 1893).

On the Great Barrier Reef *Carapus homei* (Richardson) lives commensally in the rectum of *Holothuria mammifera* Saville–Kent (Saville–Kent, 1893 and Roughley, 1936) and on the Hawaiian reefs a similar relationship occurs between *Carapus homei* and various holothuria (Tinker, 1944). Shultz (1943) records 2 species of Carapidae from the Samoan and Phoenix Islands but does not mention if they were taken from holothuria. le Danois (1957) illustrates the shrimp fish *Acoliscus stringatus* (Günther) swimming amongst the long spines of the urchin *Diadema sp.* This association is not very close as these fish are frequently observed away from the urchin. *Paramia bipunctata* Lachner have been recorded between the spines of *Diadema sp.* from the Red Sea (Lachner, 1955). This is the first record of commensalism between an apogonid and an urchin. Lachner used the term " inquilinism " for this particular relationship.

Undisturbed *Siphamia zaribae* were observed to swim around the basal half of the spines of *Echinothrix*, blending almost perfectly with its red-black colouration. However, when the host was disturbed they swam towards its corona and lay parallel to its spines. Violent disturbance of the urchin was necessary to make them move from this position, in fact, many still remained when it was taken from the water. This behaviour made collection of specimens a simple matter. If the fish alone were returned to the water they darted into the shadows of the nearest cover and remained hidden until the host was thrown back. They then immediately swam back to their former positions amongst the spines. Although these fish have not been observed feeding it is most unlikely that they move far from their host under normal conditions.

IV. Acknowledgments.

Thanks are due to Professor W. Stephenson, Dr. M. C. Bleakly and Mr. D. J. Woodland for helpful criticism and advice in the preparation of the manuscript.

This research was financed from Commonwealth Research monies of the University of Queensland.

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A SMALL COLLECTION OF FISH FROM MACQUARIE ISLAND.

R. J. Slack-Smith
Fisheries and Wildlife Department, Melbourne, Victoria.

I. Introduction.

Macquarie Island (Lat. 54° 13′ S., Long. 158° 59′ E.) is a small island situated approximately 850 miles south-south-east of Hobart, Tasmania, in the Southern Ocean. Since 1948 the Australian National Antarctic Research Expedition (ANARE) has maintained a scientific station at the northern end of the island.

In December 1959 Miss J. Hope Macpherson, Curator of Molluscs at the National Museum of Victoria, and Miss Isobel Bennett, Scientific Assistant to the Professor of Zoology at the University of Sydney accompanied the ANARE relief expedition to Macquarie Island aboard the M.V. " Thala Dan " for the purpose of carrying out ecological studies. During the five-day period spent on the island 26 fish specimens were either collected by these two workers or presented to them by Mr. D. Smith, a member of the ANARE scientific staff. All the specimens were collected from a limited area adjacent to the ANARE station.

Although all species in this collection have been previously recorded from Macquarie Island, this paper presents a further record, certain comments, and a guide to the relevant literature which it is hoped will be a starting point for future ichthyological work in this area.

All specimens are housed in the National Museum of Victoria and the registered numbers are given.

II. Fishes Collected.

Family MYCTOPHIDAE (lantern fishes).

Genus *MYCTOPHUM* Rafinesque, 1810.

MYCTOPHUM SUBASPERUM (Günther).

Scopelus subasper Gunther 1864, p. 411.

Myctophum subasperum Waite 1916, p. 59, pl. 4, fig. 2, fig. 13; Norman 1930, p. 323, fig. 29.

Nat. Mus. Vic. Reg. No. A.153, 1 specimen 90 mm. in total length. Collected by D. Smith from a rock pool in Garden Cove after a storm during June, 1959.

This specimen was identified by Dr. R. L. Bolin of the John Hopkins Marine Laboratory, California.

MYCTOPHUM SP. JUV.

Nat. Mus. Vic. Reg. No. A.154, 16 specimens, 11-19 mm. in total length. Collected by Macpherson and Bennett in an overnight surface plankton tow made from the M.V. "Thala Dan" while anchored in Buckle's Bay.

The generic identification was made from Taning (1918). These specimens were also examined by Dr. Bolin.

Family HARPAGIFERIDAE.
Genus *HARPAGIFER* Richardson, 1844.

HARPAGIFER BISPINIS (Schneider).

Callionymus bispinis Bloch and Schneider 1801, p. 45 (*ex* Forster MS).

Harpagifer bispinis Richardson 1844, p. 11, pl. 5, figs. 1-3;—1845, p. 19, pl. 12, figs. 8, 9; Waite 1916, p. 70; Norman 1937, p. 59;—1938, p. 52, fig. 32.

Nat. Mus. Vic. Reg. No. A.153. 3 specimens, 57-72 mm. in total length collected by D. Smith during April, 1959. This species was reported to be abundant in rock pools during the whole year.

A dissected specimen proved to be a ripe female containing large yellow eggs. Its gut contained a number of macerated crustaceans which appeared to be Amphipods. This circumpolar species is recorded from rock pools and shallow waters in the whole Subantarctic region and from Graham Land on the Antarctic continent.

Family NOTOTHENIIDAE.
Genus *NOTOTHENIA* Richardson, 1844.

NOTOTHENIA MACROCEPHALA Günther.

Notothenia macrocephala Günther 1860, p. 263; Regan 1913, p. 227; Waite 1916, p. 66, pl. 3, fig. 2, fig. 16; Norman 1938, p. 27.

Nat. Mus. Vic. Reg. No. A.155. Four specimens 68-187 mm. in total length. Collected by D. Smith in April, 1959. Colours in life bright red with green eyes. Common in rock pools during whole year.

Nat Mus. Vic. Reg. No. A.157. One specimen 181 mm. in total length. Found washed up on beach in Garden Cove by Macpherson and Bennett in December, 1959.

This species has been also recorded from the Patagonian Region, the Kerguelen Region and the Antipodes.

The largest and smallest specimens were dissected, both being immature and of an indeterminate sex. In view of the comparatively large size attained by this species (Waite loc. cit.) it is not surprising that our specimens were immature. The ovaries of Waite's 435 mm. fish were approaching maturity, but it is not known if this was for the first time.

The gut of the smallest fish contained unidentified crustacean remains and traces of red algae. There was a large isopod in the gut of the largest fish.

Family CONGIOPODIDAE.

Genus *ZANCLORHYNCHUS*, Günther, 1880.

ZANCLORHYNCHUS SPINIFER Günther.

Zanclorhynchus spinifer Günther 1880, p. 15, pl. 8, fig. A; Waite 1916, p. 72; Norman 1937, p. 59, fig. 4.

Nat. Mus. Vic. Reg. No. A.156. One specimen 233 mm. in total length. Collected by Macpherson and Bennett in a dredge from 30 meters in Buckle's Bay, December 1959.

This species has been recorded previously only from the Kerguelen–Macquarie Island area.

Our large specimen differed from the description of Waite (1916) and Norman (1937) in the larger size of spines on the head and the form of the anal fin. Also no mention was made of three flat, opercular spines radiating from just below the large supraopercular spine to a point a little beyond the opercular edge.

III. Discussion.

Regan (1913, 1914, 1916), Waite (1916), Norman (1937, 1940) and Whitley (1941) recorded fish from this area. Regan (1916) stated that Macquarie Island fish fauna is more closely related to that of the Kerguelen area some 3,000 miles distant, than to the Subantarctic islands of New Zealand which are only 400 miles away. He also pointed out that Macquarie Island and the Kerguelen area are almost on the same isotherm.

Waite (1916) and Norman (1937) listed the distribution of species from Macquarie Island, indicating that *Zanclorhynchus spinifer* was the only species common to the Macquarie–Kerguelen area. Of the remainder *Notothenia macrocephala* was found adjacent to the Antarctic continent. *Harpagifer bispinis* was found to be circum-polar in both the Antarctic and Subantarctic regions. *N. colbecki* was recorded from the Antipodes, but did not occur in the collection described in this paper. The biogeographic relationships are, therefore, very incompletely known and can only be elucidated by further intensive collecting from Macquarie Island and elsewhere in the Subantarctic region.

IV. Acknowledgements.

The author is indebted to Mr. P. G. Law, Director of the Antarctic Division of the Department of External Affairs, for permission to study the above collection, and to Miss J. Hope Macpherson for help and encouragement during the preparation of this paper. The manuscript was read by Mr. J. K. Ling.

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ACCRETIONARY GROWTH STRUCTURES, SOUTHWEST VICTORIAN COAST, AUSTRALIA.

By George Baker, D.Sc.

Contents.

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Abstract.

Macro- and micro-accretionary growths of calcareous, phosphatic, pyritic, limonitic, glauconitic and sulphatic composition, are marked features of some of the sediments outcropping along certain parts of the south coast of Western Victoria. Of lesser abundance are siderite, manganese dioxide and halite accretionary growths. Their distribution, mode of occurrence and nature have been studied along some 25 miles of the coastline, extending from Freetrader Point in the southeast, through Princetown and Port Campbell to beyond Peterborough in the west.

The accretionary structures range in form from isolated nodules and concretions to discontinuous layers and sheets developed under different conditions in several horizons of a stratigraphical sequence composed of Lower Cretaceous, Paleocene–Lower Eocene, Lower Miocene–Oligocene, Miocene, Post-Miocene, Pleistocene and Holocene to Recent deposits.

Introduction.

Accretionary bodies of various shapes and sizes composed of different types of secondarily aggregated mineral matter, sometimes markedly different from, often much the same as the principal constituents of their host rocks, occur sporadically in parts and in considerable prominence elsewhere along the southern coastline of southwest Victoria. These structures are in rocks ranging from Lower Cretaceous to Recent in age, exposed in occasional quarries, stream beds, road cuttings, borrow pits and landslip scars, but mainly in bold, commonly vertical sea cliffs.

The area embraced by these studies extends from Freetrader Point (fig. 1) on the south-western flanks of the Otway Ranges, along the seaboard of the Port Campbell coastal plain to a point some 25 miles to the west, beyond Peterborough. Marine and subaerial erosion combined, have exposed the more resistant accretionary growths to the best advantage in steep, high cliffs of relatively soft sediments.

The accretionary growths form sheets, discontinuous layers, irregularly-shaped tuberous forms, individual nodules and concretions, and occasional crystal aggregates. Few of the nodules and concretions reveal concentric structures internally.

Some of the accretions are epigenetic in having formed subsequently to the compaction of the host strata. Others are syngenetic or early diagenetic and were formed concomitantly with the deposition of detrital constituents or shortly afterwards.

Specimens mentioned in this paper are in the collections of the National Museum of Victoria. Reg. Nos. E.2560 to E.2599.

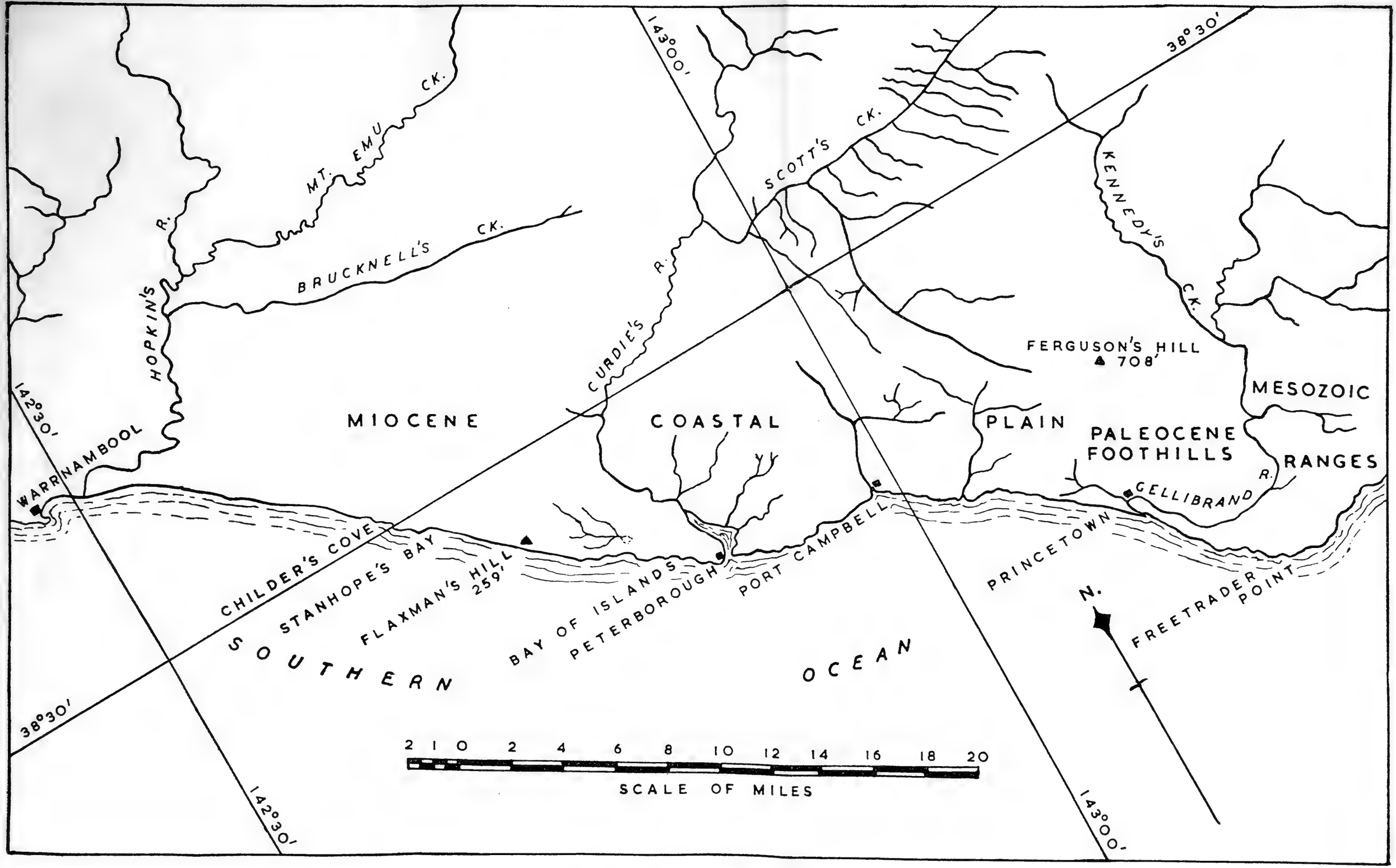

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FIGURE 1.—Locality map of the coastal region between Freetrader Point and Warrnambool, South-western Victoria.

Such accretions are products of the several processes operating when sediments are deposited in environments where they are temporarily out of equilibrium with the prevailing chemical, biochemical and physical conditions.

Factors determining the shapes of the different accretions vary from sediment to sediment and sometimes within the same sediment. Porosity of the sediment and an adequate supply of accretion-building material controlled the development of most of the accretionary bodies. Bedding and joint planes influenced the shape of epigenetic examples in particular. The shapes of some syngenetic to early diagenetic examples were primarily determined by fossil structures which acted as nuclei for precipitation. The shape of derived nodules (e.g. remanié phosphatic examples) was fundamentally controlled by rolling on the sea floor. Agitation was necessary for the development of oolithic grains in some of the sediments, and for the growth of free pisoliths and ooliths in cave pools.

The mineral matter constituting the accretions is most frequently calcareous, sometimes phosphatic and sometimes glauconitic. Less often it is pyrite, limonite, siderite, gypsum or hydrous iron sulphate, and infrequently it is halite or manganese dioxide. Growth has been by external additions and increase by adhesion or inclusion, in places more or less regularly, but not always symmetrically about a central point or line.

Calcareous accretions like those described herein have also been observed in cliffs of Miocene limestone further to the west, where they are prominent at the Bay of Islands, Flaxman's Hill, Stanhope's Bay and Childers Cove (fig. 1).

Although the accretions are minor features of some and wanting from other horizons, calcareous varieties assume importance because of their widespread lateral distribution as lines of nodules and thin sheets in the more richly calcareous horizons of the Miocene strata (Baker, 1943B, p. 360). They form conspicuous, even if small-scale features in the local geomorphology, on weathering of these strata (Baker, 1958).

Some of the accretions have been described previously (Baker, 1942, 1945; Baker and Frostick, 1951); others have received passing mention in studies of the geology and physiography of the Peterborough—Moonlight Head area (Baker, 1943A, 1943B, 1944, 1950, 1953, 1958). This paper (i) brings together the results of studies of all the various types of accretions observed, (ii) provides an overall picture of their occurrence in the stratigraphical sequence, (iii) elaborates upon their

distribution, occurrence and nature in the field, (iv) compares their chemical compositions, and (v) discusses their significance in the various host strata.

Distribution.

The distribution of the different types of accretions can be gauged from the areal extents of the various sedimentary formations and members shown in figure 2, used in conjunction with their vertical distribution in the stratigraphical column shown in Table 1.

Table 1.

Vertical distribution of macro- and micro-accretionary growth structures in the stratigraphical sequence of the Moonlight Head—Port Campbell region.

Group and Age.	Host Sediment.	Macro-accretions.	Micro-accretions.
Holocene ..	Soils..	"Buckshot gravel" nodules (ferruginous) Travertine nodules	Micro-forms of the same materials
	Beach, Cave, and Dune Sands	Calcareous sand stalagmites Normal stalactites and stalagmites Calcareous beach sand plasters on cliff bases Calcareous nodules Calcareous tubular and solid cylindrical concretions Calcareous cave pisoliths	Calcareous cave ooliths
Pleistocene ..	Dune Limestone ..	Calcareous sheets and nodules	
Post-Miocene ..	Clay Capping.. ..	Limonitic nodules Remanié (Miocene) calcareous concretions	
Heytesbury Group (Miocene)	Port Campbell Limestone (aphanitic)	Calcareous accretions Thin calcareous sheets Pyritic accretions (largely oxidized) Rare phosphatic and pyritic nodules in Rutledge's Creek Member Rare seams of gypsum	Glauconite pellets Foecal pellets
	Glenample Clay (calcareous)	Calcareous accretions Thin calcareous sheets	Glauconite pellets Foecal pellets
	Gellibrand Clay (calcareous)	Occasional calcareous accretions Occasional pyritic nodules (some oxidized) Very rare, small manganese dioxide nodules	Glauconite pellets Foecal pellets

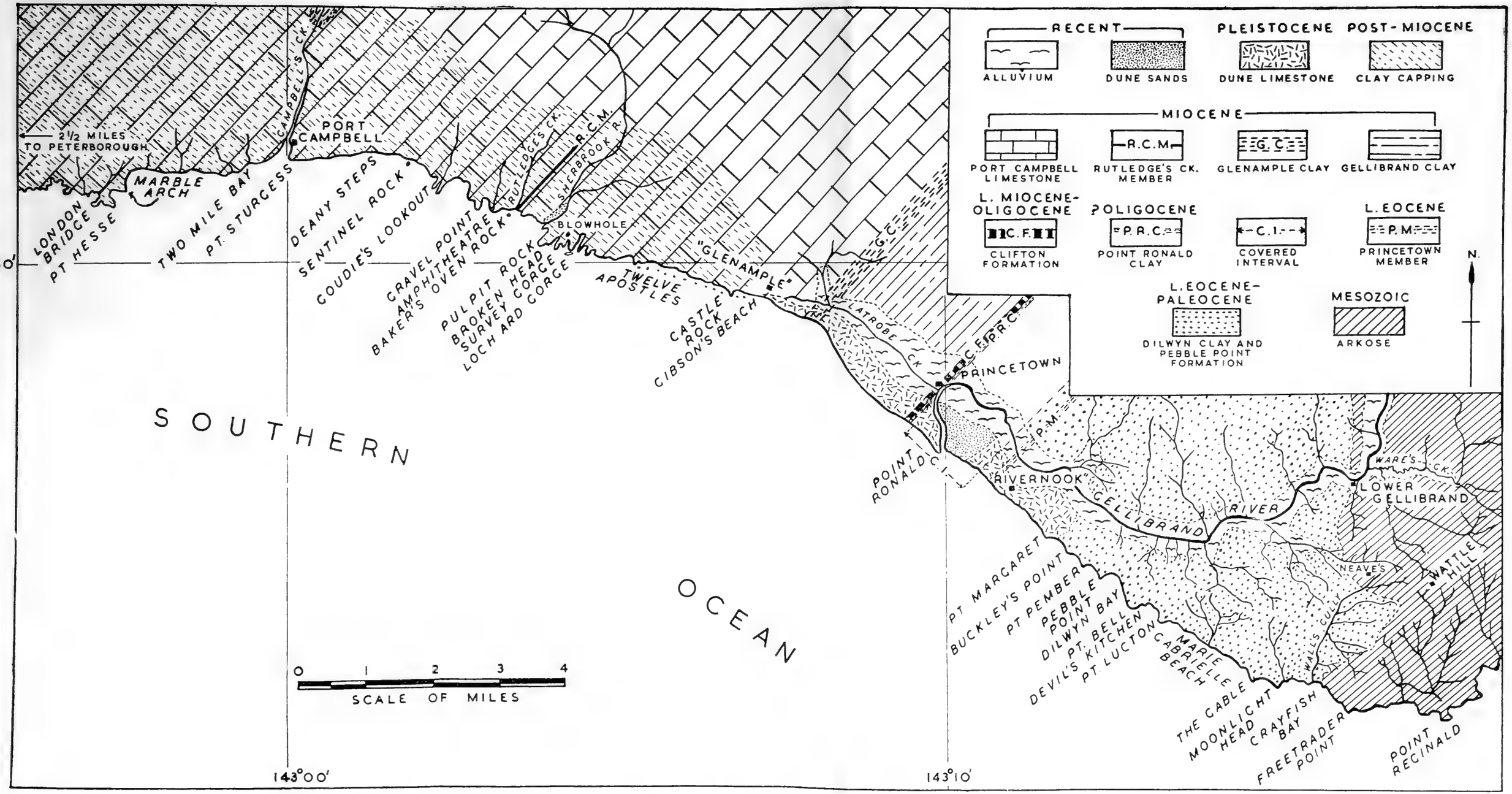

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FIGURE 2.—Geological sketch map of the Moonlight Head–Princetown–Port Campbell coastal region, showing place names.

TABLE 1—*continued.*

Group and Age.	Host Sediment.	Macro-accretions.	Micro-accretions.
Heytesbury Group (Lower Miocene to Oligocene)	Calcareous Clay of the Clifton Formation	Calcareous accretions (some septaria)	Glauconite pellets Foecal pellets
	Bryozoal Limestone of the Clifton Formation	Phosphatic sheets ..	Phosphatized foecal pellets
	Clifton Formation phosphorite	Phosphatic nodules ..	Pellet phosphate
	Gritty Quartz Sandstone (in part calcareous)	.. .. ..	Rare pellet phosphate
(?) Oligocene ..	Point Ronald Sandy Clay		
COVERED INTERVAL.			
Wangerrip Group (Lower Eocene to Paleocene)	Ferruginous Sandstone	Limonitic nodules	
	Princetown Member (carbonaceous silty sandstone) of the Dilwyn Silty Clay	Pyrite nodules Hydrous iron sulphate nodules and thin seams Crystal aggregates of pyrite Crystal aggregates of selenite	Rare, superficial crystal aggregates of halite
	Sandstone bands in Dilwyn Silty Clay	Pyrite nodules Rare phosphatic nodules	Glauconite pellets Minute crystal aggregates of pyrite
	Dilwyn Silty Clay ..	Pyrite nodules Hydrous iron sulphate nodules and thin seams Rare phosphatic nodules	Oolitic grains of collophane Micro-replacements of fossil fragments by pyrite
	Rivernook Member (glauconitic) of the Dilwyn Silty Clay	Calcareous – phosphatic nodules and thin seams Crystal aggregates of gypsum	Glauconite pellets Minute crystal aggregates of pyrite
	Pebble Point Formation (glauconitic sandstones, grits, and conglomerates)	Pyrite nodules Small phosphatic nodules Rare crystal aggregates of selenite Limonitic sheets and nodules Remanié (L. Cretaceous) siderite nodules	Glauconite pellets Foecal pellets Calcite – siderite – glauconite ooliths Calcite rims to detrital grains Collophane ooliths
ANGULAR UNCONFORMITY.			
Otway Group (L. Cretaceous)	Moonlight Head arkose and rare mudstone (Devil's Kitchen Mudstone)	Pyrite nodules Large calcareous accretions ("Cannon Balls") Smaller calcareous nodules Rare siderite nodules Calcareous sheets	Calcareous concentric rim-growths around detrital grains

Composition.

The chemical compositions of the main types of accretions are shown in Table 2.

Table 2.

Chemical Compositions of Accretionary Growths.

	1.	2.	3.	4.	5.	6.	7.	8.
	%	%	%	%	%	%	%	%
R_2O_3	0·58	1·74	1·08	0·33	33·38	41·68	0·94	3·48
$CaCO_3$	96·28	69·66	92·50	96·17	30·32	41·18	88·06	93·06
$MgCO_3$	1·72	19·83	1·62	0·87	0·67	0·77	0·83	2·54
H_2O (+)	tr.	3·06	0·31	0·12	3·11	0·22	1·11	tr.
H_2O (−)	tr.	1·16	0·11	0·11	1·61	0·17	0·80	tr.
P_2O_5	..	..	..	..	18·97	12·96	..	..
Insoluble residue ..	1·54	3·66	4·42	2·45	10·85	3·08	7·76	1·46
Total ..	100·12	99·11	100·04	100·05	98·91	100·06	100·10	100·54
Sp. Gr. of Powder* ..	2·73	2·67	2·70	2·73	2·88	2·92	2·67	2·73

(anal. G. C. Carlos.)

(*The specific gravity values of the powdered accretionary growths were determined in distilled water at 20° C. on an air-damped balance.)

Key to Table 2.

1. Dense calcareous accretion with *Ditrupa wormbetiensis*, from Port Campbell Limestone. Quarry, Spark's Gully, 2½ miles east of Port Campbell.

2. Port Campbell Limestone (aphanitic) adjacent to and enclosing specimen No. 1 (Table 2). Quarry, Spark's Gully, 2½ miles east of Port Campbell.

3. Nodular calcareous accretion from Port Campbell Limestone. Marble Arch, 2¾ miles west-southwest of Port Campbell.

4. White to buff-coloured calcareous accretion from calcareous clay immediately above limestone in the Clifton Formation. Three quarter mile southwest of Princetown.

5. Phosphatic cylindrical accretion from Gellibrand Clay, 1½ mile west of Princetown.

6. Phosphatic cylindrical accretion with shelly fragments, from coquina band, Rutledge's Creek Member. Mouth of Rutledge's Creek, 3½ miles east-southeast of Port Campbell.

7. Round, nodular calcareous accretion from Gellibrand Clay. One and half mile west of Princetown.

8. Calcareous cylindrical accretion from Port Campbell Limestone. Pulpit Rock, 4 miles east-southeast of Port Campbell.

A chemical analysis of the Port Campbell Limestone is included in Table 2 (column 2) for comparison with that of an

accretion from the same locality; this reveals that the enveloping limestone, contains approximately 11·5 times as much magnesium carbonate as the lime-rich accretion (column 1, Table 2).

Ratios of the principal constituents of the analysed accretions are listed in Table 3. These show a wide range in the relationships of $CaCO_3$ and $MgCO_3$ in nodules from different beds, and significant variations in the relationships between total carbonate contents and insoluble residues.

TABLE 3.

Ratios of principal constituents of analysed accretionary growths.

Sample Number (as in Table 2).	$CaCO_3 : MgCO_3$.	Total $CO_3 : P_2O_5$.	Total CO_3 : Insoluble Residue.
1	56·0	..	63·6
2	3·5	..	24·4
3	57·0	..	21·3
4	110·5	..	39·6
5	45·0	1·6	2·9
6	53·5	3·2	13·6
7	106·8	..	11·5
8	36·6	..	65·5

Specific Gravity.

Specific gravity values of hand specimens of different shapes of accretions of similar and different chemical compositions, determined in distilled water at 20°C. on a Walker's Steelyard, are shown in Table 4.

Specific gravity variations among accretions of the same composition (Table 4) reflect the presence of impurities such as alteration products or included alien mineral matter. Thus the specific gravity of pyritic accretions in the Gellibrand Clay (2·33—3·82) varies according to degrees of alteration to gypsum and hydrous iron sulphates (copiapite, &c.), and in older formations (2·98—4·00) according to the amounts of quartz and carbonaceous matter entrapped from the host sediment. Examinations of polished surfaces confirm these observations, and reveal that the pyrite acts as a cement to detrital quartz grains, thus contrasting with well-developed pyrite crystals in Tertiary marine clays at Torquay, Victoria (Edwards and Baker, 1951, pp. 40-44), where little host rock material has been incorporated in the pyrite.

TABLE 4.

Specific Gravity Values of various types of Accretionary Growths.

Type.	Shape.	Sediment.	Specific Gravity.
Calcareous	Sub-spherical, nodulose ..	Port Campbell Limestone ..	2·50
,, ...	Irregular	,, ,, ,, ..	2·24
,, ...	Ellipsoidal to sub-spherical, flat and nodulose	,, ,, ,, ..	2·26–2·32
,, ...	Elongated, nodulose ..	,, ,, ,, ..	2·45 2·48
,, ...	Cylindrical to sub-spherical	Gellibrand Clay	2·21–2·60
,, ...	Irregular, nodulose ..	Calcareous Clay of the Clifton Formation	2·56–2·61
Calcareous septaria ..	Sub-spherical	,, ,, ,, ,,	2·47–2·49
Pyritic, partially oxidized	Elongated, cylindrical ..	Port Campbell Limestone ..	3·67
Pyritic, altered to gypsum and copiapite, &c.	Irregular, nodulose to cylindrical	Gellibrand Clay	2·33–3·82
Pyritic, with some included carbonaceous matter	Sub-spherical to tuberous and ellipsoidal	Princetown Member (carbonaceous silty sandstone)	2·98–3·43
,, ,, ,,	Irregular	Dilwyn Clay (carbonaceous silty clay)	3·10
Pyritic	Sub-spherical to ovoidal ..	Pebble Point Formation (sandy grits, &c.)	3·90–4·00
,, ...	,, ,, ,, ..	Otway Group (arkose) ..	3·43–3·46
Phosphatic	Cylindrical	Coquina band, Rutledge's Creek Member	2·45
,, ...	Irregular, sub-spherical, ellipsoidal, cylindrical	Clifton Formation Phosphorite	2·74–3·27
Phosphatic with Glauconite	Sub-spherical to ellipsoidal	Dilwyn Silty Clay ..	2·93
,, ,, ,,	,, ,, ,, ,,	Pebble Point Formation (sandy grits, &c.)	2·69–2·73
Limonitic	Layers	Pebble Point Formation (gritty ironstone)	2·82–2·93
Limonitic (oxidized pyritic accretions)	Elongated, cylindrical ..	Port Campbell Limestone ..	2·86–3·32
Limonitic (brown) ..	Sub-spherical	Holocene " buckshot gravel " horizon	2·70–2·83
Limonitic (black) ..	,, ...	,, ,, ,, ,,	3·13–3·53

Specific gravity variations of limonitic layer accretionary structures from the Pebble Point Formation (Table 4), arise from different contents of fine to medium sand size, and sometimes coarser, quartz grains. Variations among the cylindrical limonitic accretions in the Port Campbell Limestone, result from different degrees in the alteration of pyrite to limonite. Among the " buckshot gravel " nodules and granules, the variations in specific gravity (2·70—3·53) are due primarily to

differences in the nature and amount of the iron oxide composing them, some being earthy and limonitic, others being more compact and containing magnetic iron oxide (? maghemite).

Phosphatic accretionary growths vary in specific gravity because of different contents of (*a*) shell debris and micro-fossils, (*b*) superficial alteration to limonite, (*c*)detrital quartz grains of varying size, (*d*) glauconite pellets, and (*e*) calcite ooliths.

Specific gravity differences (2·21—2·61) among calcareous accretions are due largely to varying degrees of compaction and cementation, and partly to different contents of adventitious mineral matter, shell debris, and/or small fossils.

Types of Accretionary Growth Structures.

Calcareous Accretionary Growths

The wide vertical distribution of calcareous accretions is shown in Table 1, where the range is indicated as extending from Lower Cretaceous to Recent and occurrences are listed from most of the formations.

Lower Cretaceous

Examples of late diagenetic calcareous accretions from the Lower Cretaceous arkose are two inches up to a foot or so across, mainly spherical to sub-spherical in shape, sometimes ovoidal, and on weathering, they protrude conspicuously from cliff faces and shore platforms as " cannon-balls " (cf. Edwards and Baker, 1943; Baker, 1950, p. 19). They contain from 45 per cent. to 50 per cent. acid soluble (1 : 1 HCl) carbonate, and detrital quartz, felspar, chlorite and occasional hornblende, biotite, zircon, tourmaline, &c. The carbonate is largely calcite which acts as a cement and forms coatings around most detrital grains, besides infilling many interspaces. Because of this, the " cannon-balls " seldom reveal concentric internal structures, while bedding planes, whether horizontal or dipping, sometimes appear to pass uninterruptedly through them. In places, they reveal small flange-like protuberances resulting from extended growth along the bedding planes.

In addition, flat-lying lenticular nodules and sheets occur along bedding planes, while occasional precipitation along joints, especially on the northwest side of Point Lucton, has resulted in the development of steep to almost vertical veins of epigenetic calcite.

The " cannon-balls " occur in localized positions, e.g., as at the head of Crayfish Bay and in cliff faces and shore platforms at The Gable and Point Lucton; their size and concentration are evidently due largely to variations in porosity of the host arkose. The principal cement away from these structures, is likewise calcite, but in much smaller concentrations (occasionally as low as 3 per cent. of the matrix); it was derived from connate waters (Edwards and Baker, 1943, p. 207). Layered calcite along joint and bedding planes is partly secondary to the calcite cement of the host rock, and a few examples have been observed in which they cut through the accretions.

Lower Miocene to Oligocene

Calcareous accretions in marine calcareous clays overlying the Clifton Formation limestone, average 2" x 2" x 1" in size, and are sub-spherical to irregular, rarely nodulose. Some have the typical cracks of septaria (Plate II., fig. P) which are not infilled with mineral matter and which crudely radiate and widen towards the centres of hand specimens. These are sometimes crossed by finer cracks concentric with the margins of the accretions, but the whole pattern of cracks is largely polygonal.

Most specimens have pure white, soft chalky crusts (Plate II., fig. Q) and more compact cores of cheese-like consistency and pale buff colour. They are principally calcium carbonate (Table 3, column 4), with a small amount of buff-coloured clay, minute quartz particles, rare zircon and rare dark brown, sausage-like pellets 1 mm. long (probably faecal pellets).

The growth of these accretions in calcareous clays involves initial development of a calcareous gel mass containing a little aluminium and magnesium carbonate. Case hardening, followed by dehydration of interior portions, resulted in a pattern of surface cracks from shrinkage on irreversible chemical desiccation. Subsequent exposure to atmospheric agents and wetting by sea spray, produced the white, soft chalky crusts, in a manner comparable with the production of patination in flint.

Miocene

Miocene calcareous accretions occur as occasional nodules in the marine calcareous Gellibrand Clay and Glenample Clay, and as numerous nodules, sheets and cylindrical structures, &c. in the more favourable horizons of the marine aphanitic Port Campbell Limestone.

Gellibrand Clay

Sub-spherical, cylindrical and tuberous accretions in the Gellibrand Clay are ½″ to 4″ across (Plate II., figs. L to N). They consist largely of $CaCO_3$, but contain a little magnesium carbonate, alumina, and significant proportions of insoluble residue (Table 2, column 7) composed of pale pinkish-buff clay with abundant small, angular quartz grains and rare zoisite, zircon and garnet.

In thin sections, the analysed accretion (Table 2, column 7) reveals a matrix of fine-grained, interlocking aggregates of calcite crystals 0·02 mm. across. Complete skeletons of foraminifera, minute gasteropods and ostracods like those in the host sediment, are embedded in the minutely granular calcite matrix; their interiors are usually infilled with coarser calcite crystals up to 0·15 mm. across. The matrix also contains fragments of bryozoa, broken spines and spicules, and rare fragments of larger shelly fossils. Occasional small, vugh-like structures lined with calcite crystals 0·05 mm. in size, could represent replaced portions of fragmented fossils. Rare minute pellets of glauconite are little larger than the granular calcite, while glauconite also infills a few tests of foraminifera. As there is no evidence to show that fragmentation of the fossils resulted directly from accretionary-generating processes, it is apparent that some submarine erosion, by current action, occurred prior to sedimentation, and less stable skeletal elements were thereby fractured.

The accretions are regarded as being syngenetic to early diagenetic, in a sediment accumulated partly by current action. Components were carried in to a region where a rather more stagnant environment prevailed than for the greater part of the depositional period of the younger Port Campbell Limestone. The acid soluble (1 : 1 HCl) fraction of the host calcareous clay is sometimes as low as 36 per cent., which is approximately 2·5 times less than the calcareous accretions.

The area of deposition was largely one in which fine detrital terrigenous mineral matter, accompanied by fossil fragments, micro-fossils and shells of larger forms living in the muddy calcareous environment, were accumulated under quiescent conditions. The growth of accretions in this sediment was thus comparable to that outlined by Weeks (1953). Removal of CO_2 that had accumulated under the somewhat stagnant environment was inhibited. Rapid using up of available oxygen resulted in lime being retained in solution as bicarbonate. The calcium

carbonate was subsequently deposited as accretions in favourable positions, such as around congregated fossil shelly matter, where the soft parts of the organisms, decomposing under anaerobic conditions, locally yielded centres with an alkaline environment of ammonia or amines. Conditions were thus created where the pH value was approximately 7·5 and hence favourable for $CaCO_3$ precipitation. Nuclei for initial precipitation were provided by foraminifera, ostracods, small gasteropods, small fragments of larger shells and bryozoa, and to some extent by foecal pellets, glauconite pellets and detrital mineral grains.

Somewhat stagnant environments such as this are normally low positive (only slightly oxidising) in the oxidation-reduction potential, ranging to negative (reducing); the existence of stagnant conditions rather than the low oxidising-reduction potential, initially retained the lime in solution.

Glenample Clay

Calcareous accretions in the Glenample Clay are generally similar in appearance and origin but less frequent than in the Gellibrand Clay, the sediment containing fewer fossils. Towards the top of the formation, which heralds in the more richly calcareous sedimentation of the Port Campbell Limestone formation, layered accretionary growths formed prominently along some of the bedding planes.

Port Campbell Limestone

The most abundant calcareous accretions exposed in the area studied, occur in the limestone facies characterising the Port Campbell Limestone. This formation, some 250 to 300 feet thick, occurs at the top of the not particularly thick Tertiary series of sediments (some 2,500 to 3,000 feet thick) of the Moonlight Head—Port Campbell—Peterborough region. It is of wide lateral extent, however, and exposed in many places. The best array of accretions occurs on stripped zones (Baker, 1958) produced at cliff edges in positions where sea spray and rain-water run-off combine effectively to remove vegetation, soils and veneers of Post-Miocene Clay. Such stripped zones vary in width along certain of the cliff tops from a few feet at the edges of cliffs up to 200 feet high, to 60 or 70 yards on cliff tops up to 40 or 50 feet high.

Along most parts of the limestone sections of the coastline, extending from Gibson's Beach through Port Campbell to Peterborough and beyond (figs. 1 and 2), the calcareous accretions

stand out from bold, vertical cliffs as more or less horizontal lines of small isolated knobs or as narrow, thin ledges where united into more or less continuous layers. Such growths appear in cliff faces more frequently towards the upper portions, where the several thin layers are so spaced as to extend over a zone up to 6 feet or so thick, as at Point Hesse, Broken Head and environs (Baker, 1958), the Amphitheatre, &c.

Nodular varieties of the accretions are mainly irregular in shape, sometimes tuberous (Plate I., figs. A and B), cylindrical (Plate II., fig. D), or ring-like (Baker, 1958, Plate XXVIII.). Others are sub-spheroidal to ovoidal and wrinkled (Plate I., figs. F, N, R, S and T). The more irregular of the isolated accretions commonly possess wart-like excrescences (Plate I., figs. C and U). Where a number of smaller accretions partially coalesce, filigree patterns (Plate I., fig. O) sometimes result.

None of these accretions show concentric structures. Some contain such macro-fossils as *Ditrupa wormbetiensis, Seripecten yahlensis,* echinoids, brachiopods and bryozoa, others contain micro-fossils such as foraminifera, ostracods and spicular fragments. The genera and species of these fossils are the same as in the host sediment. Less stable fossil structures were generally taken into solution, and the ingredients subsequently reprecipitated in the accretions. Thin sections reveal both a similar bio-facies and a similar litho-facies for accretions and host limestone. Cross sections of typical cylindrical and nodular accretions (analyses 3 and 8, Table 2) show rare, small angular grains of quartz, rare felspar, a little glauconite, occasional complete foraminifera and fragments of small shells and bryozoa, set in a matrix of fine-grained calcite. Much of the calcite cement is murky and forms crystals 0·005 mm. to 0·600 mm. in size; rarer clear calcite crystals average 0·040 mm. across. Apart from non-filled bryozoal structures, pore spaces are common and range in size from 0·1 mm. to cavities of irregular shape approximately 5 mm. by 2 mm.

The Port Campbell Limestone was formed on a shallow, well-aerated sea bottom subject to only small influx of clastic terrigenous material, so that relatively pure limestone accumulated. Horizons rather richer in calcareous materials than others, are up to 98 per cent. acid soluble (1 : 1 HCl.).

Much of the limestone was originally a calcareous slime into which dropped small complete organisms, fragments of organisms, and a little fine detrital mineral matter. During diagenesis, crystallization within the bounds of the growing

accretions yielded small calcite crystals in places uncleared of minute inclusions; some of the larger pore spaces became lined with clearer calcite. The rock thus seems to have been partly detrital and partly a gelatinous chemical precipitate which, during diagenesis, crystallized as fine-grained aggregates to form the numerous accretions.

Comparison of accretions and host limestone shows that the accretions contain 98 per cent. acid soluble carbonates and little fine-grained (-100 mesh B.S.S.) mineral matter, while the adjacent limestone contains rather less soluble carbonates and a little more insoluble residue (Table 2, columns 1, 2, 3 and 8). Among the insoluble residues are buff-coloured isotropic clay substances, rare angular quartz and garnet, occasional chitinous matter, a few plates of muscovite, rare prismatic tourmaline (possibly authigenic), microcline, orthoclase, zircon, a few opaque minerals and partially oxidised glauconite.

Although there was no significant change in total carbonates on accretionary growth, there are nevertheless marked differences in the relative amounts of $CaCO_3$ and $MgCO_3$ between accretion and host rock (Table 2, columns 1 and 2). Ratios of $CaCO_3$: $MgCO_3$ are similar for different accretions from localities five miles apart (Table 3, Nos. 1 and 3), but these are considerably in excess of the ratios for the host limestone (Table 3, No. 2). The greater lime carbonate content of the accretions is apparently due to calcareous shelly matter being dissolved and reprecipitated soon after deposition, under conditions of local increases of pH value favouring lime carbonate precipitation, at a time when the enveloping calcium-magnesium carbonate was unlithified and possibly gel-like.

No bedding planes have been observed passing through the accretions (cf. Tarr, 1921), and the indications are that the accretions are syngenetic to early diagenetic in origin. Whereas the magnesium-bearing host became compacted to form a soft, friable, aphanitic, pale buff-coloured limestone with an earthy appearance, the accretions were cemented into more compact bodies enclosing generally fewer but nevertheless similar fossil remains. The different physical characteristics of the accretions rendered them less prone to attack by erosion.

Post-Miocene Clay

Calcareous accretions in the Post-Miocene Clay which caps the Miocene limestone (Baker, 1944, p. 95) are identical with those in the Port Campbell Limestone formation, where they

were formed originally. They were more resistant to processes of dissolution that affected the upper horizons of the friable limestone from which the Clay capping is a residual deposit, and hence they constitute remanié accretions.

Pleistocene

The Pleistocene dune limestone contains calcareous accretions of epigenetic origin. Consisting largely of $CaCO_3$ with a little $MgCO_3$, they form secondary discontinuous layers of dense travertinous material, one to three inches thick, along some major stratification and minor cross-bedding planes. They formed from solution of comminuted shell waste that comprises a considerable proportion of the dune limestone, followed by precipitation along bedding structures. A few nodular growths arose from partial cementation by material similarly derived, but precipitated in interstices of the highly porous dune rock.

Holocene

Calcareous accretions in Recent to Holocene beach, cave and dune sands vary in shape, position of formation and mode of origin. Different forms acquired different shapes and sizes according to the prevalent conditions in their places of formation. Thus normal stalactites, stalagmites and stalagmitic encrustations were accreted in several caves in the Port Campbell Limestone along various parts of the coastline (Baker and Frostick, 1951), sand stalagmites were developed in the upper layers of the sandy floors of certain caves in the limestone (Baker, 1942, p. 662), while pisoliths and calcareous "spats" were generated in cave pools (Baker and Frostick, 1951). Beach plasters grew where higher-level beach sands averaging 75 per cent. acid soluble (1 : 1 HCl) constituents became cemented to cliff bases in places of more concentrated cliff face seepage of carbonate-rich waters (Baker, 1943, fig. 23, p. 372); their positions, up to six and eight feet above normal beach level, indicate former beach heights at the cliff bases.

In addition, tubular and solid cylindrical concretions and sub-spheroidal to ellipsoidal nodules of secondary $CaCO_3$, lying loosely in more recent (unconsolidated) dune sands, have been accumulated around roots and fallen twigs, &c.

The cave pisoliths in particular, the calcareous stalactites, stalagmites and stalagmitic encrustations generally, and some of the cylindrical concretions from the aeolian sediments, are the only ones with true concentric structures.

The soils of the district contain occasional calcareous nodules and thin sheets of calcareous "hardpan", formed epigenetically from carbonate-rich waters circulating through the Port Campbell Limestone. These are usually denser and less porous than calcareous accretions in the Port Campbell Limestone.

Calcareous micro-accretions of syngenetic to early diagenetic origin, are represented in various parts of the stratigraphical succession by such features as (i) concentric rims around detrital grains in Lower Cretaceous arkose, (ii) concentric bands and cores in calcite-siderite-glauconite ooliths in the Pebble Point Formation, and (iii) calcite coatings around detrital grains in a thin bed of sandstone interbedded with the lower part of the Dilwyn Silty Clay, where calcite also occurs in ooliths.

Of recent origin are the calcareous cave ooliths (upper size limit = 2 mm. in diameter), found with cave pisoliths in small pools of carbonated waters on the floors of caves in Loch Ard Gorge (Baker and Frostick, 1951).

Siderite Accretionary Growths

Rare nodule-like accretionary growths of siderite up to 6" and 12" across, occur in the Paleocene conglomerate of the Pebble Point Formation, Devil's Kitchen area. Derived by weathering from Lower Cretaceous arkose and mudstone, they are rounded, well-polished, often buff-coloured to darker brown, and sometimes reveal numerous fine, superficial cracks. Thin coatings of limonite on several of the siderite accretions are likewise cracked.

Phosphatic Accretionary Growths

Accretions of phosphate occur sporadically in the Paleocene and Lower Eocene strata of the Moonlight Head—Princetown district. A phosphorite bed 3 to 4 feet thick in the Lower Miocene-Oligocene Clifton Formation, is composed largely of phosphatic nodules. Isolated examples containing nearly 19 per cent. P_2O_5 appear in a few horizons of the Miocene, e.g. Gellibrand Clay and Rutledge's Creek Member.

Paleocene-Lower Eocene

Phosphatic accretions in the Paleocene Pebble Point Formation are seldom sharply defined against the matrix of the host glauconitic coarse sandstones and grits, and only become

evident on weathering. They are sub-spherical to irregular in shape (Plate II., figs. Y and Z), up to 5″ across, syngenetic in origin, and were evidently precipitated as a colloidal gel incorporating extraneous matter. On testing, they yield little evidence of carbonates and an estimated few per cent. of P_2O_5. A few contain shelly fragments, others consist of pellets of glauconite, rounded quartz grains up to 4 mm. across, and some argillaceous material with the phosphate.

In the younger Rivernook Member which is interbedded with the Dilwyn Silty Clay, occasional phosphatic accretions contain rather more calcite and a little siderite. Qualitative tests indicate an estimated amount of not over 3 or 4 per cent. P_2O_5. They are more sharply defined against the host sediment (glauconitic silty clay), and sub-spherical to spherical in shape; a few are more calcareous still, with only traces of phosphate (Baker, 1950, p. 24).

Some 250 feet stratigraphically higher in the Dilwyn Silty Clay, a few phosphatic accretions exposed in dark grey silty claystone west of Rivernook House (fig. 2), are 3″ across, light grey in colour, and almost spherical in shape. They contain *Nuculana,* small globose gasteropods, fragments of wood and an occasional propodus of *Callianassa,* all of which, among others, are represented in the Paleocene Pebble Point Formation. Along with pellets of glauconite, these fossils are enclosed in a compact cement of collophane; residues from acid digestion contain plant debris, foecal pellets and detrital quartz, bleached biotite, magnetite, epidote, zircon, flint, ilmenite and leucoxene, of average grain size 0·2 mm. Most grains are rounded to sub-angular, the smallest are quite angular.

Thin sections reveal a matrix of calcareous material and brown collophane with embedded detrital grains. Original wood fragments have been replaced by calcite, leaving isolated remnants of brown to black carbonaceous matter enclosing a few small grains of pyrite. Fragments of bryozoa have been partially replaced by collophane and some chambers of foraminifera partly infilled with pyrite and collophane.

These accretions evidently formed syngenetically on the sea floor, in the presence of organic matter and a little detritus of a non-organic character, as a result of chemical reaction and precipitation.

Lower Miocene-Oligocene

Abundant phosphatic accretions in the Clifton Formation are ½″ to 12″ long (Baker, 1945, p. 89), light to dark brown in colour, have relatively smooth surfaces, and are mostly ovoidal to irregular, sometimes cylindrical in shape (Plate II., figs. R to V).

They are principally collophane with varying amounts of shelly and detrital mineral matter; the P_2O_5 content ranges from nearly 1 per cent. to 15 per cent. Examples with dark coloured outer crusts are lighter brown inside, the outer crusts consisting of limonite up to 1 mm. thick, developed by recent weathering.

Thin sections show a cement largely constituted of isotropic, amorphous collophane, which also occurs in places as pellet phosphate. The cement includes angular quartz 0·2 mm. across and well-rounded quartz grains up to 2 mm. across; grains of fresh felspar and flakes of white mica appear in a few of the accretions. Narrow rims of manganese dioxide envelope some of the quartz grains, while layers of lepidocrocite 0·8 mm. thick, calcite 0·2 mm. thick and further lepidocrocite 0·1 mm. to 1·0 mm. thick, form the outer crust of the dark coloured nodules. The cores of such accretions are brown collophane with occasional detrital grains, foraminifera, fragments of bryozoa, small brachiopods, gasteropods and spines of echinoids. *Globigerina*, the more commonly represented genus among the foraminifera, frequently shows exceptionally well-preserved ornamentation, while some of the Lagenids and a few others are also relatively well-preserved; some are infilled with collophane, others with calcite. Zooaria of bryozoa encrusting some of the accretions, are usually phosphatized, sometimes replaced by iron hydroxide, according to whether they were exposed to recent weathering or protected in unexposed parts of the nodule bed.

These nodules were originally regarded as rolled pebbles (Wilkinson, 1865), but their phosphatic nature was not recognized until more recently (Baker, 1945). Their smooth surfaces and rounded character suggest growth while rolling on the sea bed, for even irregularly shaped and somewhat branching varieties reveal some rounding. Because of conflicting evidence, there is some doubt regarding the origin of all of these accretions. The presence among them of the derived Paleocene nautiloid *Deltoidonautilus bakeri* Teichert (cf. *Aturia clarkei* according to M. F. Glaessner), in a phosphatic matrix like that of the nodules generally, points to the possibility of some of the accretions being allochthonous. Enclosed foraminifera, &c., in other accretions

from the same deposit, however, are autochthonous, being the same as genera and species in the matrix of the host sediment, which is mainly a similar matrix to that of the Clifton limestone. Also, quartz grains of similar size and similar degree of rounding as quartz grains in the underlying deposit (gritty sandstone with shell fragments), indicate that such nodules were formed more or less *in situ*, and not transported in as products weathered from older formations. The encrusting bryozoa, which are autochthonous, do not help to solve the problem, for they could have become attached to either a newly formed or a derived nodule. Being non-weathered themselves, however, there is no doubt that such bryozoa belong to the host sediment, and hence bryozoal-encrusted phosphatic nodules were not transported in as such.

An explanation of the above evidence requires the co-existence in the same nodule bed of phosphatic accretions derived in different zones—some were chemically precipitated on a sea floor of unconsolidated gritty sandstone in Lower Miocene-Oligocene times, and are autochthonous, a smaller number was derived by erosion of nearby Lower Eocene-Paleocene sediments and transported into the Lower Miocene-Oligocene theatre of sedimentation, and are allochthonous.

The presence of such phosphatic accretions in stratigraphical sequences, usually indicates an unconformity. The Clifton phosphorite is at the base of the Clifton Formation, and apparently conformable with the underlying gritty sandstone. Its nodules are set in a mixed matrix constituted partly of Clifton limestone ingredients, partly of gritty sandstone constituents. The fossils in this matrix are the same as those in the Clifton limestone, which is rich in well-preserved bryozoa, pelecypoda, single corals, echinoids, sharks' teeth, &c. It would thus appear that the Clifton phosphorite and limestone mark the onset of late Oligocene to early Miocene sedimentation in these parts of Victoria, while the gritty sandstone forming the sea floor at that time, evidently represents the termination of Eocene sedimentation.

A few feet above the phosphorite bed, two bands up to a foot thick each, in the Clifton limestone, are also partially phosphatized. They are possibly late diagenetic or even epigenetic in origin, the phosphate coming from enclosed bryozoa, brachiopods, &c. Deposition from connate waters locally enriched in phosphate, was largely confined to two bedding planes, but also formed a few accretions within the body of the limestone.

Radioactivity of the phosphatic accretions

Autoradiographic examination of phosphatic accretions from the Clifton Formation revealed an even, though sparsely scattered distribution of alpha-particle activity, after 21 days exposure to an Ilford C2 (50 microns) nuclear research emulsion plate. Rare relatively weak concentrations of alpha-particle tracks due to point sources, indicate somewhat higher, local activity, evidently arising from small spots of radiocolloids.

Analysed phosphorites (Davidson and Atkin, 1953) show 0·001 per cent. to 0·150 per cent. U_3O_8, with thorium negligible and potash insignificant in all phosphorites.

Since no discrete uranium minerals have been detected in the Clifton phosphorite, its weak radioactivity can only be attributed to the collophane phase being uranium-bearing. The uranium evidently possesses a greater geochemical affinity with the apatite (collophane) structure than with other phases encountered, the uranium substituting for calcium in the lattice. On the other hand, the concentration of uranium in rich phosphate beds of the Phosphoria Formation, Western U.S.A. (Thompson, 1953), is not wholly due to the phosphate, and may partly depend on the organic matter or other components present. Hence, in the Clifton phosphorite, point sources of activity may represent uranium associated with organic matter containing radiocolloids, or with rare local concentration independent of such fossil organisms. The general nature of the autoradiograph, however, with its wide scatter of alpha-particle tracks, points to the wider spread collophane as the source of much of the less concentrated radioactivity.

Davidson and Atkin (1953) have shown that there is normally a fixed $U_3O_8 : P_2O_5$ ratio throughout any single sample, but that throughout any sequence of phosphatic sediments, the uranium content may so vary that the richest phosphate beds are not always the more radioactive. Since there is an antipathetic relationship between uranium and carbon dioxide, calcium-rich phosphorites are always low in uranium. On this basis, the Clifton phosphorite, with its phosphatic accretions embedded in a strongly calcareous environment, must be expected to possess only a low uranium content.

Miocene

Phosphatic accretions are sparse in the Miocene sediments. Only a few isolated examples occur in the Gellibrand Clay and in the Rutledge's Creek Member, where they are evidently syngenetic in origin.

One from the Gellibrand Clay (portion shown in Plate II., fig. O), measuring 18″ by 1″ in size, is cylindrical in shape. Its dip was the same in amount and direction as the poorly marked bedding planes of the host sediment. It is of brownish colour and contains approximately 19 per cent. P_2O_5 (Table 2, column 5). Small complete fossils and fragments of fossils in the accretion, match those in the host calcareous clay.

One in the calcareous clay at Rutledge's Creek (Plate II., fig. E), contains less P_2O_5 (Table 2, column 6) and more calcareous material. It was collected from a biostrome in the calcareous clay. The $CO_3 : P_2O_5$ ratios (Table 3, Nos. 5 and 6) are variable, being twice as great for the Rutledge's Creek specimen. This accretion is also cylindrical in shape, and measures 5″ by 1″. It likewise lay with its longer axis parallel with bedding planes which are stressed at Rutledge's Creek by laminae of shelly material in places. This accretion contains comminuted shelly matter, set in a calcareous-phosphatic-argillaceous matrix. Two biostromes in the Rutledge's Creek Member, provide records of two periods of wholesale destruction of marine Miocene organisms, the destroyed portions of which yielded small, local concentrations of phosphate, and these, with calcareous material, produced the isolated accretions.

Insoluble residues from the Miocene phosphatic accretions are small in amount, but three times as great from the Gellibrand Clay as from the Rutledge's Creek Member (Table 2, columns 5 and 6). The residues include pinkish-buff coloured clay, small angular quartz grains, and rare zircon, garnet and white mica.

Each of the accretions contains similar amounts of $MgCO_3$ (Table 2) and comparable ratios of $CaCO_3 : MgCO_3$ (Table 3).

Syngenetic to early diagenetic phosphatic micro-accretions occur as pellets in the Pebble Point Formation, and in both the limestone and the phosphorite in the Clifton Formation. Occasional oolitic collophane grains in the Dilwyn Silty Clay, and in its thin stratum of interbedded sandstone containing *Trochocyathus* and *Odontaspis,* are sometimes rimmed with pyrite, sometimes almost completely replaced by pyrite (Baker, 1943a, p. 248).

Pyritic Accretionary Growths

Accretions of pyrite are essentially small, fine-grained crystal aggregates, and are typical of less calcareous to non-calcareous carbonaceous sediments which appear low down in the Tertiary

succession, although they have also been noted in the earlier lacustrine Lower Cretaceous arkose and in the much later marine Port Campbell Limestone (Miocene).

The crystal aggregates tend to be irregular in arrangement; more regular radial structures of spherulitic types (Plate II. fig. V) are infrequent. Some contain pyritized fossils as nuclei (Plate II., figs. F and G).

Polished surfaces of the pyritic accretions from several horizons in the Tertiary sediments, and also from the Lower Cretaceous arkose, reveal that marcasite is absent (cf. Edwards and Baker, 1951, pp. 40-45; Baker, 1953, p. 128).

Lower Cretaceous

Pyritic accretionary growths have been noted in the Lower Cretaceous arkose forming the shore platform on the Devil's Kitchen side of Point Lucton, and are only accessible at low tides. They possess thin, dark brown limonitic exteriors, and occur as single nodules and small groups of nodular forms ranging up to 3″ by 2″ by $\frac{1}{2}$″ in size. Like the calcareous accretions in this rock, some of the pyritic accretions when freed from the host sediment, reveal small flange-like structures developed by slightly extended growth along a prominent bedding plane. They were evidently formed in much the same way and apparently about the same time in the late diagenetic history of the sediments, as were the calcareous and sideritic accretionary growths.

Polished surfaces reveal that the pyrite encloses translucent minerals (quartz and felspar) and the following opaque minerals: magnetite, limonite with occasional remnants of magnetite, ilmenite and rutile. Locally, the pyrite has largely replaced the calcareous and/or argillaceous cement of the arkose host. The pyrite tends to be rather more concentrated in the outer zones of the nodules, forming more heavily pyritized rims approximately 1 mm. thick. In such areas, threads of pyrite are more frequent along cracks in the quartz and along cleavage planes in the felspars, than they are towards central portions of the nodules. Parts of the pyrite nodules are crowded with minute residual particles of unreplaced gangue; such areas are more common towards central portions of the nodules.

Paleocene-Lower Eocene

A few pyrite accretions in the Pebble Point Formation are sub-spherical to ovoidal nodules up to 1″ across (Plate II., figs. V to X). Several reveal internal radial growths, in places

interrupted by included detrital quartz grains up to 0·5 mm. in size. Minute euhedra of pyrite are occasionally exposed on outer surfaces of some of the accretions. A few elongated accretions consist of pyrite replacing fossil wood, others are partially replaced shelly fossils.

Pyrite accretions occur sporadically in the Dilwyn Silty Clay, where they are sometimes flat and elongated, measuring $1\frac{1}{2}''$ by $\frac{1}{2}''$ by one sixth of an inch. In the thin interbedded sandstone bed containing *Trochocyathus* and *Odontaspis,* pyrite nodules are up to 4 mm. in size, while adjacent parts of the same bed reveal pyrite partially replacing the argillaceous matrix. They are larger and more numerous in the Princetown Member (P.M. on fig. 2), where they form nodular growths with variable amounts of interstitial pyrite cement, rather than crystal aggregates. Their shapes vary from sub-spherical ($1\frac{1}{2}''$ across) and ellipsoidal ($1''$ by $\frac{3}{4}''$ by $\frac{1}{2}''$) to irregularly tuberous ($3\frac{1}{2}''$ by $1\frac{1}{2}''$ by $1''$). Many are dense, compact nodules of pyrite, but some possess papillate protuberances with well-formed pyrite crystals a fraction of a millimetre in size, studded over the outer portions. Many contain detrital sub-angular to sub-rounded quartz grains, some carbonaceous matter, and occasional small areas of unreplaced carbonaceous silty clay. Others form pseudomorphous replacements and impressions of coalified wood fragments and of the corallum and septa of species of *Trochocyathus* (Baker, 1953, p. 128).

Miocene

Pyrite accretions are few in number, sporadically distributed and up to 3″ long in the Gellibrand Clay (Baker, 1944, p. 101) and in the Port Campbell Limestone and its interbedded Rutledge's Creek Member. Irregularly shaped forms (Plate II., fig. G) represent pyritic replacements of branching bryozoans, others partially replaced shelly fossils (Plate II., fig. F) with only slight disruption of the shells.

Pyrite accretions in the Port Campbell Limestone have been principally altered to limonite, more especially where exposed in cliff faces and on the stripped zones (Baker, 1958) near the edges of cliff tops. These accretions generally have the form of long, slender, cylindrical rods with usually more or less parallel, straight sides (sometimes broadly curving), rather roughened surfaces and dark brown colour where strongly oxidised. Several reveal remnants of pyrite occupying the cores of the long cylindrical rods.

They are usually distributed as sporadic, widely separated individual structures, but in places, as at the northwestern end of Gravel Point, they are rather more concentrated, some two dozen or so occurring over an area of approximately 50 square yards. They range in size up to 8 or 9 inches in length and just under $\frac{1}{2}''$ in diameter. Most examples lie parallel with the bedding planes, but a few are oblique to and a small number normal to the bedding; those parallel with the bedding show random orientation within any particular bedding plane. A few broken, weathered specimens possess hollows up to 3 or 4 mm. deep at each end, where either the pyrite core or its more altered and porous decomposition products (limonite, and rarely basic iron sulphates) have been removed; such hollows are not apparently allied to any fossil structures, and no such structures have been observed directly associated with these cylindrical accretions. They are, however, evidently a result of the activity of sulphur bacteria, and thus indirectly connected with the decomposition of the original organic matter incorporated in the Port Campbell Limestone.

Micro-accretions of pyrite are principally replacements of other micro-structures, often those of minute fossil organisms and occasionally of pellets of phosphate and of glauconite.

In polished surfaces of pyrite in the Dilwyn Silty Clay, small fragments of bryozoa have been detected in the pyrite. In phosphatic portions of the interbedded sandstone containing *Trochocyathus* and *Odontaspis,* microscopic spherical aggregates of pyrite are embedded in a matrix of collophane, from which they are sometimes separated by thin rims of calcite. Micro-accretions in the Gellibrand Clay (Miocene) result from the pyritic replacement of foecal pellets and the infilling of the chambers of foraminifera.

Significance of the authigenic pyrite

The significance of the authigenic pyrite developed in these sediments, lies in the fact that it usually forms where marine waters have become more or less stagnant on deoxygenation, as a result of the breakdown of organic matter on bacterial attack. During the process, H_2S was liberated and reacted with available $FeCO_3$ to form pyrite.

The organic matter was virtually all marine in the Gellibrand Clay, the Port Campbell Limestone and the Rutledge's Creek Member. In the Older Tertiary rocks, however, significant quantities of terrestrial organic matter (mainly plant debris)

were swept into the seas of the period, more especially during deposition of the carbonaceous Princetown Member and occasionally during deposition of parts of the Dilwyn Silty Clay and the Pebble Point Formation. In these sediments, syngenetic or early diagenetic pyritic accretions were more abundantly developed under conditions of more widespread stagnation. Shelly fossils no longer remain in the Princetown Member, because of the prevailing acidic conditions. In the lacustrine Lower Cretaceous sediments, the organic matter was evidently all of terrestrial origin, and pyritic accretions associated with its decomposition are very limited in distribution.

Manganese Dioxide Accretionary Growths

Accretions of manganese dioxide are scarce in the Tertiary sequence (Table 1), and have only been noted in the Gellibrand Clay (Miocene), where they are up to 0·5″ by 0·4″ by 0·4″ in size. They are evidently of syngenetic origin and are mainly composed of manganese dioxide with some iron hydroxide and a few detrital grains.

Limonitic Accretionary Growths

The limonitic accretions are epigenetic and result principally from the alteration of pyrite and glauconite in various horizons of the Tertiary sediments, in which they appear as layers and nodules.

Paleocene-Lower Eocene

Oxidation of the glauconite in gritty sandstones of the Pebble Point Formation in the Moonlight Head –Point Margaret district (fig. 2), has given rise to abundant nodules of limonite and relatively extensive layers of limonite up to 5 feet thick. Their content of quartz grains varies up to 50 per cent. of the rock. Fossil structures have been completely obliterated from parts of the sediments so affected.

Oxidation of pyritic nodules in ferruginous sandstones above the Princetown Member, has produced a few limonitic nodules.

Lower Miocene-Oligocene

A few of the smaller phosphatic nodules and some phosphatized fossils in the Clifton Formation phosphorite, have been completely replaced by limonite, while larger nodules possess enveloping crusts of limonite. Such accretions of limonite result from relatively recent weathering of phosphatic nodules exposed to sub-aerial agents, but examples with thin crusts of

limonite enveloping a layer of carbonate which is underlain by a zone of lepidocrocite concentric with outer zones, are evidently indicative of the earlier onset of limonitization.

Miocene

Most of the exposed pyrite nodules and cylindrical accretionary growths in the Gellibrand Clay, Port Campbell Limestone and Rutledge's Creek Member, have been oxidized to limonite pseudomorphs. A few exposed by quarrying of the Port Campbell Limestone are rather less altered. Occasional shells originally infilled with, but not replaced by pyrite in the Gellibrand Clay and the Rutledge's Creek Member, have become disrupted by volume increases attendant upon alteration of the pyrite.

Holocene

Limonitic accretions ("buckshot gravel") in an old lateritic soil horizon some 18" below the present soils, are mainly sub-spherical to irregular nodules up to $\frac{3}{4}$" across. Pale to deeper brownish-yellow, earthy examples are partly calcareous and limonitic. Dark brown to black, more compact varieties are strongly magnetic maghemite. Most of these are structureless, but some show concentric accretionary growth structures. Variations in composition are reflected in the specific gravity values (Table 4).

Associated with dissected Post-Miocene Clays near the edges of cliff tops, occasional mounds up to 6 feet high, composed of irregularly shaped blocks of limonite (up to a foot across), are comparable in origin with the "buckshot gravel". They represent more extensive deposition of limonite in near-surface positions (Baker, 1958, p. 178).

A few other limonitic accretions of somewhat different origin, have been generated in one or two pools in a sea cave in Loch Ard Gorge, where they are partly calcareous and were formed from iron hydroxide slime in calcium carbonate-bearing cave waters (Baker and Frostick, 1951).

Micro-accretions of limonite with sub-spherical shape and oolitic dimensions (2 mm. and under), are relatively numerous among the "buckshot gravel" components.

Glauconitic Accretionary Growths

Glauconite occurs almost entirely as micro-accretions, usually small pellets. These are most abundant in the lower part of the

Tertiary succession (cf. Table 1), especially in the Pebble Point Formation and the Rivernook Member, and at the base of the Dilwyn Silty Clay; they are rather less abundant in the sandstone bands interbedded with the Dilwyn Silty Clay.

In the younger Tertiary formations, occasional glauconite pellet accretions are dotted through the matrix materials of the Clifton phosphorite. In certain horizons of the Port Campbell Limestone, they are of sufficient abundance in some narrow bands to impart a pale greenish colour to the limestone, as at the Amphitheatre and the environs of Rutledge's Creek.

Where freshly uncovered, the glauconite pellets are green, but oxidation in many exposures has converted a large number of the pellets to a ferruginous clay-like substance. The pellets are mainly ovoidal in shape, and measure 0·5 mm. by 1·0 mm. In places, the glauconite alternates with calcite in ooliths; elsewhere, it forms rims 0·02 mm. thick on quartz grains. Some of the glauconite is weakly pleochroic and biaxial negative, and seems to have been recrystallized, probably as a result of the reconstitution of mica-type clay minerals under shallow water marine conditions, in the presence of organic agents and under reducing conditions. Some of the pellets contain admixed detrital quartz, and were apparently subjected to considerable rolling about on the sea floor.

Glauconite pellet accretions in the Port Campbell Limestone and its interbedded Rutledge's Creek Member, are principally ovoidal to sub-spherical in shape, and range up to 1 mm. in size. Several, however, are replaced micro-fossils, more often foraminifera, less frequently ostracods.

Siliceous Accretionary Growths

Nodules of flint with typical protuberances and irregularities where unbroken, occur among worn calcareous accretions forming the bulk of the infrequent and limited pebbly and cobbly beaches at the base of the steep limestone cliffs, e.g., as at Deany Steps near Port Campbell township. Similar nodular flints among the beach components near Pebble Point, are rare among a host of well-rounded pebbles of rocks alien to known outcrops in these parts of Victoria. Fractured nodules of flint also occur on cliff tops 300 feet above sea level, near Rivernook House, Princetown district; these were evidently collected from the beaches by the aborigines, and utilized by them for various purposes.

The flint nodules are dense, more or less homogeneous microcrystalline to cryptocrystalline aggregates of chalcedonic silica and quartz, and structureless except for the occasional fossils present. All are patinated, with grey to white crusts surrounding dark grey to almost black cores of varying diameter compared with the widths of the patinated crusts. A few are light grey to buff-coloured throughout, indicating extensive patination.

These flint nodules have not been observed *in situ* in any rocks of the district, and although their content of sponge spicules, echinoid spines, bryozoal fragments and occasional foraminifera seems to be generally like that of the Port Campbell Limestone, it cannot be proved at present that the nodules were syngenetically developed therein. It seems more likely that they originated elsewhere (e.g., from the Gambier Limestone in South Australia), and were carried into the area by recent ocean currents.

Sulphatic Accretionary Growths

Accretions composed of hydrous sulphates of lime (selenite) and of iron (copiapite, &c.), are epigenetic and restricted to those horizons in the Tertiary sediments which are richest in pyrite nodules.

Selenite, the least common type, occurs in the Princetown Member and in other parts of the Dilwyn Silty Clay, as isolated crystals up to an inch long, and as a few aggregates of blade-like crystals up to 3 mm. long, often cloudy from inclusion of silt and clay from the host rock. Rare, flat-lying seams consist of the more fibrous variety of gypsum.

In sediments such as the Gellibrand Clay and the Rutledge's Creek Member, small crystals of selenite are usually confined to encrustations on partially oxidized pyritic replacements of fossil gasteropods and bryozoa.

More common, especially in the carbonaceous sediments in the lower portions of the Tertiary sequence, are pale sulphur yellow and sometimes deeper yellow to pale orange coloured, earthy nodules of irregular shape, and narrow seams and films along poorly defined bedding and joint planes. These consist of basic iron sulphates derived from alteration of the pyritic accretionary growths, and in places they have migrated considerable distances through the host sediments, picking out structure planes that are otherwise difficult to trace.

Halite

Microscopic crystals of halite up to 1 mm. in size at the most, and aggregate growths of halite in parts of the Princetown Member and the Rutledge's Creek Member, are locally abundant and epigenetic in origin. They are derived largely from present day cyclic salts, and as a result of wetting by salt spray followed by drying, the crystallization of halite (i) in the pore spaces of the rock, (ii) along contacts between host rock and fossils, and (iii) within the structural elements of some of the fossils, plays an important part in causing swelling and disintegration of the sediments.

Descriptions of Plates.

Plate I.

A to U—calcareous accretions from the Port Campbell Limestone at Marble Arch, 3 miles west of Port Campbell, Victoria. (all x 0·9).

Plate II.

(A to Z—all x 0·9).

A to D—calcareous accretions from the Port Campbell Limestone at Broken Head (A), at Deany Steps (B) and at Pulpit Rock (C and D).

E—portion of phosphatic accretion with included shell fragments, from coquina band in Rutledge's Creek Member, Rutledge's Creek, 3½ miles east-southeast of Port Campbell.

F to K—partially oxidized pyritic replacements and nodules from the Gellibrand Clay, 1½ mile west of Princetown, Victoria. In F, pyrite has partially disrupted a gasteropod; in G, pyrite has replaced a fragment of a bryozoan.

L to N—calcareous accretions from the Gellibrand Clay, 1¼ mile west of Princetown, Victoria.

O—portion of 18″ long phosphatic accretion from the Gellibrand Clay, 1¼ mile west of Princetown, Victoria.

P—septarian nodule (calcareous) from calcareous clay immediately above the Clifton limestone, nearly 1 mile southwest of Princetown, Victoria.

Q—calcareous nodule with white, chalky crust (enclosing buff-coloured, more compact core), from same locality and horizon as P.

R to U—superficially oxidized phosphatic replacements and nodules from the Clifton Formation phosphorite, nearly 1 mile southwest of Princetown, Victoria. R = tuberous form; S = half of a cylindrical form, with depression at the top; T = replaced bryozoan; U = sub-spherical nodule polished by exposure to recent wave action.

V to X—unaltered pyritic nodules from the Pebble Point Formation, Pebble Point, 3¾ miles southeast of Princetown, Victoria.

V—broken in half to expose internal radial growth structure.

Y to Z—sub-spherical to irregularly shaped phosphatic—calcareous glauconitic accretions from the Pebble Point Formation, Pebble Point and environs, 3¾ miles southeast of Princetown, Victoria.

Z—reveals occasional quartz grains 3 mm. across.

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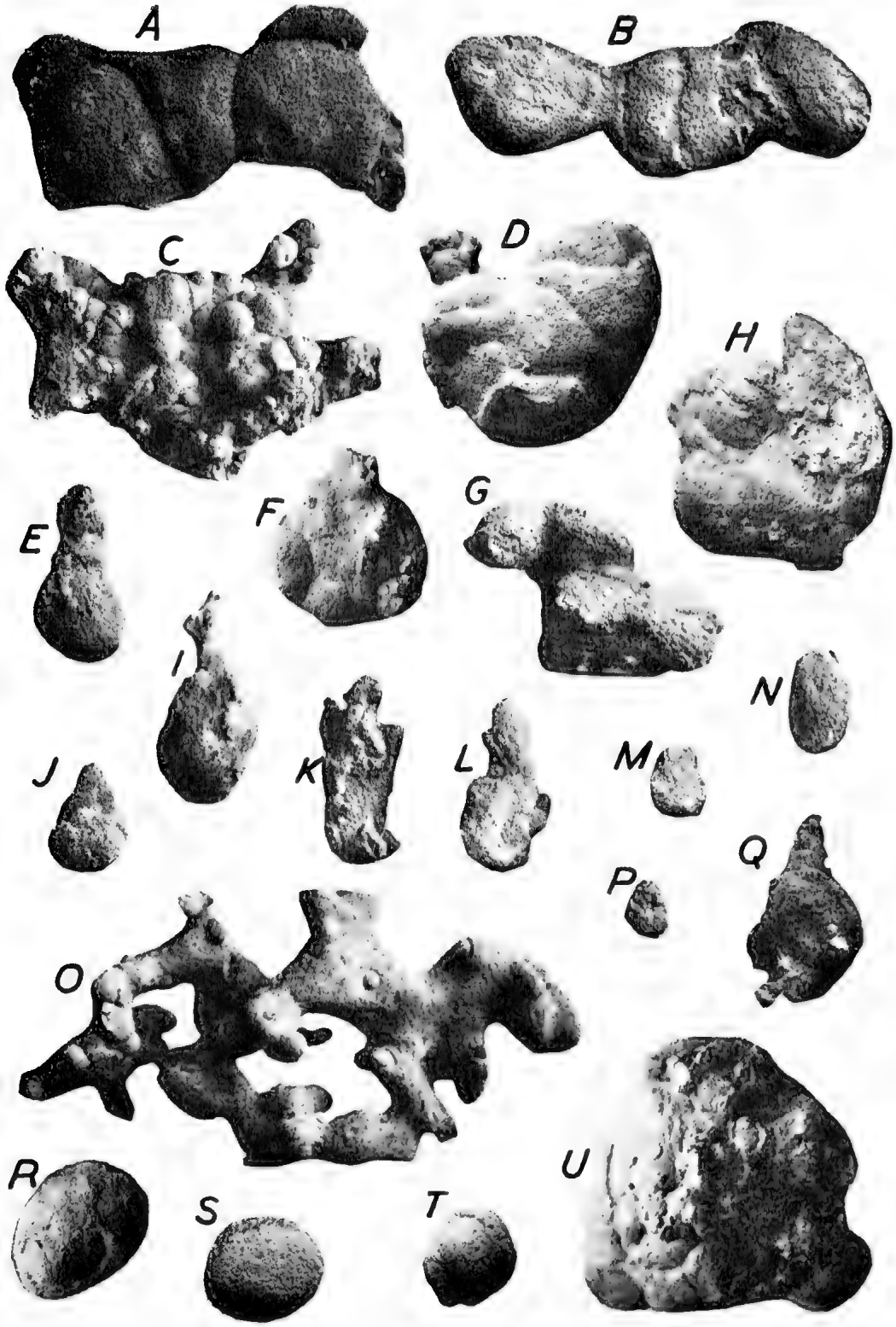


PLATE I.

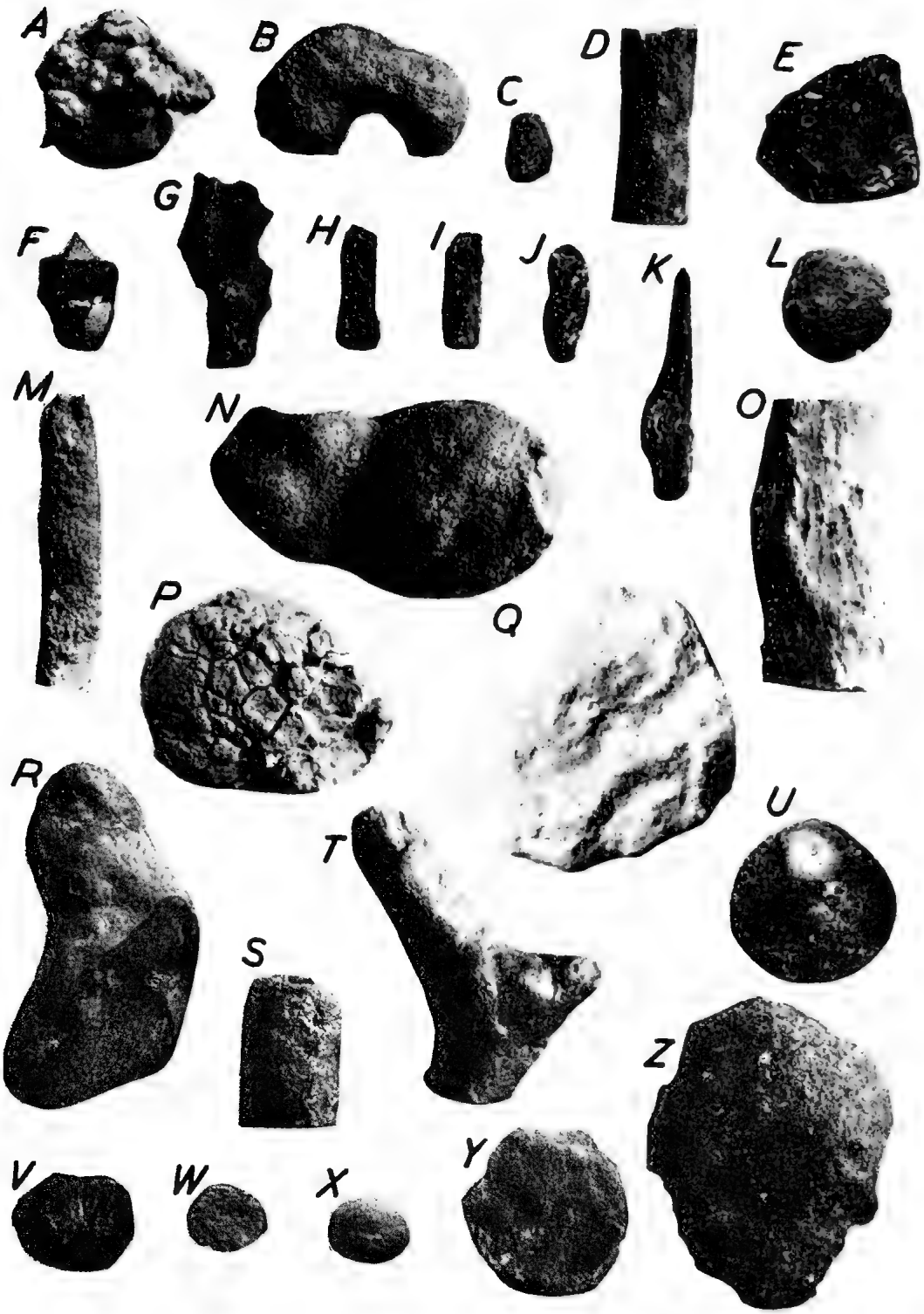


PLATE II.

CATALOGUE OF MIDDLE PALAEOZOIC TYPES AND FIGURED SPECIMENS IN THE NATIONAL MUSEUM OF VICTORIA. PART 1.

By Edmund D. Gill, Curator of Fossils, assisted by Mrs. E. M. Davies and J. J. Jenkin.

The first part of a catalogue of types and figured specimens (Quaternary) has already been published (Gill 1953), with a statement of the principles on which fossils are numbered and registered in this institution. Plants, brachiopods and trilobites are covered in the present list. It was purposed originally to re-figure specimens needing this attention, but so many require modern illustration and re-description that it was found necessary at this stage only to list them. However, a few notes are provided on classification, and where the determination given in the literature is believed to be doubtful, the name has been placed in inverted commas.

1. Plantae.

Archaeopteris howittii McCoy. P 1316
P 1318

Upper Devonian.
Iguana Creek, Mitchell River, Gippsland, Victoria.
Syntype (P 1316; counterpart P 1318).
McCoy, F., 1876. *Prod. Pal. Vict.* 4: 21, pl. 36, figs. 1-2a.

Axis with laterally placed branch. P 15219

Silurian.
Quarry on N. side of Warburton–Woods Point road, about 17 miles from the latter township. Also called "Yarra Track" and "19 mile quarry" because it is 19 miles from McVeigh's, a village now under the Upper Yarra dam, Victoria. Harris and Thomas (1937) call this site the "18½ mile quarry", while Lang and Cookson (1935) describe it as being 17 miles from Woods Point. This locality is referred to in further references in this list as Woods Point Road, Victoria.
Figured specimen.
Lang, W. H., and Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.224: 421-449, pl. 32, fig. 46.

Baragwanathia longifolia Lang and Cookson. P 15205

Silurian.
Woods Point Road, Victoria.
Syntype counterpart (the type was left with Prof. W. H. Lang of Manchester).
Lang, W. H., and Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.224: 421-449, pl. 29, fig. 2.

Baragwanathia longifolia Lang and Cookson. P 15206
Silurian.
Killingworth Road, Yea, Victoria.
Syntype.
Lang, W. H., and Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.224: 421-449, pl. 29, fig. 3.

Baragwanathia longifolia Lang and Cookson. P 15207
Silurian.
Woods Point Road, Victoria (recorded in error as from Killingworth Road, Victoria).
Syntype.
Lang, W. H., and Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.224: 421-449, pl. 29, fig. 5.

Baragwanathia longifolia Lang and Cookson. P 15208
Silurian.
Locality 4-5, Alexandra, Victoria.
Syntype.
Lang, W. H., and Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.224: 421-449, pl. 29, fig. 10.

Baragwanathia longifolia Lang and Cookson. P 15209
Silurian.
Woods Point Road, Victoria.
Syntype.
Lang, W. H., and Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.224: 421-449, pl. 30, fig. 12.

Baragwanathia longifolia Lang and Cookson. P 15210
Silurian.
Killingworth Road, Yea, Victoria.
Syntype.
Lang, W. H., and Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.224: 421-449, pl. 30, fig. 14.

Baragwanathia longifolia Lang and Cookson. P 15211
Silurian.
Killingworth Road, Yea, Victoria.
Syntype.
Lang, W. H., and Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.224: 421-449. pl. 30, fig. 15.

Baragwanathia longifolia Lang and Cookson. P 15212
Silurian.
Killingworth Road, Yea, Victoria.
Syntype.
Lang, W. H., and Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.224: 421-449, pl. 30, fig. 16.

Baragwanathia longifolia Lang and Cookson. P 15213
Silurian.
Killingworth Road, Yea, Victoria.
Syntype.
Lang, W. H., and Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.224: 421-429, pl. 30, figs. 17-18.

Baragwanathia longifolia Lang and Cookson. **P 15214**

Silurian.
Killingworth Road, Yea, Victoria.
Syntype.
Lang, W. H., and Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.224: 421-449, pl. 30, figs. 20-22.

Baragwanathia longifolia Lang and Cookson. P 15215

Silurian.
Killingworth Road, Yea, Victoria.
Syntype.
Lang, W. H., and Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.224: 421-449, pl. 30, figs. 23-24, pl. 31, fig. 25.

Baragwanathia longifolia Lang and Cookson. P 15216

Silurian.
Killingworth Road, Yea, Victoria.
Syntype.
Lang, W. H., and Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.224: 421-449, pl. 31, fig. 27.

Baragwanathia longifolia Lang and Cookson. P 15129

Silurian.
Woods Point Road, Victoria.
Syntype.
Lang, W. H., and Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.224: 421-429, pl. 29, fig. 1.

Baragwanathia longifolia Lang and Cookson. P 15226

Silurian.
Woods Point Road, Victoria.
Syntype.
Lang, W. H., and Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.224: 421-449, pl. 29, fig. 6.
Walton, J., 1953. An introduction to the study of fossil plants, London. fig. 4B.

Baragwanathia longifolia Lang and Cookson. P 15227

Silurian.
Woods Point Road, Victoria.
Syntype.
Lang, W. H., and Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.224: 421-449, pl. 30, fig. 11.
Walton, J., 1953. An introduction to the study of fossil plants, London. fig. 4A.

Baragwanathia longifolia Lang and Cookson, with *Monograptus.* P 15220

Silurian.
Woods Point Road, Victoria.
Hypotype.
Lang, W. H., and Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.224: 421-449, pl. 32, fig. 51.

Baragwanathia longifolia Lang and Cookson. P 15172

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Figured specimen.
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 11, fig. 37.

cf. Baragwanathia longifolia Lang and Cookson. P 15173-4

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Figured specimen (P 15173; counterpart P 15174).
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 11, fig. 38.

cf. Baragwanathia longifolia Lang and Cookson. P 15175

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Figured specimen.
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 11, fig. 39.

Baragwanathia with *Monograptus.* P 15221-2

Silurian.
Locality 9, Alexandra, Victoria.
Figured specimen (P 15221; counterpart P 15222).
Lang, W. H., and Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.224: 421-449, pl. 32, fig. 52.

Baragwanathia with *Monograptus.* P 15223-4

Silurian.
Locality 9, Alexandra, Victoria.
Figured specimen (P 15223; counterpart P 15224).
Lang, W. H., and Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.224: 421-449, pl. 32, fig. 53.

Branch system. P 15169

Silurian.
Hall's Flat Road, Alexandra, Victoria.
Figured specimen.
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 10, fig. 22.

Branched stem. P 15183-4

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Figured specimen (P 15183; counterpart P 15184).
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 11. fig. 45.

Branched axis showing base of third branch. P 15247

Lower Devonian.
Warburton–Woods Point Road, near Yankee Jim Creek, Reefton, Victoria.
Figured specimen.
Cookson, I. C., 1949. *Mem. Nat. Mus. Melb.* 16: 117-131, pl. 6, fig. 26.

"Bythotrephis divaricata Kidston". P 12883

Lower Devonian.
Centennial Mine (Vale's Adit), Walhalla, Victoria.
Hypotype.
Chapman, F., 1912. *Rec. Geol. Surv. Vict.* 3: 231-233, pl. 38, fig. 1.

Bythotrephis tenuis Hall. P 2979

Silurian (Melbournian).
Botanical Gardens, Melbourne, Victoria.
Hypotype.
Chapman, F., 1903. *Proc. Roy. Soc. Vict.* 15: 104-5, pl. 16, fig. 1.

Coiled stem tip. P 15170

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Figured specimen.
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 10, fig. 19.

Confervites acicularis Göppert. P 12884

Silurian.
Centennial Mine (Vale's Adit) Walhalla, Victoria.
Hypotype.
Chapman, F., 1912. *Rec. Geol. Surv. Vict.* 3: 224-233, pl. 38, fig. 2.

Cordaites australis McCoy. P 1309
P 1307

Upper Devonian.
Iguana Creek, Mitchell River, Gippsland, Victoria.
Syntype (P 1309; counterpart P 1307).
McCoy, F., 1876. *Prod. Pal. Vict.* 4: 22-3, pl. 36, fig. 7 (figure reversed).

Cordaites australis McCoy. P 1310
P 1308

Upper Devonian.
Iguana Creek, Mitchell River, Gippsland, Victoria.
Syntype (P 1310; counterpart P 1308).
McCoy, F., 1876. *Prod. Pal. Vict.* 4: 22-3, pl. 36, fig. 6 (figure reversed).

Curved stem showing spines. P 15178-9

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Figured specimen (P 15178; counterpart P 15179).
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 11, fig. 41.

Dichotomous axis. P 15218

Silurian.
Killingworth Road, Yea, Victoria.
Figured specimen.
Lang, W. H., and Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.224: 421-449, pl. 32, fig. 47.

Encrustation showing two connected axes. **P 15168**

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Figured specimen.
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 10, fig. 21.

Epidermal pattern on encrustation. **P 15176-7**

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Figured specimen.
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 11, fig. 40.

Fructification, incertae sedis. **P 15146**

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Figured specimen.
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 11, fig. 36.

Girvanella conferta Chapman. **P 12832**

Lower Devonian.
Tyers River, Gippsland, Victoria.
Tectoholotype (slide from large pellet).
Chapman, F., 1907. *Rec. Geol. Surv. Vict.* 2: 74-5, pl. 6, figs. 13-14.
Chapman, F., 1908. *Rept. A.A.N.S. Adelaide Mtg.* 1907, 11: 377-386, pl. 2, figs. 3-4.

Girvanella? pisolitica Weathered. **P 12830**

Lower Devonian.
Tyers River, Gippsland, Victoria.
Figured specimen (slide showing initial stages).
Chapman, F., 1907. *Rec. Geol. Surv. Vict.* 2: 75, pl. 5, fig. 10.
Chapman, F., 1908. *Rept. A.A.N.S. Adelaide Mtg.* 1907, 11: 377-386, pl. 1, figs. 1-6.

Girvanella wetheredii Chapman. **P 12831**

Lower Devonian.
Tyers River, Gippsland, Victoria.
Tectohypotype (slide from small pellet).
Chapman, F., 1907. *Rec. Geol. Surv. Vict.* 2: 75, pl. 5, figs. 11-12.
Chapman, F., 1908. *Rept. A.A.N.S. Adelaide Mtg.* 1907, 11: 377-386, pl. 2, figs. 1-2.

"*Haliserites dechenianus* Göppert". **P 12878**

Silurian.
Near Northern Boundary, Thomson River, Victoria.
Hypotype (Ovate? leaves; counterpart P 12879).
Chapman, F., 1912. *Rec. Geol. Surv. Vict.* 3: 231-233, pl. 37, fig. 1.

"*Haliserites dechenianus* Göppert". P 12879

Silurian.
Near Northern Boundary, Thomson River, Victoria.
Hypotype (circinate termination; counterpart P 12878).
Chapman, F., 1912. *Rec. Geol. Surv. Vict.* 3: 231-233, pl. 37, fig. 2.

"*Haliserites dechenianus* Göppert". P 12880

Lower Devonian.
Centennial Mine, Walhalla, Victoria.
Hypotype (stem with ? sporangiophore and leaves).
Chapman, F., 1912. *Rec. Geol. Surv. Vict.* 3: 231-233, pl. 37, fig. 3.

"*Haliserites dechenianus* Göppert". P 12881

Lower Devonian.
West of Thomson River, Gippsland, Victoria.
Hypotype (stem and leaves).
Chapman, F., 1912. *Rec. Geol. Surv. Vict.* 3: 231-233, pl. 37, figs. 4-5.

Hedeia corymbosa Cookson. P 15130

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Syntype.
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 11, figs. 27-28.

Hedeia corymbosa Cookson. P 15139

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Syntype.
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 11, figs. 29-30.

Hedeia corymbosa Cookson. P 15140-1

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Syntype (P 15140; counterpart P 15141).
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 11, figs. 25-26.

Hedeia corymbosa Cookson. P 15142-3

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Syntype (P 15142; counterpart P 15143).
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 11, fig. 31.

Hedeia cf. *corymbosa* Cookson. P 14658-9

Lower Devonian.
Syme's Homestead, Killara, Victoria.
Figured specimen (P 14659; counterpart P 14658).
Cookson, I. C., 1949. *Mem. Nat. Mus. Vict.* 16: 117-131, pl. 5, fig. 17.

Hedeia cf. *corymbosa* Cookson. P 14661-2, 14664

Lower Devonian.
Corner of Main Street and Albert Hill Road, Lilydale, Victoria.
Figured specimens (branch system P 14661-2; counterpart P 14664).
Cookson, I. C., 1949. *Mem. Nat. Mus. Vict.* 16: 117-131, pl. 4, figs. 10-11.

Hedeia cf. *corymbosa.* P 14663 P 14660

Lower Devonian.
Corner of Main Street and Albert Hill Road, Lilydale, Victoria.
Figured specimen (P 14663; counterpart P 14660).
Cookson, I. C., 1949. *Mem. Nat. Mus. Vict.* 16: 117-131, pl. 5, fig. 16.

Hedeia cf. *corymbosa* Cookson. P 15237

Lower Devonian.
Hull Road, Lilydale, Victoria.
Figured specimen.
Cookson, I. C., 1949. *Mem. Nat. Mus. Vict.* 16: 117-131, pl. 4, fig. 9.

Hedeia cf. *corymbosa* Cookson. P 15238-9

Lower Devonian.
Albert Hill Road, Lilydale, Victoria.
Figured specimen (P 15239; counterpart P 15238).
Cookson, I. C., 1949. *Mem. Nat. Mus. Vict.* 16: 117-131, pl. 5, fig. 15.

cf. *Hostimella* sp. P 15163

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Figured specimen.
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 10, fig. 16.

cf. *Hostimella* sp. P 15164-5

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Figured specimen (P 15164; counterpart P 15165).
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 10, fig. 17.

cf. *Hostimella* sp. P 15166

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Figured specimen.
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 10, fig. 18.

Hostimella sp. P 15185

Lower Devonian.
North Road Quarry, Walhalla, Victoria.
Counterpart (in sandstone with plant remains).
Lang, W. H., and Cookson, I. C., 1930. *Phil. Trans. Roy. Soc. Lond.* B.219: 133-165, pl. 11, fig. 1.

Hostimella sp. P 15187
Lower Devonian.
North Road Quarry, Walhalla, Victoria.
Figured specimen (smooth axis showing two lateral branches).
Lang, W. H., and Cookson, I. C., 1930. *Phil. Trans. Roy. Soc. Lond.* B.219: 133-163, pl. 11, fig. 3.

Hostimella sp. P 15188
Lower Devonian.
North Road Quarry, Walhalla, Victoria.
Figured specimen (axis with one branch).
Lang, W. H., and Cookson, I. C., 1930. *Phil. Trans. Roy. Soc. Lond.* B.219: 133-163, pl. 11, fig. 4.

Hostimella sp. P 15189
Lower Devonian.
North Road Quarry, Walhalla, Victoria.
Figured specimen (axis with one branch).
Lang, W. H., and Cookson, I. C., 1930. *Phil. Trans. Roy. Soc. Lond.* B.219: 133-163, pl. 11, fig. 5.

Hostimella sp. P 15190
Lower Devonian.
North Road Quarry, Walhalla, Victoria.
Figured specimen (branched axis).
Lang, W. H., and Cookson, I. C., 1930. *Phil. Trans. Roy. Soc. Lond.* B.219: 133-163, pl. 11, fig. 7.

Hostimella sp. P 15191
Lower Devonian.
North Road Quarry, Walhalla, Victoria.
Figured specimen (branched axis).
Lang, W. H., and Cookson, I. C., 1930. *Phil. Trans. Roy. Soc. Lond.* B.219: 133-163, pl. 11, fig. 8.

Hostimella sp. P 15192
Lower Devonian.
Knott, Narracan Shire, Victoria.
Figured specimen (branched axis).
Lang, W. H., and Cookson, I. C., 1930. *Phil. Trans. Roy. Soc. Lond.* B.219: 133-163, pl. 11, fig. 9.

Pachytheca sp. P 15225
Silurian.
Mt. Pleasant, Alexandra, Victoria.
Figured specimen.
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 10, figs. 1-2.

Palaeachlya cf. *tortuosa* Etheridge. P 12331
Silurian.
Flemington, Victoria.
Figured specimen (on same slide as P 12329).
Chapman, F., 1911. *Proc. Roy. Soc. Vict.* 24: 179-186, pl. 45, fig. 6.

Pinnately branched axis. P 15245

Lower Devonian.
Warburton–Woods Point Road, near Yankee Jim Creek, Reefton, Victoria.
Figured specimen.
Cookson, I. C., 1949. *Mem. Nat. Mus. Melb.* 16: 117-131, pl. 6, fig. 24.

Pinnately branched smooth axis. P 15167

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Figured specimen.
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 10, fig. 20.

"*Psilophyton*" sp. P 13750

Silurian.
"Quarry 18 miles E. of McVeigh's", Victoria.
Figured specimen.
Keble, R. A., 1933. *Vict. Nat.* 49: 293-296, fig. 2.

"*Psilophyton*" sp. P 13753

Silurian.
"Quarry 18 miles E. of McVeigh's", Victoria.
Figured specimen.
Keble, R. A., 1933. *Vict. Nat.* 49: 293-296, fig. 5.

Reniform body with small concavities. P 15153

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Figured specimen.
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 10, fig. 8.

Reticulate encrustation. P 15201

Lower Devonian.
North Road Quarry, Walhalla, Victoria.
Figured specimen.
Lang, W. H., and Cookson, I. C., 1930. *Phil. Trans. Roy. Soc. Lond.* B.219: 133-163, pl. 13, fig. 40.

Ribbed branched axis. P 15186

Lower Devonian.
North Road Quarry, Walhalla, Victoria.
Figured specimen.
Lang, W. H., and Cookson, I. C., 1930. *Phil. Trans. Roy. Soc. Lond.* B.219: 133-163, pl. 11, fig. 2.

Ribbed stem. P 15171

Silurian.
Hall's Flat Road, Alexandra, Victoria.
Figured specimen.
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 10, fig. 24.

Shortly stalked tuberculate body. P 15151

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Figured specimen (? sporangium).
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 10, fig. 6.

Slender axis with branch. P 15217

Silurian.
Killingworth Road, Yea, Victoria.
Figured specimen.
Lang, W. H., and Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.224: 421-449, pl. 32, fig. 45.

Small branch system. P 15180

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Figured specimen.
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 11, fig. 42.

Smooth axis. P 15202

Lower Devonian.
Woods Point, Victoria.
Figured specimen.
Lang, W. H., and Cookson, I. C., 1930. *Phil. Trans. Roy. Soc. Lond.* B.219: 133-163, pl. 13, fig. 42.

Smooth axis with smaller lateral branch. P 15243

Lower Devonian.
Hull Road, Lilydale, Victoria.
Figured specimen.
Cookson, I. C., 1949. *Mem. Nat. Mus. Vict.* 16: 117-131, pl. 5, fig. 20.

Smooth branched axis. P 15240-1

Lower Devonian.
Hull Road, Lilydale, Victoria.
Figured specimen (P 15240; counterpart P 15241).
Cookson, I. C., 1949. *Mem. Nat. Mus. Vict.* 16: 117-131, pl. 5, fig. 18.

Smooth branched axis. P 15242

Lower Devonian.
Hull Road, Lilydale, Victoria.
Figured specimen.
Cookson, I. C., 1949. *Mem. Nat. Mus. Vict.* 16: 117-131, pl. 5, fig. 19.

Specimen showing "H"-shaped branching. P 15244

Lower Devonian.
Warburton–Woods Point Road, near Yankee Jim Creek, Reefton, Victoria.
Figured specimen.
Cookson, I. C., 1949. *Mem. Nat. Mus. Melb.* 16: 117-131, pl. 6, fig. 23.

Sphaerocodium gippslandicum Chapman. P 13908-10

Middle Devonian.
Junction of Wombat Creek and Mitta Mitta River, N.E. Victoria.
Holotype (P 13908-9 in limestone; P 13910 slide).
Chapman, F., 1920. *Rec. Geol. Surv. Vict.* 4: 179-182, pl. 16, fig. 1.

Sphenopteris (*Eremopteris*) *iguanensis* McCoy. P 12267-9

Upper Devonian.
Iguana Creek, Gippsland, Victoria.
Syntypes.
McCoy, F., 1876. *Prod. Pal. Vict.* 4: 22, pl. 36, figs. 3-5A.

Spherical tuberculate body. P 15147-8

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Figured specimen (P 15147; counterpart P 15148).
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 10, fig. 3.

Spherical tuberculate body. P 15149-50

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Figured specimen (P 15149; counterpart P 15150).
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 10, figs. 4-5.

Sporoganites chapmanii Lang and Cookson. P 15193-4

Lower Devonian.
North Road Quarry, Walhalla, Victoria.
Holotype (P 15193; counterpart P 15194).
Lang, W. H., and Cookson, I. C., 1930. *Phil. Trans. Roy. Soc. Lond.* B.219, 133-163, pl. 11, figs. 10-12.

Sporogonites chapmanii forma *minor* Lang and Cookson. P 15195-6

Lower Devonian.
Stringer's Creek, Walhalla, Victoria.
Holotype (P 15195; counterpart P 15196).
Lang, W. H., and Cookson, I. C., 1930. *Phil. Trans. Roy. Soc. Lond.* B.219: 133-163, pl. 11, figs. 13-14.

cf. *Sporogonites.* P 15228

Lower Devonian.
Hull Road, Lilydale, Victoria.
Figured specimen.
Cookson, I. C., 1949. *Mem. Nat. Mus. Melb.* 16: 117-131, pl. 4, fig. 1.

cf. *Sporogonites.* P 15229-30

Lower Devonian.
Hull Road, Lilydale, Victoria.
Figured specimen (P 15229; counterpart P 15230).
Cookson, I. C., 1949. *Mem. Nat. Mus. Melb.* 16: 117-131, pl. 4, figs. 3, 2.

Stem showing small concavites. P 15246

Lower Devonian.
Warburton–Woods Point Road, near Yankee Jim Creek, Reefton, Victoria.
Figured specimen.
Cookson, I. C., 1949. *Mem. Nat. Mus. Melb.* 16: 117-131, pl. 6, fig. 25.

Stem with small elevations. P 15181

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Figured specimen.
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 11, fig. 43.

Stem with larger elevations. P 15182

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Figured specimen.
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 11, fig. 44.

Tuberculate reniform body. P 15152

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Figured specimen (sporangium).
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 10, fig. 7.

Yarravia cf. *oblonga* Lang and Cookson. P 15231-2

Lower Devonian.
Hull Road, Lilydale, Victoria.
Figured specimen (P 15231; counterpart P 15232).
Cookson, I. C., 1949. *Mem. Nat. Mus. Melb.* 16: 117-131, pl. 4, figs. 4-5.

Yarravia cf. *oblonga* Lang and Cookson. P 15233

Lower Devonian.
Hull Road, Lilydale, Victoria.
Figured specimen.
Cookson, I. C., 1949. *Mem. Nat. Mus. Melb.* 16: 117-131, pl. 4, fig. 6.

cf. *Yarravia oblonga* Lang and Cookson. P 15137-8

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Figured specimen (P 15137; counterpart P 15138).
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 11, fig. 34.

cf. *Yarravia oblonga* Lang and Cookson. P 15144-5

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Figured specimen (P 15144; counterpart P 15145).
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 11, fig. 35.

Zosterophyllum australianum Lang and Cookson. **P 15197-8**

Lower Devonian.
North Road Quarry, Walhalla, Victoria.
Syntype (P 15197; counterpart P 15198).
Lang, W. H., and Cookson, I. C., 1930. *Phil. Trans. Roy. Soc. Lond.* B.219: 133-163, pl. 12, figs. 15-17.

Zosterophyllum australianum Lang and Cookson. P 15199-200

Lower Devonian.
North Road Quarry, Walhalla, Victoria.
Syntype (P 15200; counterpart P 15199).
Lang, W. H., and Cookson, I. C., 1930. *Phil. Trans. Roy. Soc. Lond.* B.219: 133-163, pl. 12, figs. 18-20.

Zosterophyllum australianum Lang and Cookson. P 15131-2

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Hypotype (P 15131; counterpart P 15132).
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 10, fig. 12.

Zosterophyllum australianum Lang and Cookson. P 15154

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Hypotype.
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 10, fig. 9.

Zosterophyllum australianum Lang and Cookson. P 15155-6

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Hypotype (P 15155; counterpart P 15156).
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 10, fig. 10.

Zosterophyllum australianum Lang and Cookson. P 15157

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Hypotype.
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 10, fig. 11.

Zosterophyllum australianum Lang and Cookson. P 15158-9

Silurian.
Hall's Flat Road, Alexandra, Victoria.
Hypotype (P 15158; counterpart P 15159).
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 10, fig. 13.

Zosterophyllum australianum Lang and Cookson. P 15160

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Hypotype.
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 10, fig. 14.

Zosterophyllum australianum Lang and Cookson. P 15161-2

Silurian.
Mt. Pleasant, Alexandra, Victoria.
Hypotype (P 15161; counterpart P 15162).
Cookson, I. C., 1935. *Phil. Trans. Roy. Soc. Lond.* B.225: 127-148, pl. 10, fig. 15.

Zosterophyllum australianum Lang and Cookson. P 15234-5

Lower Devonian.
Hull Road, Lilydale, Victoria.
Hypotype (P 15234; counterpart P 15235).
Cookson, I. C., 1949. *Mem. Nat. Mus. Melb.* 16: pl. 4, fig. 7.

Zosterophyllum australianum Lang and Cookson. P 15236

Lower Devonian.
Hull Road, Lilydale, Victoria.
Hypotype.
Cookson, I. C., 1949. *Mem. Nat. Mus. Melb.* 16: 117-131, pl. 4, fig. 8.

2. Brachiopoda

"*Atrypa aspersa* (Schlotheim)". P 12413

Lower Devonian (Yeringian).
Loyola, via Mansfield, Victoria.
Hypotype (external mould of ventral valve).
Chapman, F., 1913. *Proc. Roy. Soc. Vict.* 26: 99-113, pl. 11, fig. 14.

Atrypa fimbriata Chapman. P 12415

Lower Devonian (Yeringian).
Near Lilydale, Victoria.
Holotype (steinkern of dorsal valve).
Chapman, F., 1913. *Proc. Roy. Soc. Vict.* 26: 99-113, pl. 11, fig. 15.

Atrypa reticularis (Linnaeus). P 12258

Lower Devonian (Yeringian).
Yering, Victoria.
Hypotype (both valves).
McCoy, F., 1877. *Prod. Pal. Vict.* 5: 25-26, pl. 47, figs. 1-1c (figures reversed). "*Spirigerina reticularis*".
Gill, E. D., 1951. *Proc. Roy. Soc. Vict.* 63: 31-39.

Atrypa reticularis (Linnaeus). P 12259

Lower Devonian (Yeringian).
Yering, Victoria.
Hypotype (steinkern of ventral valve).
McCoy, F., 1877. *Prod. Pal. Vict.* 5: pl. 47, fig. 2 (figure reversed). "*Spirigerina reticularis*".
Gill, E. D., 1951. *Proc. Roy. Soc. Vict.* 63: 31-39.

Atrypa reticularis decurrens Chapman. P 12412
Lower Devonian (Yeringian).
Ruddock's Quarry, near Lilydale, Victoria.
Holotype (external mould of ventral valve).
Chapman, F., 1913. *Proc. Roy. Soc. Vict.* 26: 99-113, pl. 11, fig. 13.

Australocoelia polyspera (Gill). P 16810
Lower Devonian (Bell Shale).
Right Bank, Little Henty River, 1 mile S.E. of Zeehan, Tasmania.
Hypotype (ventral valve).
Boucot, A. J., and Gill, E. D., 1956. *J. Paleont.* 30: 1173-1178, pl. 126, fig. 14.

Australocoelia polyspera (Gill). P 16811
Lower Devonian (Bell Shale).
Right Bank, Little Henty River, 1 mile S.E. of Zeehan, Tasmania.
Hypotype (dorsal valve).
Boucot, A. J., and Gill, E. D., 1956. *J. Paleont.* 30: 1173-1178, pl. 126, fig. 15.

Camarotoechia synchoneua Gill. P 14844
Lower Devonian.
Loc. 17, Smelter's Ridge, S.E. of Zeehan, Western Tasmania.
Holotype (steinkern of ventral valve).
Gill, E. D., 1950. *Pap. & Proc. Roy. Soc. Tas. for* 1949. 231-258, pl. 1, figs. 12-13.

Camaroteochia synchoneua Gill. P 14845
Lower Devonian.
Loc. 17, Smelter's Ridge, S.E. of Zeehan, Western Tasmania.
Paratype (steinkern of dorsal valve).
Gill, E. D., 1950. *Pap. & Proc. Roy. Soc. Tas. for* 1949. 231-258, pl. 1, figs. 19-20.

Chonetes australis McCoy. P 1222
Middle Devonian.
Buchan, Victoria.
Hypotype (calcined ventral valve).
Gill, E. D., 1951. *Proc. Roy. Soc. Vict.* 63: 57-72, text fig. 7.

Chonetes australis McCoy. P 15134
Middle Devonian.
Buchan, Victoria.
Hypotype (acid etched ventral valve).
Gill, E. D., 1951. *Proc. Roy. Soc. Vict.* 63: 57-72, text fig. 6.

Chonetes cresswelli Chapman. P 652
Lower Devonian (Yeringian).
North of Lilydale, Victoria.
Holotype (steinkern of ventral valve).
Chapman, F., 1903. *Proc. Roy. Soc. Vict.* 16: 60-82, pl. 12, fig. 7.
Gill, E. D., 1945. *Proc. Roy. Soc. Vict.* 57: 125-150.
Gill, E. D., 1951. *Proc. Roy. Soc. Vict.* 63: 57-72, pl. 3, fig. 5.

Chonetes cresswelli Chapman. P 14712

Lower Devonian (Yeringian).
" Wilson's ", Loc. 2, Lilydale, Victoria.
Hypotype (steinkern and external mould).
Gill, E. D., 1951. *Proc. Roy. Soc. Vict.* 63: 57-72, text fig. 2.

Chonetes melbournensis Chapman. P 636

Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Syntype (steinkern of ventral valve).
Chapman, F., 1903. *Proc. Roy. Soc. Vict.* 16: 60-82, pl. 11, figs. 3-4.
Gill, E. D., 1945. *Proc. Roy. Soc. Vict.* 57: 125-150.

Chonetes melbournensis Chapman. P 1419

Silurian (Melbournian).
Sewerage Tunnel, near old Fishmarket, Melbourne, Victoria.
Syntype (ventral valve).
Chapman, F., 1903. *Proc. Roy. Soc. Vict.* 16: 60-82, pl. 11, fig. 2.
Gill, E. D., 1945. *Proc. Roy. Soc. Vict.* 57: 125-150.

Chonetes micrus Gill. P 14698-9

Lower Devonian (Yeringian).
Hull Road, Mooroolbark, Victoria.
Holotype (steinkern P 14698 and external mould P 14699 of ventral valve).
Gill, E. D., 1951. *Proc. Roy. Soc. Vict.* 63: 57-72, pl. 3, figs. 6-8.

Chonetes micrus Gill. P 14700-1

Lower Devonian (Yeringian).
Hull Road, Mooroolbark, Victoria.
Paratype (steinkern P 14701 and external mould P 14700 of a dorsal valve).
Gill, E. D., 1951. *Proc. Roy. Soc. Vict.* 63: 57-72, pl. 3, figs. 9-11, text fig. 3.

Chonetes productoida Gill. P 14520

Lower Devonian (Yeringian).
North of Lilydale, Victoria.
Holotype (internal cast of ventral valve).
Gill, E. D., 1945. *Proc. Roy. Soc. Vict.* 57: 125-150, pl. 8, figs. 7, 12.

Chonetes productoida Gill. P 14521

Lower Devonian (Yeringian).
North of Lilydale, Victoria.
Hypotype (internal cast of ventral valve).
Gill, E. D., 1945. *Proc. Roy. Soc. Vict.* 57: 125-150, pl. 8, fig. 3.

Chonetes psiloplia Gill. P 14519

Lower Devonian (Yeringian).
Killara, Victoria.
Holotype (internal cast of ventral valve).
Gill, E. D., 1945. *Proc. Roy. Soc. Vict.* 57: 125-150, pl. 8, fig. 15.

Chonetes robustus Chapman. P 1417

Lower Devonian (Yeringian).
North of Lilydale, Victoria.
Holotype (steinkern of ventral valve and external mould of dorsal valve).
Chapman, F., 1903. *Proc. Roy. Soc. Vict.* 16: 60-82, pl. 12, fig. 8.
Gill, E. D., 1949. *Mem. Nat. Mus. Vict.* 16: 91-115, pl. 3, fig. 17.
Gill, E. D., *Proc. Roy. Soc. Vict.* 57: 125-150.

Chonetes robustus Chapman. P 1418

Lower Devonian (Yeringian).
North of Lilydale, Victoria.
Hypotype (steinkern of ventral valve).
Chapman, F., 1903. *Proc. Roy. Soc. Vict.* 16: 60-82.
Gill, E. D., *Mem. Nat. Mus. Vict.* 16: 91-115, pl. 3, fig. 15.

Chonetes aff. *ruddockensis* Gill. P 14804

Lower Devonian (Bell Shale).
Quarry on N. bank of creek, N. of timber mill, N. of Zeehan, Tasmania.
Figured specimen (steinkern of ventral valve).
Gill, E. D., 1950. *Pap. & Proc. Roy. Soc. Tas. for* 1949: 231-258, pl. 8, fig. 36.

Coelospira australis Chapman. P 13969

Lower Devonian (Yeringian).
Mitta Mitta River, N.E. Victoria.
Holotype.
Chapman, F., 1917. *Rec. Geol. Survey Vict.* 4: 103-104, pl. 32, fig. 43.

Coelospira australis Chapman. P 792

Lower Devonian (Yeringian).
Cowombat, near Forest Hill, Gippsland, Victoria.
Paratype.
Chapman, F., 1917. *Rec. Geol. Survey Vict.* 4: 103-104, pl. 32, fig. 44.

Conchidium sp. P 12244

Lower Devonian (Yeringian).
Yering, Victoria.
Figured specimen (steinkern, umbonal part of both valves).
McCoy, F., 1877. *Prod. Pal. Vict.* 5: 28-29, pl. 47, fig. 10 (figure reversed). "*Pentamerus australis.*"
Gill, E. D., 1951. *Proc. Roy. Soc. Vict.* 63: 31-38, pl. 2, fig. 9.

Crania pulchelloides Chapman. P 12399

Lower Devonian (Yeringian).
Ruddock's Quarry, near Lilydale, Victoria.
Holotype (steinkern).
Chapman, F., 1913. *Proc. Roy. Soc. Vict.* 26: 99-113, pl. 10, figs. 2*a-b*.

Craniella lata Chapman. P 896

Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Holotype.
Chapman, F., 1903. *Proc. Roy. Soc. Vict.* 16: 60-82, pl. 10, figs. 4, 14.

?Cymatostrophia cresswelli (Chapman). P 669-670

Silurian.
Deep Creek, 7 miles S.W. of Walhalla, Victoria.
Holotype (counterparts of ventral valve).
Chapman, F., 1903. *Proc. Roy. Soc. Vict.* 16: 60-82, pl. 11, figs. 8-10. *" Plectabonites ".*

Cyrtia tasmaniensis Gill. P 14547

Lower Devonian.
Lyell Highway, road cutting on N. side 100 yards E. of 12-mile post from Queenstown, Western Tasmania.
Holotype (steinkern of two valves together).
Gill, E. D., 1948. *Rec. Queen Vict. Mus. Launceston.* 2: 57-74, pl. 8, fig. 23.

Cyrtia tasmaniensis Gill. P 14548-9

Lower Devonian.
Lyell Highway, road cutting on N. side 100 yards E. of 12-mile post from Queenstown, Western Tasmania.
Paratype (steinkern P 14548 and external mould P 14549 of ventral valve).
Gill, E. D., 1948. *Rec. Queen Mus. Launceston.* 2: 57-74, pl. 8, figs. 24-6.

Cyrtina sub-biplicata Chapman. P 12416

Lower Devonian (Yeringian).
Ruddock's Quarry, Lilydale, Victoria.
Holotype (steinkern of ventral valve).
Chapman, F., 1913. *Proc. Roy. Soc. Vict.* 26: 99-113, pl. 11, figs. 16*a-c*.

Eatonia (*Eatonia*) *pleonecta* Gill. P 14840

Lower Devonian.
Loc. 23, Smelter's Ridge, S.E. of Zeehan, Western Tasmania.
Holotype (steinkern of both valves).
Gill, E. D., 1950. *Pap. & Proc. Roy. Soc. Tas. for* 1949: 231-258, pl. 1, figs. 33-35.

Eatonia (*Eatonia*) *pleonecta* Gill. P 14841-2

Lower Devonian.
Loc. 23, Smelter's Ridge, S.E. of Zeehan, Western Tasmania.
Paratype (steinkern P 14841 and external mould P 14842, of ventral valve).
Gill, E. D., 1950. *Pap. & Proc. Roy. Soc. Tas. for* 1949: 231-258, pl. 1, fig. 34.

Eatonia (Pareatonia) euplecta Gill. P 14545

Lower Devonian.
Lyell Highway, road cutting on N. side, 100 yards E. of 12-mile post from Queenstown, Western Tasmania.
Holotype (steinkern with associated piece of external mould).
Gill, E. D., 1948. *Rec. Queen Vict. Mus. Launceston.* 2: 57-74, pl. 8, figs. 16-18.

Eatonia (Pareatonia) euplecta Gill. P 14546

Lower Devonian.
Block *non in situ* from bed of N. branch of Nelson River where it crosses Lyell Highway, 14 miles E. of Queenstown, Western Tasmania.
Hypotype (steinkern of both valves together).
Gill, E. D., 1948. *Rec. Queen Vict. Mus. Launceston.* 2: 57-74, pl. 8, figs. 15, 19-22.

Eospirifer sp. P 14105

Lower Devonian (Yeringian).
" Wilson's ", Lilydale, Victoria.
Figured specimen (steinkern of dorsal valve).
Gill, E. D., 1942. *Proc. Roy. Soc. Vict.* 54: 21-52, pl. 6, fig. 8.

Eospirifer sp. P 14106

Lower Devonian (Yeringian).
Ruddock's Quarry, Lilydale, Victoria.
Figured specimen (steinkern of dorsal valve).
Gill, E. D., 1942. *Proc. Roy. Soc. Vict.* 54: 21-52, pl. 6, figs. 8-9.

Eospirifer densilineatus (Chapman). P 10301

Silurian.
Creek near Glenburnie Road, Whittlesea, Victoria.
Syntype (steinkern of dorsal valve).
Chapman, F., 1908. *Proc. Roy. Soc. Vict.* 21: 217-224, pl. 5, fig. 2. " *Spirifer* ".
Gill, E. D., 1942. *Proc. Roy. Soc. Vict.* 54: 21-52.

Eospirifer densilineatus (Chapman). P 10302-3

Silurian.
Cemetery Hill Road, Whittlesea, Victoria.
Syntype (steinkern P 10302 and external mould P 10303 of dorsal valve).
Chapman, F., 1908. *Proc. Roy. Soc. Vict.* 21: 217-224, pl. 5, figs. 1-3. " *Spirifer* ".
Gill, E. D., 1942. *Proc. Roy. Soc. Vict.* 54: 21-52.

" *Eospirifer macropleurus* (Conrad) ". P 883

Silurian.
Kilmore, Victoria.
Hypotype (steinkern of dorsal valve).
McCoy, F., 1877. *Prod. Pal. Vict.* 5: 22-23, pl. 46, fig. 8 (figure reversed).
" *Spirifera plicatella* var. *macropleura* ".

" *Eospirifer macropleurus* (Conrad) ". P 884

Silurian.
Kilmore, Victoria.
Hypotype (steinkern of ventral valve).
McCoy, F., 1877. *Prod. Pal. Vict.* 5: 22-23, pl. 46, fig. 7-7*b* (figures reversed).
" *Spirifera plicatella* var. *macropleura* ".

Eospirifer parahentius Gill. P 14792 P 15712

Lower Devonian (Bell shale).
Right bank Little Henty River, 1 mile S.E. of Zeehan, Tasmania.
Holotype (steinkern of both valves P 14792; external mould of dorsal valve P 15712). Since description the steinkern has parted from the matrix, thus revealing that it is a steinkern of both valves.
Gill, E. D., 1950. *Pap. & Proc. Roy. Soc. Tas. for* 1949: 231-258, pl. 1, fig. 1.

Eospirifer parahentius Gill. P 14793 P 14826

Lower Devonian (Bell Shale).
Right bank Little Henty River, 1 mile S.E. of Zeehan, Tasmania.
Paratype (steinkern P 14793 and external mould P 14826 of dorsal valve).
Gill, E. D., 1950. *Pap. & Proc. Roy. Soc. Tas. for* 1949: 231-258, pl. 1, figs. 4-6.

Eospirifer parahentius Gill. P 14826

Lower Devonian (Bell Shale).
Right bank Little Henty River, 1 mile S.E. of Zeehan, Tasmania.
Hypotype (steinkern of ventral valve).
Gill, E. D., 1950. *Pap. & Proc. Roy. Soc. Tas. for* 1949: 231-258, pl. 1, figs. 2-3.

Gypidula victoriae Chapman. P 12411

Lower Devonian (Yeringian).
Ruddock's Quarry, near Lilydale, Victoria.
Holotype (steinkern of both valves).
Chapman, F., 1913. *Proc. Roy. Soc. Vict.* 26: 99-113, pl. 11, fig. 12.

Hipparionyx minor Clarke. P 14104

Lower Devonian (Yeringian).
" Wilson's ", Lilydale, Victoria.
Hypotype (internal cast of dorsal valve).
Gill, E. D., 1942. *Proc. Roy. Soc. Vict.* 54: 21-52, pl. 6, fig. 2.

Howittia howitti (Chapman). P 1233

Middle Devonian.
Bindi, Victoria.
Holotype (both valves).
Chapman, F., 1905. *Proc. Roy. Soc. Vict.* 18: 16-19, pl. 5, figs. 4*a-c*. " *Spirifer howitti* ".
Talent, J. A., 1956. *Proc. Roy. Soc. Vict.* 68: 1-56.

Howittia howitti (Chapman). P 7596

Middle Devonian.
Bindi, Victoria.
Paratype (parts of both valves).
Chapman, F., 1905. *Proc. Roy. Soc. Vict.* 18: 16-19, pl. 5, fig. 5. "*Spirifer howitti*".
Talent, J. A., 1956. *Proc. Roy. Soc. Vict.* 68: 1-56.

Howittia howitti (Chapman). P 7597

Middle Devonian.
Bindi, Victoria.
Paratype (dorsal valve).
Chapman, F., 1905. *Proc. Roy. Soc. Vict.* 18: 16-19, pl. 5, fig. 6. "*Spirifer howitti*".
Talent, J. A., 1956. *Proc. Roy. Soc. Vict.* 68: 1-56.

Kozlowskiella cf. *cooperi* (Gill). P 12256

Lower Devonian (Yeringian).
Yering, Victoria.
Figured specimen (ventral valve).
McCoy, F., 1877. *Prod. Pal. Vict.* 5: 23-24, pl. 46, figs. 10, 10*a*, (figures reversed). "*Spirifera sulcata*".
Gill, E. D., 1951. *Proc. Roy. Soc. Vict.* 63: 31-39.
Boucot, A. J., 1957. *Senckenberg. Leth.* 38: 311-334.

Kozlowskiella cf. *cooperi* (Gill). P 12257

Lower Devonian (Yeringian).
Yering, Victoria.
Figured specimen (both valves).
McCoy, F., 1877. *Prod. Pal. Vict.* 5: 23-24, pl. 46, figs. 9-9*b*, (figures reversed). "*Spirifera sulcata*".
Gill, E. D., 1951. *Proc. Roy. Soc. Vict.* 63: 31-39.
Boucot, A. J., 1957. *Senckenberg. Leth.* 38: 311-334.

"*Leptaena rhomboidalis* (Wilckens)". P 12402

Lower Devonian.
Loyola, near Mansfield, Victoria.
Figured specimen (interior of brachial valve).
Chapman, F., 1913. *Proc. Roy. Soc. Vict.* 26: 99-113, pl. 10, figs. 4-5. This is probably a *Leptaenisca*.

?Leptaena rhomboidalis (Wilckens). P 12184

Lower Devonian (Yeringian).
Yering, Victoria.
Figured specimen (ventral valve).
McCoy, F., 1877. *Prod. Pal. Vict.* 5: 19-20, pl. 46, fig. 1 (figure reversed).
Gill, E. D., 1951. *Proc. Roy. Soc. Vict.* 63: 31-39.

?Leptaena rhomboidalis (Wilckens). P 12401

Lower Devonian (Yeringian).
Loyola, near Mansfield, Victoria.
Figured specimen.
Chapman, F., 1913. *Proc. Roy. Soc. Vict.* 26: 99-113, pl. 10, fig. 3.
Gill, E. D., 1942. *Proc. Roy. Soc. Vict.* 54: 21-52.

Leptocoelia polyspera Gill. P 14795-7

Lower Devonian.
Little Henty River, right bank, 1 mile S.E. Zeehan, Western Tasmania.
Holotype (steinkern of ventral valve P 14795).
Paratype (steinkern P 14796 and external mould P 14797 of dorsal valve).
Gill, E. D., *Pap. & Proc. Roy. Soc. Tas for* 1949: 231-258, pl. 1, figs. 25-28, 38.

Lingula flemingtonensis Chapman. P 12064

Silurian.
Moonee Ponds Creek, Flemington, Victoria.
Holotype.
Chapman, F., 1911. *Proc. Roy. Soc. Vict.* 24: 179-186, pl. 45, fig. 1. "*Lingula lewisii* var. *flemingtonensis.*"
This sub-species is here raised to full specific rank.

Lingula flemingtonensis Chapman. P 12065

Silurian.
Moonee Ponds Creek, Flemington, Victoria.
Paratype.
Chapman, F., 1911. *Proc. Roy. Soc. Vict.* 24: 179-186, probably pl. 45, figs. 2-6, taken from this specimen, which was designated the paratype by Chapman.

Lingula flemingtonensis Chapman. P 12329

Silurian.
Moonee Ponds Creek, Flemington, Victoria.
Tecto-paratype (slide).
Chapman, F., 1911. *Proc. Roy. Soc. Vict.* 24: 179-186, pl. 45, figs. 3, 5.

Lingula flemingtonensis Chapman. P 12330

Silurian.
Moonee Ponds Creek, Flemington, Victoria.
Tecto-paratype (slide).
Chapman, F., 1911. *Proc. Roy. Soc. Vict.* 24: 179-186, pl. 45, fig. 4.

Lingula spryi Chapman. P 598

Silurian.
Swanston Street Sewer, near Collins Street, Melbourne, Victoria.
Holotype (? Ventral valve).
Chapman, F., 1903. *Proc. Roy. Soc. Vict.* 16: pl. 10, fig. 9, 9*a*.

Lingula cf. *striata* Sowerby. P 12061

Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Figured specimen.
Chapman, F., 1911. *Proc. Roy. Soc. Vict.* 24: 293-300, pl. 45, fig. 7.

Lingulidiscina ranfti Allan. P 14751

Lower Devonian (Reefton Beds).
Reefton, New Zealand.
Holotype (steinkern of dorsal valve).
Allan, R. S., 1935. *D.S.I.R. Pal. Bull.* 14: 1-72, pl. 2, fig. 8.

Maoristrophia banksi Gill. P 14608-11

Lower Devonian.
Little Henty River, 1 mile S.E. Zeehan, Western Tasmania.
Holotype (steinkern of ventral valve P 14609).
Paratype (steinkern of dorsal valve P 14610).
Hypotype (steinkern of young specimen P 14611).
Hypotype (steinkern of ventral valve P 14608).
Gill, E. D., 1950. *Pap. & Proc. Roy. Soc. Tas. for* 1949: 231-258.
Gill, E. D., 1952. *Trans. Roy. Soc. New Zealand.* 80: 171-185, pl. 36, figs. 4-8.

Maoristrophia careyi Gill. P 14605-6

Lower Devonian.
Little Henry River, 1 mile S.E. Zeehan, Western Tasmania.
Holotype (steinkern P 14605 and external mould P 14606 of ventral valve).
Gill, E. D., 1950. *Pap. & Proc. Roy. Soc. Tas. for* 1949: 231-258.
Gill, E. D., 1952. *Trans. Roy. Soc. New Zealand.* 80: 171-185, pl. 36, figs. 1-2.

Maoristrophia careyi Gill. P 14607-8

Lower Devonian.
Little Henty River, 1 mile S.E. Zeehan, Western Tasmania.
Paratype (steinkern P 14607 and external mould P 14608 of dorsal valve).
Gill, E. D., 1950. *Pap. & Proc. Roy. Soc. Tas. for* 1949: 231-258.
Gill, E. D., 1952. *Trans. Roy. Soc. New Zealand.* 80: 171-185, pl. 36, figs. 3-4.

Maoristrophia keblei Gill. P 14612-4

Lower Devonian (Yeringian).
Hull Road, Loc. 13, Mooroolbark, Victoria.
Holotype (steinkern P 14612 and external mould P 14613 of ventral valve).
Paratype (steinkern of dorsal valve P 14614).
Gill, E. D., 1950. *Pap. & Proc. Roy. Soc. Tas. for* 1949: 231-258.
Gill, E. D., 1952. *Trans. Roy. Soc. New Zealand.* 80: 171-185, pl. 36, figs. 9-11.

Maoristrophia neozelanica Allan. P 14786

Lower Devonian.
Baton River Beds, Baton River, South Island, New Zealand.
Hypotype.
Gill, E. D., 1950. *Pap. & Proc. Roy. Soc. Tas. for* 1949: 231-258. pl. 1, fig. 39.

Meristella australis (McCoy). P 12243

Lower Devonian (Yeringian).
Yering, Victoria.
Lectoholotype (steinkern of ventral valve).
McCoy, F., 1877. *Prod. Pal. Vict.* 5: 28-29, pl. 47, figs. 9-9*a* (figures reversed). *"Pentamerus australis"*.
Gill, E. D., 1951. 63: 31-39, pl. 2, figs. 1-2.

Meristella australis (McCoy). P 12242

Lower Devonian (Yeringian).
Yering, Victoria.
Lectoparatype (steinkern of ventral valve).
McCoy, F., 1877. *Prod. Pal. Vict.* 5: 28-29, pl. 47, fig. 11 (figure reversed). *"Pentamerus australis"*.
Gill, E. D., 1951. *Proc. Roy. Soc. Vict.* 63: 31-39, pl. 2, figs. 7-8.

Meristella australis (McCoy). P 12241

Lower Devonian (Yeringian).
Yering, Victoria.
Lectohypotype (steinkern, ? ventral valve).
McCoy, F., 1877. *Prod. Pal. Vict.* 5: 28-29, pl. 47, fig. 12 (figure reversed). *"Pentamerus australis"*.
Gill, E. D., 1951. *Proc. Roy. Soc. Vict.* 63: 31-39.

Meristella bellensis Gill. P 14823-4

Lower Devonian.
Little Henty River, 1 mile S.E. of Zeehan, Western Tasmania.
Holotype (steinkern of ventral valve P 14823).
Hypotype (steinkern of ventral valve P 14823).
Paratype (steinkern of dorsal valve P 14824).
Gill, E. D., 1950. *Pap. & Proc. Roy. Soc. Tas. for* 1949: 231-258, pl. 1, figs. 14-18.

Notanoplia australis (Gill). P 14790

Lower Devonian (Yeringian).
Wither's Loc. 5, C.R.B. Quarry S. of Kinglake W. or Tommy's Hut Road, 1 mile S.W. Kinglake West, Victoria.
Hypotype (steinkern of dorsal valve).
Gill, E. D., 1945. *Proc. Roy. Soc. Vict.* 57: 125-150, pl. 8, fig. 4.

Notanoplia loyolensis Gill. P 12403

Lower Devonian.
Loyola, near Mansfield, Victoria.
Holotype (steinkern of ventral valve).
Chapman, F., 1913. *Proc. Roy. Soc. Vict.* 26: 99-113, pl. 10, figs. 6-7. *"Leptaena rhomboidalis"*.
Gill, E. D., 1951. *Proc. Roy. Soc. Vict.* 63: 57-72, pl. 3, figs. 1-4.

Notanoplia pherista Gill. P 14827

Lower Devonian (Bell Shale).
Right bank Little Henty River, 1 mile S.E. of Zeehan, Tasmania.
Holotype (steinkern of ventral valve).
Gill, E. D., 1950. *Pap. & Proc. Roy. Soc. Tas. for* 1949: 231-258, pl. 1, figs. 29-30.

Notanoplia pherista Gill. P 14827-8

Lower Devonian.
Right bank Little Henty River, 1 mile S.E. of Zeehan, Tasmania.
Paratype (steinkern P 14828 and external mould P 14827 of dorsal valve).
Gill, E. D., 1950. *Pap. & Proc. Roy. Soc. Tas. for* 1949: 231-258, pl. 1, figs. 31-32.

Notoconchidium florencensis Gill. P 14798-9

Lower Devonian.
Silver Bell Railway Station Yard, cutting on E. side, S. of Zeehan, Western Tasmania.
Holotype (steinkern P 14799 and external mould P 14798 of dorsal valve).
Gill, E. D., 1950. *Pap. & Proc. Roy. Soc. Tas. for* 1949: 231-258, pl. 1, figs. 7-9.

Notoconchidium thomasi Gill. P 12407

Lower Devonian.
Geol. Survey, Loc. Bb 51, Heathcote, Victoria.
Figured specimen.
Chapman, F., 1913. *Proc. Roy. Soc. Vict.* 26: 99-113, pl. 11, fig. 11. *"Conchidium knightii".*
Gill, E. D., 1951. *Mem. Nat. Mus. Vict.* 17: 187-205.

Notoleptaena otophera Gill. P 14687-8

Lower Devonian (Yeringian).
Syme's Homestead, Killara, Victoria.
Holotype (steinkern of ventral valve P 14687, external mould P 14688).
Gill, E. D., 1951. *Mem. Nat. Mus. Vict.* 17: 187-205, pl. 1, figs. 24-26.

Notoleptaena otophera Gill. P 14689

Lower Devonian (Yeringian).
Syme's Homestead, Killara, Victoria.
Hypotype (steinkern of ventral valve).
Gill, E. D., 1951. *Mem. Nat. Mus. Vict.* 17: 187-205, pl. 1, fig. 27.

Nucleospira australis McCoy. P 12251

Silurian.
Near Mt. Disappointment, Victoria.
Syntype (steinkern of both valves).
McCoy, F., 1877. *Prod. Pal. Vict.* 5: 27-28, pl. 47, figs. 7-7*d*.

Nucleospira australis McCoy. P 12252

Silurian.
Near Mt. Disappointment, Victoria.
Syntype (steinkern of ventral valve).
McCoy, F., 1877. *Prod. Pal. Vict.* 5: 27-28, pl. 47, figs. 8-8*b*.

Nucleospira megalorhyncha Gill. P 14551

Lower Devonian.
Lyell Highway, in road cutting on N. side, 100 yards E. of 12-mile post from Queenstown, Western Tasmania
Syntype (steinkern of ventral valve).
Gill, E. D., 1948. *Rec. Queen Vict. Mus. Launceston* 2: 57-74, pl. 8, figs. 27, 42.

Nucleospira megalorhyncha Gill. P 14552

Lower Devonian.
Lyell Highway, in road cutting on N. side, 100 yards E. of 12-mile post from Queenstown, Western Tasmania.
Syntype (steinkern of dorsal valve).
Gill, E. D., 1948. *Rec. Queen Vict. Mus. Launceston* 2: 57-74, pl. 8, figs. 28, 43.

"*Orbiculoidea diminuens* Chapman". P 13965

Silurian.
Wombat Creek, N.E. Gippsland, Victoria.
Holotype (steinkern of ventral valve).
Chapman, F., 1920. *Rec. Geol. Surv. Vict.* 4: 175-194, pl. 32, figs. 41-42.
The author considers this to be the operculum of a gasteropod.

Orbiculoidea selwyni Chapman. P 612

Silurian.
Merri Creek, Kalkallo, Victoria.
Syntype (steinkern).
Chapman, F., 1903. *Proc. Roy. Soc. Vict.* 16: 60-82, pl. 10, figs. 6, 6*a*.

Orbiculoidea selwyni Chapman. P 613-4

Silurian.
Merri Creek, Parish of Merriang, Victoria.
Syntype (external mould **P 613** and steinkern **P 614**).
Chapman, F., 1903. *Proc. Roy. Soc. Vict.* 16: 60-82, pl. 10, figs. 5, 12.

Parmorthis aff. *allani* (Shirley). P 14836

Lower Devonian.
Little Henty River, right bank, 1 mile S. E. Zeehan, Western Tasmania.
Figured Specimen.
Gill, E. D., 1950. *Pap. & Proc. Roy. Soc. Tas. for* 1949: 231-258. pl. 1, fig. 24.

Parmorthis vandiemeni Gill. P 14543

Lower Devonian.
Lyell Highway, road cutting on N. side, 100 yds. E. of 12-mile post from Queenstown, Western Tasmania.
Holotype (steinkern of dorsal valve).
Gill, E. D., 1948. *Rec. Queen Vict. Mus. Launceston* 2: 57-74, pl. 8, fig. 30.

" Plagiorhyncha decemplicata (Sowerby) ". P 12253

Silurian.
West of Mt. Disappointment, Victoria.
Hypotype (steinkern of ventral valve).
McCoy, F., 1877. *Prod. Pal. Vict.* 5: 26-27, pl. 47, fig. 6 (figure reversed). *" Camarotoechia decemplicata ".*

"Plagiorhyncha decemplicata (Sowerby) ". P 12254

Silurian.
West of Mt. Disappointment, Victoria.
Hypotype (steinkerns of ventral valve and dorsal valve).
McCoy, F., 1877. *Prod. Pal. Vict.* 5: 26-27, pl. 47, fig. 5 (figure reversed). *" Camarotoechia decemplicata ".*

" Plagiorhyncha decemplicata (Sowerby) ". P 12255

Silurian.
West of Mt. Disappointment, Victoria.
Hypotype (steinkern of ventral valve).
McCoy, F., 1877. *Prod. Pal. Vict.* 5: 26-27, pl. 47, fig. 6 (figure reversed). *" Camarotoechia decemplicata ".*

" Plagiorhyncha decemplicata (Sowerby) ". P 12185

Silurian.
Section 44, Parish of Wallan, Victoria.
Hypotypes (two figured specimens on one slab, steinkerns of ventral valve and dorsal valve).
McCoy, F., 1877. *Prod. Pal. Vict.* 5: 26-27, pl. 47, fig. 4 (figure reversed). *" Camarotoechia decemplicata ".*

Plectodonta bipartita (Chapman). P 12405

Lower Devonian (Yeringian).
Simmond's Bridge Hut on Yarra River, Victoria.
Syntype (steinkern of dorsal valve).
Chapman, F., 1913. *Proc. Roy. Soc. Vict.* 26: 99-113, pl. 10, fig. 10.

Plectodonta bipartita (Chapman). P 12404

Lower Devonian (Yeringian).
Ruddock's Quarry, N.W. of Lilydale, Victoria.
Syntype (steinkern of ventral valve).
Chapman, F., 1913. *Proc. Roy. Soc. Vict.* 26: 99-113, pl. 10, fig. 8.

Plectodonta bipartita (Chapman). P 12406

Lower Devonian (Yeringian).
Simmond's Bridge Hut on Yarra River, Victoria.
Paratype (steinkern of ventral valve).
Chapman, F., 1913. *Proc. Roy. Soc. Vict.* 26: 99-113, pl. 10, fig. 9.

Plectodonta bipartita (Chapman). P 14804

Lower Devonian (Bell Shale).
Quarry on N. bank of creek, N. of timber mill, N. of Zeehan, Tasmania.
Hypotype (steinkern of ventral valve).
Gill, E. D., 1950. *Pap. & Proc. Roy. Soc. Tas. for* 1949: 231-258, pl. 1, fig. 21.

Plectodonta bipartita (Chapman). P 14807

Lower Devonian (Bell Shale).
Quarry on N. bank of creek, N. of timber mill, N. of Zeehan, Tasmania.
Hypotype (steinkern of dorsal valve).
Gill, E. D., 1950. *Pap. & Proc. Roy. Soc. Tas. for* 1949: 231-258, pl. 1, fig. 22.

Plectodonta bipartita (Chapman). P 14810

Lower Devonian (Bell Shale).
Quarry on N. bank of creek, N. of timber mill, N. of Zeehan, Tasmania.
Hypotype (external mould of dorsal valve).
Gill, E. D., 1950. *Pap. & Proc. Roy. Soc. Tas. for* 1949: 231-258, pl. 1, fig. 23.

Protoleptostrophia alata (Chapman). P 665

Lower Devonian.
North of Lilydale, Victoria.
Syntype (steinkern of dorsal valve).
Chapman, F., 1903. *Proc. Roy. Soc. Vict.* 16: 60-82, pl. 11, fig. 6; pl. 12, fig. 1. *"Stropheodonta alata".*
Gill, E. D., 1949. *Mem. Nat. Mus. Vict.* 16: 91-115.

Protoleptostrophia alata (Chapman). P 666

Lower Devonian.
North of Lilydale, Victoria.
Syntype (steinkern of ventral valve).
Chapman, F., 1903. *Proc. Roy. Soc. Vict.* 16: 60-82, pl. 11, fig. 7. *"Stropheodonta alata".*
Gill, E. D., 1949. *Mem. Nat. Mus. Vict.* 16: 91-115.

Protoleptostrophia alata (Chapman). P 1421

Lower Devonian.
North of Lilydale, Victoria.
Syntype (steinkern of ventral valve).
Chapman, F., 1903. *Proc. Roy. Soc. Vict.* 16: 60-82, pl. 12, fig. 9. *"Stropheodonta alata".*
Gill, E. D., 1949. *Mem. Nat. Mus. Vict.* 16: 91-115.

Protoleptostrophia plateia Gill. P 14563

Lower Devonian.
Lyell Highway, in road cutting on N. side, 100 yards E. of 12-mile post from Queenstown, Western Tasmania.
Holotype (steinkern of ventral valve).
Gill, E. D., 1948. *Rec. Queen Vict. Mus. Launceston* 2: 57-74, pl. 8, fig. 29.

Protoleptostrophia plateia Gill. P 14564

Lower Devonian.
Lyell Highway, in road cutting on N. side, 100 yards E. of 12-mile post from Queenstown, Western Tasmania.
Paratype (steinkern of ventral valve).
Gill, E. D., 1948. *Rec. Queen Vic. Mus. Launceston* 2: 57-74, pl. 8, fig. 45.

" Rhynchospirina formosa (Hall) ". P 12386

Silurian.
West of Mt. Disappointment, Victoria.
Hypotype (steinkern of ventral valve).
McCoy, F., 1877. *Prod. Pal. Vic.* 5: pl. 46, figs. 6-6*b* (figures reversed). *" Trematospira formosa ".*

Rhynchotrema liopleura (McCoy). P 12387

Silurian.
Near Mt. Disappointment, Victoria.
Syntype (steinkern of dorsal valve).
McCoy, F., 1877. *Prod. Pal. Vict.* 5: 21-22, pl. 46, figs. 2-2*b* (figures reversed). *"Trematospira liopleura ".*

Rhynchotrema liopleura (McCoy). P 12388

Silurian.
Near Mt. Disappointment, Victoria.
Syntype (steinkern of dorsal valve).
McCoy, F., 1877. *Prod. Pal. Vict.* 5: 21-22, pl. 46, figs. 4-4a (figures reversed). *"Trematospira liopleura ".*

Rhynchotrema liopleura (McCoy). P 12389

Silurian.
Near Mt. Disappointment, Victoria.
Syntype (steinkern of both valves).
McCoy, F., 1877. *Prod. Pal. Vict.* 5: 21-22, pl. 46, figs. 5-5*d* (figures reversed). *"Trematospira liopleura ".*

Rhynchotrema liopleura (McCoy). P 12390

Silurian.
Near Mt. Disappointment, Victoria.
Syntype (steinkern of both valves).
McCoy, F., 1877. *Prod. Pal. Vict.* 5: 21-22, pl. 46, figs. 3-3*c* (figures reversed). *"Trematospira liopleura ".*

Siphonotreta australis Chapman. P 603

Silurian.
Sewerage Works, Domain Road, South Yarra, Victoria.
Syntype (impression of valve).
Chapman, F., 1903. *Proc. Roy. Soc. Vict.* 16: 60-82, pl. 10, fig. 8.

Siphonotreta australis Chapman. P 608

Silurian.
Sewerage Works, Domain Road, South Yarra, Victoria.
Syntype (impression of dorsal valve).
Chapman, F., 1903. *Proc. Roy. Soc. Vict.* 16: 60-82, pl. 11, fig. 1.

Siphonotreta australis Chapman. P 610-11

Silurian.
Sewerage Tunnel, near old Fish Market, Melbourne, Victoria.
Syntype (external mould of ventral valve P 610; steinkern of same P 611).
Chapman, F., 1903. *Proc. Roy. Soc. Vict.* 16: 60-82, pl. 10, fig. 13.

Siphonotreta plicatella Chapman. P 12398

Silurian.
Yan Yean, Victoria.
Holotype (steinkern of ventral valve).
Chapman, F., 1913. *Proc. Roy. Soc. Vict.* 26: 90-113, pl. 10, figs. 1*a-c*.

Spinella buchanensis Talent. P 7595

Middle Devonian.
Bindi, Victoria.
Hypotype.
Chapman, F., 1905. *Proc. Roy. Soc. Vict.* 18: 16-19, pl. 5, fig. 3. "*Spirifer yassensis* de Koninck".
Talent, J. A., 1956. *Proc. Roy. Soc. Vict.* 68: 1-56.

Spinella buchanensis Talent. P 7598

Middle Devonian.
Buchan, Victoria.
Hypotype.
Chapman, F., 1905. *Proc. Roy. Soc. Vict.* 18: 16-19, pl. 5, fig. 2. "*Spirifer yassensis* de Koninck".
Talent, J. A., 1956. *Proc. Roy. Soc. Vict.* 68: 1-56.

Spinella buchanensis Talent. P 7599

Middle Devonian.
Buchan, Victoria.
Hypotype.
McCoy, F., 1876. *Prod. Pal. Vict.* 4: 16-17, pl. 35, figs. 2-2*b* (figures reversed). "*Spirifera laevicosta* (Val.)".
Talent, J. A., 1956. *Proc. Roy. Soc. Vict.* 68: 1-56.

Spinella buchanensis Talent. P 16423-4

Middle Devonian. P 13967-8
Limestone Creek near Dead Horse Creek, Eastern Victoria. P 13976
Hypotype (5 specimens remaining from preparation of slides 1356-1357. The latter is a tectohypotype figured pl. 16, fig. 2 P 13968). P 15997
Chapman, F., 1920. *Rec. Geol. Surv. Vict.* 4: 175-194. "*Spirifer yassensis* de Koninck".

Spinocyrtia ostiolata (Schlotheim). P 11098

Middle Devonian.
The Eifel, Germany.
Hypotype (both valves).
Chapman, F., 1905. *Proc. Roy. Soc. Vict.* 18: 16-19, pl. 5, fig. 1. "*Spirifer laevicosta*".

"*Spirifer*" sp. P 14550

Lower Devonian.
Lyell Highway, in road cutting on N. side, 100 yards E. of 12-mile post from Queenstown, Western Tasmania.
Figured specimen (steinkern of ventral valve).
Gill. E. D., 1948. *Rec. Queen Vict. Mus. Launceston* 2: pl. 8, fig. 31.

"Spirifer" chapmani Allan. P 14749-50

Lower Devonian (Reefton Beds).
Reefton, New Zealand.
Holotype (steinkern of dorsal valve P 14749, external mould P 14750).
Allan, R. S., 1935. *D.S.I.R. Pal. Bull.* 14: 1-72, pl. 2, fig. 7.

Spirifer lilydalensis Chapman. P 756

Lower Devonian (Yeringian).
North of Lilydale, Victoria.
Syntype (steinkern of ventral valve).
Chapman, F., 1913. *Proc. Roy. Soc. Vict.* 26: pl. 11, fig. 17.

Spirifer lilydalensis Chapman. P 12417

Lower Devonian (Yeringian).
Wilson's Quarry, near Lilydale, Victoria.
Syntype (steinkern of dorsal valve).
Chapman, F., 1913. *Proc. Roy. Soc. Vict.* 26: 99-113, pl. 11, fig. 18.

Stropheodonta (Brachyprion) lilydalensis Chapman. P 660

Lower Devonian.
North of Lilydale, Victoria.
Holotype (steinkern of dorsal valve).
Chapman, F., 1903. *Proc. Roy. Soc. Vict.* 16: 60-82, pl. 11, fig. 5; pl. 12, fig. 2.

Strophonella australiensis Gill. P 14553

Lower Devonian.
Lyell Highway, in road cutting on north side, 100 yards E. of 12-mile post from Queenstown, Western Tasmania.
Syntype (steinkern of ventral valve).
Gill, E. D., 1948. *Rec. Queen Vict. Mus. Launceston* 2: 57-74, pl. 8, fig. 38.

Strophonella australiensis Gill. P 14554-5

Lower Devonian.
Lyell Highway, road cutting on N. side, 100 yards E. of 12-mile post from Queenstown, Western Tasmania.
Syntype (steinkern of dorsal valve P 14554, external mould P 14555).
Gill, E. D., 1948. *Rec. Queen Vict. Mus. Launceston* 2: 57-74, pl. 8, figs. 39, 37.

Strophonella australiensis Gill. P 14557

Lower Devonian.
Lyell Highway, in road cutting on N. side, 100 yards E. of 12-mile post from Queenstown, Western Tasmania.
Paratype (steinkern of ventral valve).
Gill, E. D., 1948. *Rec. Queen Vict. Mus. Launceston* 2: 57-74, pl. 8, fig. 36.

Strophonella australiensis Gill. P 14556

Lower Devonian.
Lyell Highway, in road cutting on N. side, 100 yards E. of 12-mile post from Queenstown, Western Tasmania.
Paratype (steinkern of ventral valve).
Gill, E. D., 1948. *Rec. Queen Vict. Mus. Launceston* 2: 57-74, pl. 8, fig. 44.

Strophonella australiensis Gill. P 14558

Lower Devonian.
Lyell Highway, in road cutting on N. side, 100 yards E. of 12-mile post from Queenstown, Western Tasmania.
Hypotype (steinkern of dorsal valve).
Gill, E. D., 1948. *Rec. Queen Vict. Mus. Launceston* 2: 57-74, pl. 8, fig. 40.

Strophonella australiensis Gill. P 14579

Lower Devonian.
Lyell Highway, in road cutting on N. side, 100 yards E. of 12-mile post from Queenstown, Western Tasmania.
Hypotype (steinkern of part of ventral valve).
Gill, E. D., 1948. *Rec. Queen Vict. Mus. Launceston* 2: 57-74, pl. 8, fig. 35.

Strophonella euglyphoides Chapman. P 694

Lower Devonian.
North of Lilydale, Victoria.
Syntypes (impressions of two valves).
Chapman, F., 1903. *Proc. Roy. Soc. Vict.* 16: 60-82, pl. 12, figs. 3-6.

Strophonella lyelli Gill. P 14559

Lower Devonian.
Lyell Highway, in road cutting on N. side, 100 yards E. of 12-mile post from Queenstown, Western Tasmania.
Syntype (steinkern of ventral valve).
Gill, E. D., 1948. *Rec. Queen Vict. Mus. Launceston* 2: 57-74, pls. 7-8, fig. 33.

Strophonella lyelli Gill. P 14560

Lower Devonian.
Lyell Highway, in road cutting on N. side, 100 yards E. of 12-mile post from Queenstown, Western Tasmania.
Syntype (steinkern of dorsal valve).
Gill, E. D., 1948. *Rec. Queen Vict. Mus. Launceston* 2: 57-74, pl. 8, fig. 34.

Strophonella lyelli Gill. P 14562

Lower Devonian.
Lyell Highway, in road cutting on N. side, 100 yards E. of 12-mile post from Queenstown, Western Tasmania.
Syntype (steinkern of dorsal valve).
Gill, E. D., 1948. *Rec. Queen Vict. Mus. Launceston* 2: 57-74, pl. 8, fig. 32.

Strophonella lyelli Gill. P 14561

Lower Devonian.
Lyell Highway, in road cutting on N. side, 100 yards E. of 12-mile post from Queenstown, Western Tasmania.
Hypotype (steinkern of ventral valve).
Gill, E. D., 1948. *Rec. Queen Vict. Mus. Launceston* 2: 57-74, pl. 8, fig. 41.

3. Trilobita.

Acanthopyge australis (McCoy). P 7490

Lower Devonian (Yeringian).
Junction of Woori Yallock Creek and Yarra River, Victoria.
Lectoholotype (steinkern of cranidium).
McCoy, F., 1876. *Prod. Pal. Vic.* Dec. 3: 18-19, pl. 22 (fig. unnumbered and reversed). "*Lichas australis*".
Gill, E. D., 1951. *Proc. Roy. Soc. Vict.* 63: 31-39, pl. 2, figs. 3-4.

Acanthopyge australis (McCoy). P 7489

Lower Devonian (Yeringian).
Junction of Woori Yallock Creek and Yarra River, Victoria.
Lectoparatype (steinkern of cephalon).
McCoy, F., 1876. *Prod. Pal. Vict.* Dec. 3: 18-9, pl. 22, fig. 11 (figure reversed). "*Lichas australis*".
Gill, E. D., 1951. *Proc. Roy. Soc. Vict.* 63: 31-39, pl. 2, figs. 5-6.

Acanthopyge australis (McCoy). P 14087

Lower Devonian (Yeringian).
Syme's Quarry, Killara, Victoria.
Hypotype (steinkern of carapace).
Gill, E. D., 1939. *Mem. Nat. Mus. Melb.* 11: 140-142, pl. 5, fig. 1. "*Lichas australis*".
Gill, E. D., 1951. *Proc. Roy. Soc. Vict.* 63: 31-39.

Acanthopyge australis (McCoy). P 14088 P 14771

Lower Devonian (Yeringian).
Syme's Tunnel, Killara, Victoria.
Hypotype (steinkern of cephalon P 14088; external mould P 14771).
Gill, E. D., 1939. *Mem. Nat. Mus. Melb.* 11: 140-142, pl. 5, fig. 2.
Gill, E. D., 1951. *Proc. Roy. Soc. Vict.* 63: 31-39.

Ampyx parvulus jikaensis Chapman. P 12297

Silurian (Melbournian).
Moonee Ponds Creek, Flemington, Victoria.
Holotype (steinkern of carapace).
Chapman, F., 1912. *Proc. Roy. Soc. Vict.* 24: 293-300, pl. 61, fig. 1.

Ampyx parvulus jikaensis Chapman. P 12685

Silurian (Melbournian).
Moonee Ponds Creek, Victoria.
Paratype (steinkern of cephalon with proximal part of frontal spine).
Chapman, F., 1912. *Proc. Roy. Soc. Vict.* 24: 293-300, pl. 61, fig. 2.

Ampyx yarraensis Chapman. P 12298

Silurian (Melbournian).
South Yarra, Victoria.
Holotype (steinkern of cephalon).
Chapman, F., 1912. *Proc. Roy. Soc. Vict.* 24: 293-300, pl. 61, fig. 3.

Calymene bowiei Gill. P 14504-5

Lower Devonian (Yeringian).
Syme's Homestead, Killara, Victoria.
Holotype (steinkern of cranidium P 14504, external mould P 14505).
Gill, E. D., 1945. *Proc. Roy. Soc. Vict.* 56: 171-186, pl. 7, figs. 1-2, 6.

Calymene cf. *blumenbachi* Brongniart. P 1207

Lower Devonian (Yeringian).
Section 12, Parish of Yering, Victoria.
Figured specimen (steinkern of cephalon).
Chapman, F., 1915. *Proc. Roy. Soc. Vict.* 28: 157-171, pl. 15, fig. 11.

Calymene killarensis Gill. P 14506

Lower Devonian (Yeringian).
Syme's Tunnel, Killara, Victoria.
Holotype (steinkern of cranidium).
Gill, E. D., 1945. *Proc. Roy. Soc. Vict.* 56: 171-186, pl. 7, fig. 8.

Calymene killarensis Gill. P 14511-2

Lower Devonian (Yeringian).
Syme's Tunnel, Killara, Victoria.
Hypotype (steinkern P 14511 and external mould P 14512 of pygidium).
Gill, E. D., 1945. *Proc. Roy. Soc. Vict.* 56: 171-186, pl. 7, figs. 3-4.

Cheirurus sp. P 12875

Middle Devonian.
Buchan, Victoria.
Figured specimen ("*Hydrospire*").
Chapman, F., 1912. *Rec. Geol. Surv. Vict.* 3: 218-222, pl. 36, fig. 13.

Cheirurus sp. *sensu stricto.* P 14565

Lower Devonian.
Lyell Highway, in road cutting on N. side, 100 yards E. of 12-mile post from Queenstown, Western Tasmania.
Figured specimen (steinkern of glabella).
Gill, E. D., 1948. *Rec. Queen Vic. Mus. Launceston*, 2: 57-74, pl. 8, fig. 6.

Cheirurus sternbergi (Boeck). P 12678

Lower Devonian (Yeringian).
Ruddock's Quarry, N.W. of Lilydale, Victoria.
Hypotype (steinkern of cephalon and thorax).
Chapman, F., 1915. *Proc. Roy. Soc. Vict.* 28: 157-171, pl. 15, fig. 13; pl. 16, fig. 22.

Cyphaspis bowningensis Mitchell. P 12672

Lower Devonian (Yeringian).
Loyola, near Mansfield, Victoria.
Hypotype (steinkern of cephalon and thorax).
Chapman, F., 1915. *Proc. Roy. Soc. Vict.* 28: 157-171, pl. 14, fig. 5; pl. 16, fig. 18.

Cyphaspis lilydalensis Chapman. P 12671

Lower Devonian (Yeringian).
Wilson's Quarry, Lilydale, Victoria.
Holotype (steinkern of carapace).
Chapman, F., 1915. *Proc. Roy. Soc. Vict.* 28: 157-171, pl. 14, fig. 6; pl. 16, fig. 19.

Cyphaspis yassensis Etheridge and Mitchell. P 12674

Lower Devonian (Yeringian).
Wombat Creek, N.E. Gippsland, Victoria.
Hypotype (steinkern of pygidium).
Chapman, F., 1915. *Proc. Roy. Soc. Vict.* 28: 157-171, pl. 16, fig. 21.

Cyphaspis yassensis Etheridge and Mitchell. P 12673

Lower Devonian (Yeringian).
Wombat Creek, tributary of Mitta Mitta River, N.E. Gippsland, Victoria.
Hypotype (steinkern of cephalon).
Chapman, F., 1915. *Proc. Roy. Soc. Vict.* 28: 157-171, pl. 14, fig. 7; pl. 16, fig. 20.

"*Dalmanites meridianus* Etheridge and Mitchell." P 7502

Lower Devonian (Yeringian).
Junction of Woori Yallock Creek and Yarra River, Victoria.
Hypotype (eye).
McCoy, F., 1876. *Prod. Pal. Vict.* Dec. 3: 13-15, pl. 22, fig. 2 (figure reversed). "*Phacops caudatus*".
Gill, E. D., 1938. *Vict. Nat.* 54: 167-171, figs. 3-4.

P 7495

Dalmanites wandongensis Gill.

Silurian (Melbournian).
Broadhurst's Creek, E. of Kilmore, Victoria.
Hypotype (steinkern of thorax and pygidium).
McCoy, F., 1876. *Prod. Pal. Vict.* Dec. 3: 13-15, pl. 23, fig. 9 (figure reversed). "*Phacops caudatus*".
Gill, E. D., 1948. *J. & Proc. Roy. Soc. N.S.W.* 82: 16-24.

P 7496

Dalmanites wandongensis Gill.

Silurian (Melbournian).
Broadhurst's Creek, E. of Kilmore, Victoria.
Hypotype (steinkern of pygidium).
McCoy, F., 1876. *Prod. Pal. Vict.* Dec. 3: 13-15, pl. 22, fig. 6 (figure reversed). "*Phacops caudatus*".
Gill, E. D., 1948. *J. & Proc. Roy. Soc. N.S.W.* 82: 16-24.

P 7497

Dalmanites wandongensis Gill.

Silurian (Melbournian).
Broadhurst's Creek, E. of Kilmore, Victoria.
Hypotype (steinkern of pygidium).
McCoy, F., 1876. *Prod. Pal. Vict.* Dec. 3: 13-15, pl. 22, fig. 7 (figure reversed). "*Phacops caudatus*".
Gill, E. D., 1948. *J. & Proc. Roy. Soc. N.S.W.* 82: 16-24.

P 7498

Dalmanites wandongensis Gill.

Silurian (Melbournian).
Broadhurst's Creek, E. of Kilmore, Victoria.
Hypotype (steinkern of cephalon).
McCoy, F., 1876. *Prod. Pal. Vict.* Dec. 3: 13-15, pl. 23, fig. 7 (figure reversed). "*Phacops caudatus*".
Gill, E. D., 1948. *J. & Proc. Roy. Soc. N.S.W.* 82: 16-24.

P 7499

Dalmanites wandongensis Gill.

Silurian (Melbournian).
Broadhurst's Creek, E. of Kilmore, Victoria.
Hypotype (steinkern of portion of pygidium).
McCoy, F., 1876. *Prod. Pal. Vict.* Dec. 3: 13-15, pl. 23, fig. 10 (figure reversed). "*Phacops caudatus*".
Gill, E. D., 1948. *J. & Proc. Roy. Soc. N.S.W.* 82: 16-24.

P 7500

Dalmanites wandongensis Gill.

Silurian (Melbournian).
Broadhurst's Creek, E. of Kilmore, Victoria.
Hypotype (hypostome).
McCoy, F., 1876. *Prod. Pal. Vict.* Dec. 3: 13-15, pl. 22, fig. 3 (figure reversed). "Phacops caudatus".
Gill, E. D., 1948. *J. & Proc. Roy. Soc. N.S.W.* 82: 16-24.

P 7501

Dalmanites wandongensis Gill.

Silurian (Melbournian).
Broadhurst's Creek, E. of Kilmore, Victoria.
Hypotype (steinkern of cephalon).
McCoy, F., 1876. *Prod. Pal. Vict.* Dec. 3: 13-15, pl. 23, fig. 8 (figure reversed). "*Phacops caudatus*".
Gill, E. D., 1948. *J. & Proc. Roy. Soc. N.S.W.* 82: 16-24.

Dalmanites aff. *wandongensis* Gill. P 14567-8

Lower Devonian.
Lyell Highway, road cutting on N. side, 100 yards E. of 12-mile post from Queenstown, Western Tasmania.
Figured specimen (steinkern of pygidium, P 14567; external mould, P 14568).
Gill, E. D., 1948. *Rec. Queen Vic. Mus. Launceston*, 2: 57-74, pl. 8, figs. 1-2.

Dalmanites aff. *wandongensis* Gill. P 14566

Lower Devonian.
Lyell Highway, road cutting on N. side, 100 yards E. of 12-mile post from Queenstown, Western Tasmania.
Figured specimen (steinkern of an imperfect cranidium).
Gill, E. D., 1948. *Rec. Queen Vic. Mus. Launceston*, 2: 57-74, pl. 8, fig. 3.

Dicranurus kinglakensis Gill. P 14522

Silurian.
Davies' Quarry, W. branch of Stony Creek, about 1 mile N. of Kinglake West State School, Victoria.
Topotype (mentioned in original description).
Gill, E. D., 1948. *Proc. Roy. Soc. Vict.* 59: 8-18.

Dicranurus kinglakensis Gill. P 14523

Silurian.
Davies' Quarry, W. branch of Stony Creek, about 1 mile N. of Kinglake West State School, Victoria.
Topotype (mentioned in original description).
Gill, E. D., 1948. *Proc. Roy. Soc. Vict.* 59: 8-18.

Encrinurus aff. *silverdalensis* Etheridge & Mitchell. P 14569

Lower Devonian.
Lyell Highway, road cutting on N. side, 100 yards E. of 12-mile post from Queenstown, Western Tasmania.
Figured specimen (steinkern of cranidium).
Gill, E. D., 1948. *Rec. Queen Vic. Mus. Launceston*, 2: 57-74, pl. 8, fig. 7.

Encrinurus aff. *silverdalensis* Etheridge & Mitchell. P 14570

Lower Devonian.
Lyell Highway, road cutting on N. side, 100 yards E. of 12-mile post from Queenstown, Western Tasmania.
Hypotype (steinkern of pygidia).
Gill, E. D., 1948. *Rec. Queen Vic. Mus. Launceston*, 2: 57-74, pl. 8, fig. 8.

Encrinurus spryi Chapman. P 12300

Silurian (Melbournian).
South Yarra, Victoria.
Holotype (steinkern of carapace).
Chapman, F., 1912. *Proc. Roy. Soc. Vict.* 24: 293-300, pl. 62, fig. 1.

Flexicalymene sp. P 1208

Silurian.
Range on E. side of Reserve of Commonage, Kilmore, Victoria.
Figured specimen (steinkern of cranidium).
Chapman, F., 1915. *Proc. Roy. Soc. Vict.* 28: 157-171,
Gill, E. D., 1945. *Proc. Roy. Soc. Vict.* 56: 171-186, pl. 7, fig. 11.

Gravicalymene australis (Etheridge & Mitchell). P 14574-5

Lower Devonian.
Lyell Highway, road cutting on N. side, 100 yards E. of 12-mile post from Queenstown, Western Tasmania.
Hypotype (steinkern of pygidium P 14574; external mould, P 14575).
Gill, E. D., 1948. *Rec. Queen Vic. Mus. Launceston* 2: 57-74, pl. 8, figs. 11-12.

Gravicalymene australis (Etheridge & Mitchell). P 14572-3

Lower Devonian.
Lyell Highway, road cutting on N. side, 100 yards E. of 12-mile post from Queenstown, Western Tasmania.
Hypotype (steinkern of cranidium, P 14572; external mould, P 14573).
Gill, E. D., 1948. *Rec. Queen Vic. Mus. Launceston* 2: 57-74, pl. 8, fig. 10.

Gravicalymene australis (Etheridge & Mitchell). P 14571

Lower Devonian.
Lyell Highway, road cutting on N. side, 100 yards E. of 12-mile post from Queenstown, Western Tasmania.
Hypotype (steinkern of cranidium).
Gill, E. D., 1948. *Rec. Queen Vic. Mus. Launceston* 2: 57-74, pl. 8, fig. 9.

Gravicalymene angustior (Chapman). P 12675

Lower Devonian (Yeringian).
Ruddock's Quarry, N.W. of Lilydale, Victoria.
Holotype (steinkern of pygidium, thorax and glabella).
Chapman, F., 1915. *Proc. Roy. Soc. Vict.* 28: 157-171, pl. 15, fig. 8.
Gill, E. D., 1945. *Proc. Roy. Soc. Vict.* 56: 171-186, pl. 7, figs. 5, 10.

Gravicalymene angustior (Chapman). P 14507

Lower Devonian (Yeringian).
Ruddock's Quarry, N.W. of Lilydale, Victoria.
Hypotype (steinkern of cephalon).
Gill, E. D., 1945. *Proc. Roy. Soc. Vict.* 56: 171-186, pl. 7, fig. 5.

Gravicalymene angustior (Chapman). P 12676

Lower Devonian (Yeringian).
Ruddock's Quarry, N.W. of Lilydale, Victoria.
Paratype (steinkern of carapace).
Chapman, F., 1915. *Proc. Roy. Soc. Vict.* 28: 157-171, pl. 15, fig. 9.
Gill, E. D., 1945. *Proc. Roy. Soc. Vict.* 56: 171-186.

Gravicalymene aff. *angustior* (Chapman). P 453

Lower Devonian (Yeringian).
Kilmore Creek, N. of special survey, Victoria.
Figured specimen (steinkern of cephalon).
Chapman, F., 1915. *Proc. Roy. Soc. Vict.* 28: 157-171, pl. 15, fig. 10.
Gill, E. D., 1945. *Proc. Roy. Soc. Vict.* 56: 171-186.

Gravicalymene cootamundrensis Gill. P 14084-5

Upper Silurian.
Oaks Creek, Cootamundra, New South Wales.
Holotype (steinkern of cephalon, P 14084; external mould, P 14085).
Gill, E. D., 1940. *Proc. Roy. Soc. Vict.* 52: 106-110, pl. 5, figs. 2-3.

Gravicalymene cootamundrensis Gill. P 14083

Upper Silurian.
Oaks Creek, Cootamundra, New South Wales.
Paratype (steinkern of thorax and pygidium).
Gill, E. D., 1940. *Proc. Roy. Soc. Vict.* 52: 106-110, pl. 5, fig. 1.

Gravicalymene cootamundrensis Gill. P 14086

Upper Silurian.
Oaks Creek, Cootamundra, New South Wales.
Paratype (steinkern of cephalon).
Gill, E. D., 1940. *Proc. Roy. Soc. Vict.* 52: 106-110, pl. 5, fig. 4.

Gravicalymene hetera Gill. P 14508

Silurian.
Kilmore East, Victoria.
Holotype (steinkern of cranidium).
Gill, E. D., 1945. *Proc. Roy. Soc. Vict.* 56: 171-186, pl. 7, fig. 12.

Gravicalymene kilmorensis Gill. P 14509

Silurian.
Kilmore East, Victoria.
Holotype (steinkern of cranidium).
Gill, E. D., 1945. *Proc. Roy. Soc. Vict.* 56: 171-186, pl. 7, fig. 9.

Gravicalymene cf. *kilmorensis* Gill. P 14510

Silurian.
Moonee Ponds Creek, Victoria.
Figured specimen (steinkern of cranidium).
Gill, E. D., 1945. *Proc. Roy. Soc. Vict.* 56: 171-186, pl. 7, fig. 7.

"*Hausmannia meridianus* Etheridge and Mitchell." P 14770

Silurian.
Kilmore, Victoria.
Hypotype (external mould of cephalon).
Etheridge, R., and Mitchell, J., 1896. *Proc. Linn. Soc. N.S.W.* 10: 486-511, pl. 40, fig. 1.

Illaenus jutsoni Chapman. P 12299

Lower Silurian.
Quarry, between Heidelberg and Templestowe, Victoria.
Holotype.
Chapman, F., 1912. *Proc. Roy. Soc. Vict.* 24: 293-300, pl. 61, figs. 4-5.
Gill, E. D., 1952. *Vict. Nat.* 69: 41-47.
Öpik, A. A., 1953. *Mem. Geol. Surv. Vict.* 19: 25-26.

Illaenus aff. *jutsoni* Chapman. P 14719

Lower Silurian.
Hill Road, North Balwyn, Victoria.
Figured specimen.
Gill, E. D., 1952. *Vict. Nat.* 69: 41-47, pl. 1, fig. 1.

Odontochile formosa Gill. P 14597

Lower Devonian.
Carmen's Quarry, Kinglake West, Victoria.
Hypotype (hypostome).
Gill, E. D., 1949. *Proc. Roy. Soc. Vict.* 61: 123-131, pl. 14, fig. 8.

Odontochile formosa Gill. P 16193-4

Lower Devonian.
Syme's Tunnel, Killara, Victoria.
Figured specimen (steinkern P 16193; external mould, P 16194).
Gill, E. D., 1938. *Vict. Nat.* 54: 167-171, figs. 3-4.

Odontopleura aff. *rattei* Etheridge and Mitchell. P 14576

Lower Devonian.
Lyell Highway, road cutting on N. side, 100 yards E. of 12-mile post from Queenstown, Western Tasmania.
Figured specimen (steinkern of cranidium).
Gill, E. D., 1948. *Rec. Queen Vic. Mus. Launceston* 2: 57-74, pl. 8, fig. 4.

Odontopleura aff. *rattei* Etheridge and Mitchell. P 14577

Lower Devonian.
Lyell Highway, road cutting on N. side, 100 yards E. of 12-mile post from Queenstown, Western Tasmania.
Figured specimen (free cheek).
Gill, E. D., 1948. *Rec. Queen Vict. Mus. Launceston* 2: 57-74, pl. 8, fig. 5.

Odontopleurid hypostome. P 14602
Lower Devonian (Yeringian).
Syme's Homestead, Killara, Victoria.
Figured specimen.
Gill, E. D., 1949. *Proc. Roy. Soc. Vict.* 61: 123-131, pl. 14, fig. 5.

Phacopid hypostome. P 14599
Lower Devonian (Yeringian).
Syme's Quarry, Killara, Victoria.
Figured specimen.
Gill, E. D., 1949. *Proc. Roy. Soc. Vict.* 61: 123-131, pl. 14, figs. 3-4.

Phacopid hypostome. P 14600
Lower Devonian (Yeringian).
Syme's Homestead, Killara, Victoria.
Figured specimen.
Gill, E. D., 1949. *Proc. Roy. Soc. Vict.* 61: 123-131, pl. 14, figs. 6-7.

Phacopid hypostome. P 14601
Lower Devonian (Yeringian).
Syme's Homestead, Killara, Victoria.
Figured specimen.
Gill, E. D., 1949. *Proc. Roy. Soc. Vict.* 61: 123-131, pl. 14, fig. 9.

"*Phacops crossleii* Etheridge and Mitchell". P 12679
Lower Devonian.
Ruddock's Quarry, N.W. of Lilydale, Victoria.
Hypotype (steinkern of carapace).
Chapman, F., 1915. *Proc. Roy. Soc. Vict.* 28: 157-171, pl. 15, fig. 14.

"*Phacops crossleii* Etheridge and Mitchell". P 12680
Lower Devonian.
Ruddock's Quarry, N.W. of Lilydale, Victoria.
Hypotype (steinkern of pygidium).
Chapman, F., 1915. *Proc. Roy. Soc. Vict.* 28: 157-171, pl. 15, fig. 15.

Phacops aff. *fecundus* Gill. P 14598
Lower Devonian (Yeringian).
Syme's Homestead, Killara, Victoria.
Figured specimen (steinkern of hypostome *in situ*).
Gill, E. D., 1949. *Proc. Roy. Soc. Vict.* 61: 123-131, pl. 14, figs. 1-2.

Phacops mansfieldensis Etheridge and Mitchell. P 15604
Lower Devonian.
Mansfield, Victoria.
Holotype (steinkern of cephalon).
Etheridge, R., and Mitchell, J., 1896. *Proc. Linn. Soc. N.S.W.* 10: 486-511, pl. 39, fig. 12.

"*Phacops* (*Portlockia*) *fecundus* Barrande". P 12116-20
Lower Devonian.
Section 12, Parish of Yering, Victoria.
Figured specimens (5).
McCoy, F., 1876. *Prod. Pal. Vict.* Dec. 3: 15-16, pl. 23, figs. 1 (P 12116), 2 (P 12117), 3 (P 12118), 4 (P 12119), 5 (P 12120) (figures reversed).
Gill, E. D., 1951. *Proc. Roy. Soc. Vict.* 63: 31-39. (Determined as *Phacops* sp. nov.)

"*Phacops serratus* Foerste". P 2304
Lower Devonian (Yeringian).
One and a half miles below Simmond's Bridge Hut on Yarra River, Victoria.
Hypotype (steinkern of carapace).
Chapman, F., 1915. *Proc. Roy. Soc. Vict.* 28: 157-171, pl. 15, fig. 16.

Phacops sweeti Etheridge and Mitchell. P 15605-10
Lower Devonian.
Mansfield, Victoria.
Syntypes (6 specimens including 2 counterparts).
Etheridge, R., and Mitchell, J., 1896. *Proc. Linn. Soc. N.S.W.* 10: 486-511, pl. 38, fig. 9 (P 15605); pl. 39, figs. 1 (P 15608), 2 (P 15609), pl. 40, fig. 10 (probably P 15610).

Proetus euryceps (McCoy). P 546
Silurian (Melbournian).
Broadhurst's Creek, E. of Kilmore, Victoria.
Holotype (steinkern of carapace).
McCoy, F., 1876. *Prod. Pal. Vict.* Dec. 3: 17-18, pl. 22, figs. 10-10*a* (figures reversed). "*Forbesia euryceps*".
Chapman, F., 1915. *Proc. Roy. Soc. Vict.* 28: 157-171, pl. 14, fig. 4.

Proetus euryceps (McCoy). P 12669
Lower Devonian (Yeringian).
Ruddock's Quarry, N.W. of Lilydale, Victoria.
Hypotype (steinkern of carapace).
McCoy, F., 1876. *Prod. Pal. Vict.* Dec. 3: 17-18, pl. 22, figs. 10-10*a* (figures reversed). "*Forbesia euryceps*".
Chapman, F., 1915. *Proc. Roy. Soc. Vict.* 28: 157-171, pl. 14, fig. 4.

Scutellum cresswelli (Chapman). P 485
Lower Devonian (Yeringian).
Cooper's Creek, Gippsland, Victoria.
Holotype (pygidium).
Chapman, F., 1915. *Proc. Roy. Soc. Vict.* 28: 157-171, pl. 14, fig. 3; pl. 16, fig. 17. "*Goldius cresswelli*".

Scutellum greenii (Chapman). P 12668
Lower Devonian (Yeringian).
Ruddock's Quarry, N.W. of Lilydale, Victoria.
Holotype (steinkern of carapace).
Chapman, F., 1915. *Proc. Roy. Soc. Vict.* 28: 157-171, pl. 14, fig. 1. "*Goldius greenii*".

Scutellum greenii (Chapman). P 12667

Lower Devonian (Yeringian).
Ruddock's Quarry, N.W. of Lilydale, Victoria.
Paratype (steinkern of pygidium).
Chapman, F., 1915. *Proc. Roy. Soc. Vict.* 28: 157-171, pl. 14, fig. 2. "*Goldius greenii*".

Trimerus harrisoni (McCoy). P 7503

Silurian (Melbournian).
Moonee Ponds Creek, Royal Park, Victoria.
Holotype (steinkern of carapace).
McCoy, F., 1876. *Prod. Pal. Vict.* Dec. 3: 13-15, pl. 23, fig. 11 (figure reversed). "*Homalonotus harrisoni*".
Gill, E. D., 1949. *Proc. Roy. Soc. Vict.* 61: 61-73, text fig. 1*a*.

Trimerus kinglakensis Gill. P 14580-1

Lower Devonian.
Davies' Quarry, also known as Middendorp's Quarry, W. branch, Stony Creek, about 1 mile N. of Kinglake West State School, Victoria.
Holotype (steinkern of cephalon P 14580; external mould P 14581).
Gill, E. D., 1949. *Proc. Roy. Soc. Vict.* 61: 61-73, pl. 8, figs 1-2; pl. 9, fig. 3; text fig. 1*e*.

Trimerus kinglakensis Gill. P 14582-3

Lower Devonian.
Davies' Quarry, also known as Middendorp's Quarry, W. branch, Stony Creek, about 1 mile N. of Kinglake West State School, Victoria.
Paratype (steinkern of thorax and pygidium P 14582; external mould P 14583).
Gill, E. D., 1949. *Proc. Roy. Soc. Vict.* 61: 61-73, pl. 8, fig. 3.

Trimerus kinglakensis Gill. P 14584

Lower Devonian.
Davies' Quarry, also known as Middendorp's Quarry, W. branch, Stony Creek, about 1 mile N. of Kinglake West State School, Victoria.
Hypotype (steinkern of thorax and pygidium; cephalon on other side).
Gill, E. D., 1949. *Proc. Roy. Soc. Vict.* 61: 61-73, pl. 9, fig. 5.

Trimerus kinglakensis Gill. P 14585-6

Lower Devonian.
Davies' Quarry, also known as Middendorp's Quarry, W. branch, Stony Creek, about 1 mile N. of Kinglake West State School, Victoria.
Hypotype (steinkern of pygidium P 14585; external mould P 14586).
Gill, E. D., 1949. *Proc. Roy. Soc. Vict.* 61: 61-73, p. 9, fig. 6.

Trimerus lilydalensis Gill. P 14587-8

Lower Devonian (Yeringian).
Hull Road, Lilydale, Victoria.
Holotype (steinkern of cephalon P 14587; external mould P 14588).
Gill, E. D., 1949. *Proc. Roy. Soc. Vict.* 61: 61-73, pl. 8, figs. 4-5, text fig. 1*f*.

Trimerus lilydalensis Gill. P 14589

Lower Devonian (Yeringian).
Hull Road, Lilydale, Victoria.
Paratype (steinkern of pygidium).
Gill, E. D., 1949. *Proc. Roy. Soc. Vict.* 61: 61-73, pl. 9, fig. 7.

Trimerus vomer (Chapman). P 12301

Silurian.
Wandong, Victoria.
Holotype (steinkern of cephalon and part of thorax).
Chapman, F., 1912. *Proc. Roy. Soc. Vict.* 24: 293-300, pl. 62, fig. 3. "*Homalontous vomer*".
Gill, E. D., 1949. *Proc. Roy. Soc. Vict.* 61: 61-73, text fig. 1*c*.

Trimerus vomer (Chapman). P 12302

Silurian.
Wandong, Victoria.
Paratype (steinkern of thorax and pygidium).
Chapman, F., 1912. *Proc. Roy. Soc. Vict.* 24: 293-300, pl. 63, fig. 2. "*Homalonotus vomer*".
Gill, E. D., 1949. *Proc. Roy. Soc. Vict.* 61: 61-73.

Trimerus vomer (Chapman). P 12303

Silurian.
Wandong, Victoria.
Paratype (steinkern of cephalon, immature specimen).
Chapman, F., 1912. *Proc. Roy. Soc. Vict.* 24: 293-300, pl. 63, fig. 1. "*Homalonotus vomer*".
Gill, E. D., 1949. *Proc. Roy. Soc. Vict.* 61: 61-73, text fig. 1*b*.

Trimerus zeehanensis Gill. P 14590-1

Lower Devonian (Bell Shale).
Right bank, Little Henty River, 1 mile S.E. of Zeehan, Tasmania.
Holotype (steinkern of cephalon P 14590; external mould P 14591).
Gill, E. D., 1949. *Proc. Roy. Soc. Vict.* 61: 61-73, pl. 9, fig. 1-2, text fig. 1*d*.

Trimerus zeehanensis Gill. P 14592-3

Lower Devonian (Bell Shale).
Right bank, Little Henty River, 1 mile S.E. of Zeehan, Tasmania.
Paratype (steinkern of pygidium P 14592; external mould P 14593).
Gill, E. D., 1949. *Proc. Roy. Soc. Vict.* 61: 61-73, pl. 9, fig. 4.

DESCRIPTIONS OF VICTORIAN NUDIBRANCHIATE MOLLUSCA, WITH A COMPREHENSIVE REVIEW OF THE EOLIDACEA.

By Robert Burn.

Text figure 1-26.

SUMMARY.

This paper is divided into two parts, although they are not marked as such. The suborders DORIDACEA and DENDRONOTACEA are contained in the first part while the suborder EOLIDACEA comprises the whole of the second part. The species belonging to the first two suborders are largely odds and ends known only from one or two specimens which have recently been discovered or collected. In the second part the review of the EOLIDACEA is as comprehensive as is possible for the present time. A list of the previously known species is appended in order to show the paucity of past records. Victoria now has fifteen EOLIDACEAN species while from the remainder of Australia a further twelve species have been described or recorded.

The 22 species dealt with below bring the list of Victorian OPISTHOBRANCHIA, as recorded by the author (Burn 1957, 1958), to a total of 67 species divided among 45 genera. A further twenty species are known to occur along the Victorian coastline but from lack of material, these are not discussed at present.

All the type and paratype specimens, and representative specimens of new records, have been presented to the National Museum of Victoria, Melbourne. The numbers following the specimens collected at various localities indicate the registered numbers of the above-mentioned institution. Unless otherwise stated all specimens were collected by the author.

The author wishes to thank Mr. C. W. Brazenor and Miss J. H. Macpherson, respectively Director and Curator of Molluscs, National Museum of Victoria, for allowing him the privilege of examining the Museum nudibranch collection in search of new records or further material. To Mr. and Mrs D. I. Hartley, of the Malacological Society of Australia, Melbourne, go his thanks for making possible or available a number of collecting trips, literature, and nudibranch material.

List of species dealt with in this paper.

Gymnodoris arnoldi (Burn, 1957).
Tambja verconis (Basedow and Hedley, 1905), gen. nov.
Polycera janjukia sp. nov.
Trippa albata sp. nov.
Aphelodoris berghi Odhner, 1924.
Dendrodoris maugeana sp. nov.
Paratritonia lutea Baba, 1949.
Coryphellina rubrolineata O'Donoghue, 1929.
Coryphellina poenicia (Burn, 1957).
Coryphellina poenicia aurantia var. nov.
Cuthona bractea sp. nov.
Catriona viridiana sp. nov.
Tergipes pauculas sp. nov.
Facelina newcombi (Angas, 1864).
Facelina hartleyi sp. nov.
Favorinus pannuceus sp. nov.
Cratena macphersonae sp. nov.
Cratena serrata (Baba, 1949).
Austraeolis ornata (Angas, 1864), gen. nov.
Austraeolis fucia sp. nov.
Echinopsole breviceratae sp. nov.
Aeolidiella faustina Bergh, 1900.
Aeolidiella macleayi (Angas, 1864).

Description of Species.

GYMNODORIS ARNOLDI (Burn).

Text fig. 1-2.

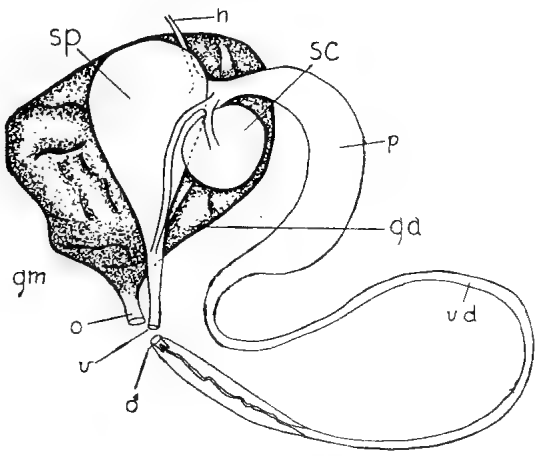
Nembrotha arnoldi Burn, 1957, *J. Malac. Soc. Aust.*, 1, p. 16, pl. 2, fig. 13-14.

An examination of further material has made it necessary to transfer this species from *Nembrotha* Bergh, 1877 to *Gymnodoris* Stimpson, 1855. The absence of a rhachidian in the radula immediately separates this species from *Nembrotha*. A probable synonym of *Gymnodoris* is *Angasiella* Crosse, 1864, although in the past, authors including Bergh and O'Donoghue have united *Nembrotha* and *Angasiella*. The basis of this suggestion is the apparent similarity of *G. arnoldi* and *A. edwardsi* Angas, 1864, the type of *Angasiella*. Possibly *G. arnoldi* is a synonym of *A. edwardsi* in which case the latter name has nearly 100 years priority. However, until the latter species is again collected the author thinks it better to retain the 2 names.

The radula contains 40 rows of teeth of the formula 7.1.0.1.7. The inner lateral is very small, about half the size of the first marginal. All marginals simple, the inner marginal is by far the largest tooth in a row.

Text fig. 1.—*Gymnodoris arnoldi* (Burn). Half row of radula ; *a*—inner lateral, *b*—outer laterals.

The inner lateral is simply hamate; the remaining teeth are shallowly curved. Labial armature chitonous, rather smooth but appears to be composed of very thin quadrangualr and triangular plates.



Text fig. 2.—*Gymnodoris arnoldi* (Burn). Distal genital organs ; ga—albumen gland, gm—mucus gland, h—hermaphrodite duct, o—oviduct, p—prostate, sc—spermatocyst, sp—spermatheca, v—vagina, vd—vas deferens, ♂—male aperture.

The genital organs are very similar to those figured by White (1951, p. 243) for *G. impudica* (Rüppell et Leuckart) from the Red Sea. Here however the prostate gland is not quite as large, and the vas deferens is very much longer and more slender. The spermatheca is very large and pear-shaped as usual; the uterine duct from the mucus gland is narrow and short, and the vagina is short and broad for it is little more than an extension of the lower part of the spermatheca. The spermatocyst is small and spherical; it debouches into the uterine duct close to its origin on the upper prostate gland. The oviduct is very short and in size nearly twice the diameter of the vagina. The vas deferens has, at its distal end, a strong elongate penial sheath but lacks an accessory or penal gland.

Locality: Torquay (1 specimen 7th January, 1958 F20,500; 1 specimen 27th January, 1958, F20,501; 1 specimen 30th October, 1958, F20,502). This last specimen was 20 mm. long in life and was the specimen in which the radula and genital organs were examined.

Station: Usually under stones at low tide but occasionally found crawling over stones covered by a few inches of water.

Remarks: The colour varies from pale pink to dark brown with the rhinophores either yellow or white. The spicules of the skin are always black tipped and give the body the appearance of a secondry colour skin over the body-colour.

Some remarks regarding the family GYMNODORIDIDAE follow after the description of the new genus proposed below.

TAMBJA gen. nov.

Diagnosis: Polycerids, without frontal or velar processes and with a vestigial frontal veil, with one pair of short extrabranchial processes, having the body tuberculose. Body-colour monotone, with the tubercles of an opposite colour. Radula having 18 rows of teeth of the formula 3 4.1.1.1.3—4. rhachidian notched medianly (left side lower than right), first lateral bifid at tip. Jaws not present, replaced by a strong labial collar. Penis with fleshy knobs, each containing a minute calcareous centre. Without a prostate gland. Rhinophores without sheaths, contractile, with numerous laminae. Branchiae 3 or 5 in number.

Type species: *Nembrotha* (?) *verconis* Basedow and Hedley, 1905.

Remarks: A second species of *Tambja* is *Nembrotha sagamiana* Baba, 1955 from Japan. Although Baba does not describe his species as tuberculose or with extrabranchial processes, his figures indicate these characters. The peculiar rhachidian of the radula at once separates the two species from *Nembrotha* Bergh, 1877, as does also the bifid first lateral. A point worthy of mention is that this new genus has few marginals while *Nembrotha* has between seven and twenty.

The relationship of *Tambja* to other polycerid genera has been carefully reviewed by the author. Odhner, 1941, placed *Nembrotha* and *Gymnodoris* in a new family, Gymnodorididae, to which should also be added the genera *Analogium* Risbec, 1928, and *Paliolla* Burn, 1958. But here the author regards *Nembrotha* as the immediate relative of *Tambja* and places both genera in the family Polyceridae with *Tambja* near to the ancestral or archaic root from which all the other polycerid genera developed. *Nembrotha* should be regarded as an independent offshoot of this ancestral form that has developed along parallel lines to that of the Gymnodorididae, i.e., the degeneration and subsequent loss of velar and extrabranchial processes. The remaining genera of the Polyceridae, following through from one genus to another, can be traced back to *Tambja*. It is only necessary to imagine the division through the notch of the rhachidian tooth of *Tambja* to obtain a typical *Polycera*

radula formula with the left side lower than the right. The acquisition of velar and extrabranchial processes, all simple in form, are the later development of the tubercles of *Tambja*, as opposed to the dendritic processes of the Triophidae with a Dendronotacean ancestry (Odhner, 1941, p. 12).

TAMBJA VERCONIS (Basedow and Hedley).

Nembrotha (?) *verconis* Basedow and Hedley, 1905, *Trans. roy. Soc. S.A.*, 29, p. 158, pl. 2, fig. 1-3.

A single specimen, in the collection of the National Museum of Victoria, is the basis for this record. It is a small specimen when compared with the dimensions of the type but agrees completely with the type description; the dimensions of the present specimen are 16·5 mm. long, 5·5 mm. broad and 9·5 mm. high. Unfortunately the specimen was allowed to die in strong sunlight and the colours have darkened considerably; however colour photographs of the living animal when first collected show it to be in agreement with Basedow and Hedley's figure of the type, e.g., bright yellow sparsely covered by dark blue spots.

The radula formula of the specimen is 12 — 13 × 4.1.1.1.4, this small number of rows bearing out the fact that the specimen is a juvenile. The type specimen had 18 rows of teeth. Except that the rhachidial tooth is stronger than is indicated in the type figure the shape of the teeth is exactly similar.

The vestigial frontal veil consists of three or four narrow ridges above the head, the lateral ridges skirt around the rhinophore bases and gradually fade out along the pallial line of tubercles.

Locality: South Channel Fort, Port Phillip Bay (1 specimen 8th December, 1957, F19,905, collected J. H. Macpherson).

Station: Collected from a rock and seaweed bottom in 10-12 feet of water (by skindivers).

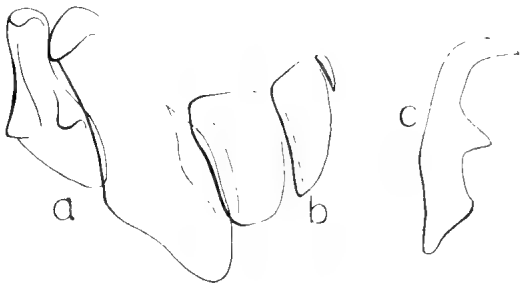
Remarks: A more detailed examination of this specimen is to be undertaken in the future in connection with a review of the Australian Polyceridae.

POLYCERA JANJUKIA sp. nov.

Text figs. 3-4.

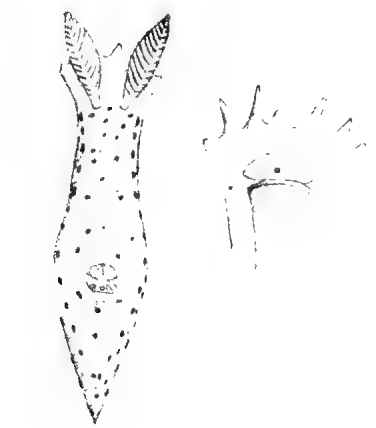
Diagnosis: A typical polyceridiform species with very large rhinophores. Length alive 8 mm. but in spirits it has contracted to 5 mm. Velar processes 6 (or 7), simple, not regular in size or shape. Back or pallial margin represented by a single row of raised coloured spots. A similar row of spots is present along the upper edge of the foot. Rhinophores immense in

comparison to the body—actual length about 3 mm., with 12-15 laminae and terminating in a small cylindrical cap. Branchiae 5 in number, contractile, bipinnate; anterior three larger than posterior two; anus protrudes between rear two plumes. Oral tentacles merely lobes of the head, indistinct. Foot very narrow and attenuated into a long tail.



Text fig. 3.—*Polycera janjukia* sp. nov. Half row of radula; a—inner laterals, b—outer laterals, c—first inner lateral in side view.

Jaws with posterior flange. Radula small, formula 7 x 3.2.0.2.3. The inner lateral is about half the length of its partner and as usual in the genus has a spur halfway along its inner side; the second lateral is strongly curved at the apex with a somewhat perpendicular flange towards the base. The marginals are thin, outer one vestigial, very small and in some rows non-apparent.



Text figure 4.—*Polycera janjukia* sp. nov. Dorsal view and detail of velum, head and anterior foot.

Body-colour bright pink, covered sparsely with medium sized ochraceous spots. Pallial and foot margin spots ochraceous; rhinophores and branchiae dirty yellow; foot, velum and head without spots, pink in colour. In spirits the spots have disappeared and the body is palest pink.

Locality: Torquay (1 specimen 27th April, 1958, F20,503).

Station: Under stone at low tide.

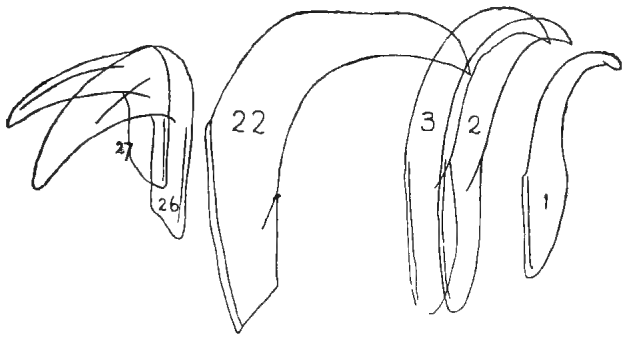
Remarks: A congener of this species is *Polycera parvula* (Burn, 1958) which was described as a species of the genus *Palio* Gray, 1857. This latter species is readily separable from *P. janjukia* in that its maroon body-colour is always present and that it has two velar processes instead of 6 or 7.

The specific name alludes to the Jan Juc Creek which enters the sea just south of the Torquay township.

TRIPPA ALBATA sp. nov.

Text fig. 5.

Diagnosis: Length about 10 mm. Body soft, rather broad, flat; mantle covered with low pustules all of about the same size, these in turn are beset by short white divergent spicules which in spirits are very nearly fully embedded in the pustules. A definite middorsal crest is present, extending from between the rhinophores to the branchial cavity. Branchial cavity with an irregular outline, branchiae unknown in number. Rhinophores with small raised sheaths, perfoliate. Foot not as long as mantle, rather broad and flat as in *Dendrodoris* spp. Oral tentacles stoutly digitiform, in fact nearly triangular.



Text fig. 5.—*Trippa albata* sp. nov. Half row of radula, the numbers refer to each tooth's position in the half row.

Buccal mass very small. Radula formula 15 x 27.0.27. The inner four laterals are minutely hooked and increase quickly in size; tooth 8 on either side of the bare rhachis are the largest teeth in a full row, and except for the two marginals little variation in size and shape occurs. The outer marginal is half as long as the antepenultimate tooth and the penultimate is midway between these two in the size of the cusp. All teeth simply hamate.

Colour pure white, sometimes cream on the mantle. Underside pure white.

Localities: Sutherlands Bay, Phillip Island (1 specimen 13th January, 1957, type, F20,504); Explosive Anchorage Buoy, off Altona, Port Phillip Bay (1 specimen, F19,908, in National Museum of Victoria, collected J. H. Macpherson); Westernport Bay, off Cowes, dredged (1 specimen, F18,828, in National Museum of Victoria, collected J. H. Macpherson).

Station: Under a mud stone at extreme low tide (type); dredged.

Remarks: Three specimens from diverse localities, all being very similar in every characteristic makes the species appear a constant one. The New South Wales species *T. intecta* Kelaart, 1859, (= *Goniodoris crinaceus* Angas, 1864) is usually much larger than the above species and is of an ashy-brown colour; this is the only previous record of the genus from Australian waters. The genus *Trippa* Bergh, 1877, is very constant in radula characters, all species described have radula formulae within the scope of the representative generic formula of 15 – 30 x 27 – 45.0.27 – 45 and all teeth are simply hamate.

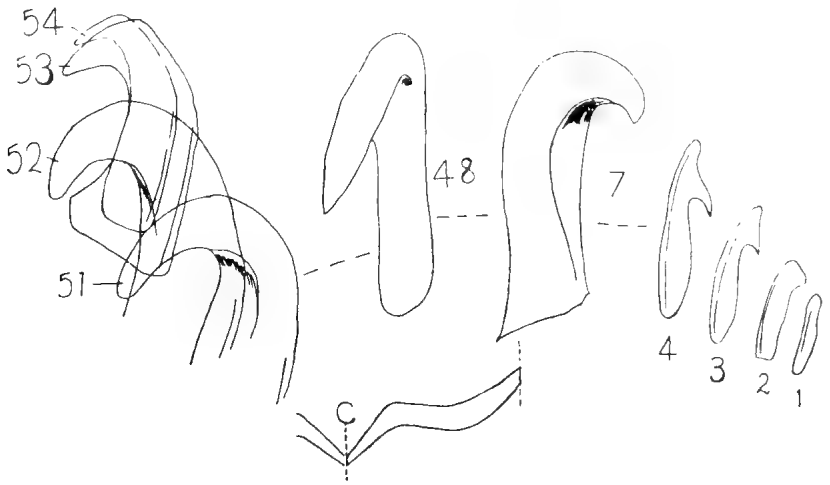
APHELODORIS BERGHI Odhner.

Text figs. 6-7.

Aphelodoris berghi Odhner, 1924, *Vidensk. Medd. naturh. Foren. Kjöb.*, 77, p. 53; nom. nov.,

= *A. luctuosa* Bergh, 1905, *Semper's Reisen*, 9, Heft 2, p. 75, pl. 5, fig. 26-32, pl. 6, 1-2; non Cheeseman, 1882.

Diagnosis: Dimensions up to 30 mm. in length and 12 mm. in breadth; rather like a *Chromodoris* in shape, very convex with high sides. The body is extremely soft, the skin is thick and composed of many fibre-like spiculae; the surface of the skin is easily detached from the body and in some specimens large patches of colour are missing from rough handling. Along the mantle in two near parallel rows are two series of varying sized, soft, blister-like tubercles, arising behind the rhinophores and ending just in front of the branchial cavity with a single small tubercle. Rhinophores with five laminae, retractile within large cylindrical sheaths; when erected only the clavus protrudes above the sheath margin; in spirits, the sheaths do not contract. Branchiae eight in number; bipinnate surrounding the anus, retractile within a large sheathed cavity. Oral tentacles grooved on their upper anterior edges.



Text fig. 6.—*Aphelodoris berghi* Odhner. Half row of radula; the numbers refer to each tooth's position the half row; c—centre or rhachis of radula in relation to the size and shape of a half row of the radula.

Radula formula 19 x 54.0.54. The inner lateral is very small and simple, and as with the subsequent three teeth is separated from its neighbour; all the succeeding laterals lie one upon the next. The largest tooth in a half row is about six from the margin; beyond this the teeth decrease a little in size but are still considerably larger than the inner laterals. All teeth except the inner two or three are simply hamate. Labial armature not smooth, consisting of short rods which lay towards the centre, i.e., inwards and downwards towards the radula.

Text fig. 7.—*Aphelodoris berghi* Odhner. Dorsal view, detail of head, and detail of rhinophore and sheath.

Colour is a good point upon which to identify the species whether alive or preserved providing the superficial colour skin is present. The body-colour is grey-fawn; a large irregular patch of maroon or purple-blue covers the median part of the dorsum. From this patch radiate 10-13 blue-grey rays, none of which are regular in shape. It is from between these blue-grey rays that the actual grey-fawn body-colour can be seen, i.e., the superficial skin is not pigmented between the blue-grey rays. Rhinophores and branchiae similar in colour to the median maroon patch. Underside of mantle and sides of foot spotted with maroon or blue-grey; sole of foot orange.

Locality: Torquay (1 specimen 25th October, 1957, F20,505; 2 specimens 7th January, 1958, F20,506; 1 specimen 17th January, 1959, F20,507).

Station: The first-mentioned specimen was collected from under a stone at extreme low tide, the other three were all crawling about over stones in shallow rock pools at low tide level.

Remarks: The rediscovery of this species removes from doubt another of those somewhat mysterious species described by Bergh from Tasmania. This species is closely related to the New South Wales and South Australian *A. varia* Abraham, 1877, but does not attain the dimensions of that species nor is it as light in colour; *A. varia* also does not have such large rhinophore sheaths as this species, in fact they sometimes appear to be non-existent.

DENDRODORIS MAUGEANA sp. nov.

Text fig. 8.

Diagnosis: Length up to 36 mm., body four times as long as broad, rather convex; mantle margin finely and intricately crenulate; rhinophores and branchiae very close to their respective ends of the body. Rhinophores with 12 laminae on a simple clavus, retractile within low-sheathed cavities. Branchiae 8 in number; tripinnate and bushy, surrounding the anus. Foot extends posteriorly beyond the mantle into a blunt tail; anteriorly it is thickened and notched. Orals small; leaf-like as usual in the genus.

Text fig. 8.—*Dendrodoris maugeana* sp. nov. Dorsal view.

Colour brilliant. Body-colour orange, mantle everywhere spotted with red; the spots are larger and closer together medianly than about the margins where they are also lighter in colour. The rhinophore clavi are dark brown; branchiae orange, sometimes red-tipped; the anus has a red spotted margin. Underside of mantle with a number of large brown spots, sole of foot clear yellow-orange.

Locality: Flinders (2 specimens 10th February, 1958, F20,509; 1 specimen 25th May, 1958, F20,508, type).

Station: Under stones at low tide. During the early part of 1958, this was a quite common find among the molluscan fauna of Flinders, but previous to that time it had not been noticed, nor has it been noticed since.

Remarks: *D. guttata* (Odhner, 1917) from Western Australia is, as far as the author knows, the only species with similarities to this but differences in colouring separate them. Other Victorian species of *Dendrodoris* lack red spotting upon the dorsum, nor do any of them have the rhinophores and branchiae so far separated and the mantle margin as crenulate as in the present species. The specific name is chosen to commemorate the occurrence of this species in the zoogeographical part of the Victorian coastline known as the Maugean Region.

PARATRITONIA LUTEA Baba.

Paratritonia lutea Baba, 1949, *Opisthobranchia of Sagami Bay*, p. 166, pl. 34, fig. 123, text fig. 104-106.

This record adds another family, genus and species to Victoria's short list of DENDRONOTACEA. The species is diagnosed as follows:—

DENDRONOTACEAN species of the family Tritoniidae with six pairs of dorso-lateral processes, beneath the first of which on the right side is the genital aperture and in front of the second are the anal and renal (nephroproct) apertures. The median tooth with a single cusp and three lateral denticles; the first lateral not much differentiated from the succeeding hamate laterals; marginals needle-shaped and denticulate. The jaw plates having two or more rows of scales along the edge; velum with 3-4 short processes either side of a shallow median notch; head distinct with lobiform orals. Foot narrow except at the anterior end. The present specimen is pale pink in colour; in life the dorsal brim is reddish. The radula formula is 56 x 100.1.1.1.100, and the dimensions are 18 x 5 x 6 mm. in length, breadth and height respectively.

Locality: South Channel Fort, Port Phillip Bay (1 specimen 8th December, 1957, F19,906, in National Museum of Victoria, collected J. H. Macpherson).

Station: Collected alive on the gorgonian coral *Mopsella* sp. in 10-12 feet of water, taken by skindivers.

Remarks: The distribution of *P. lutea* appears to cover the whole of the western Pacific Ocean although it is of very recent description. The author has seen specimens collected in Sydney Harbour, N. S. W., about 1890 and others from the Great Barrier Reef in 1930. Many further species could be recorded from Australia, but except for Odhner, 1936, no DENDRONOTACEAN species have been described for many years.

NUDIBRANCHIA EOLIDACEA.

The fifteen species described below are well distributed among the major and minor divisions of the suborder EOLIDACEA. In fact they form a very sound and representative collection upon which to institute research when dealing with what may be termed a ' forgotten group ' of Australian fauna. At present the species can be easily placed by reference to Odhner's classification of 1939. As further material becomes available it may be necessary to add to this classification.

As mentioned above the system of classification followed here is that of Odhner, 1939, modified by Marcus 1958. The position of the anus in relation to the liver system is the apparent solution to all the problems surrounding the EOLIDACEAN classification. Nevertheless certain difficulties can be experienced with some of the smaller species of

Coryphellids which belong to the superfamily Pleuroprocta. The Pleuroprocta nearly all have a mantle brim with the cerata above or dorsal and the anus below or lateral. But in *Coryphellina poenicia* (Burn 1957) this brim is rarely apparent in living specimens and never apparent in preserved material. A similar situation occurs in the northern European *Coryphella pedata* (Montagu 1815) but there the anus is further lateral than in the present species. Of the fifteen species here recorded for Victoria, ten of them have been collected at the one locality, Torquay. This should give some indication of the richness of a carefully searched area. Many more species should be found if similar careful collecting is carried out in other areas along the Victorian coastline.

For interest's sake a chronological list of the known Australian eolid species is here appended. This shows very well the paucity of past records. For comparison it should be remembered that in this paper the author has nearly doubled the number of species known and recorded from Australia.

1855 *Eolis cacoatica* Stimpson.
1864 *Aeolis foulsi* Angas.
Aeolis macleayi Angas—described below.
Flabellina ianthina Angas.
Flabellina ornata Angas—described below.
Flabellina newcombi Angas—described below.
1884 *Rizzolia australis* Bergh.
1895 *Fiona marina* (Forskäl, 1775).
1900 *Aeolidiella faustina* Bergh—described below.
1903 *Glaucus atlanticus* Forster, 1777.
1940 *Glaucilla briareus* Bergh, 1864.
1947 *Baeolidia major* Eliot, 1903, (= *Berghia amakusana* Baba, 1937, vide Marcus, 1958, p. 68).
1957 *Hervia poenicia* Burn—described below.

Superfamily PLEUROPROCTA.

EOLIDACEA which have a lateral anus below or outside the liver system. The families of this superfamily are regarded as archaic.

Family CORYPHELLIDAE.

Cerata numerous, crowded or in clusters. Nephroproct abanal (between anus and genital aperture). Radula triseriate.

Genus *CORYPHELLINA* O'Donoghue, 1929.

Pleuroproct Eolidacea, having the cerata in distinct clusters and the nephroproct just in front of the anus; rhinophores with rows of papillae along the posterior edge; radula triseriate, median tooth with a central cusp not markedly longer than the lateral denticles.

The genus is in need of further revision as it is very similar to *Coryphella* Gray, 1850. The two are separated because *Coryphellina* has papillae on portion of the rhinophores and is far more slender than its congener. The genital organs have yet to be investigated.

CORYPHELLINA RUBROLINEATA O'Donoghue.

Coryphellina rubrolineata O'Donoghue, 1929, *Trans. Zool. Soc. Lond.*, 22 (6), p. 798, text figs. unnumbered.

Diagnosis: Body very slender, length 10 mm. and breadth 1 mm. Sides high and straight, mantle brim present between the cerata groups; more apparent posteriorly than anteriorly. Foot corners narrowly tentaculiform, not very long. Cephalic tentacles long and slender. Rhinophores very large in proportion to the body, rear edge finely papillate, with many more and smaller papillae than the next species. Liver system with five branches on each side. Right liver and anterior branch of left liver each with four simple rows; the second, third and fourth branches of the left liver on either side contain two single rows each, and finally there is a single row each side. The cerata formula is 1.2.2.2—2.2—2.1—1, (see next species for explanation of cerata formula). The cerata are fusiform but not long, and are inserted singly in the simple rows. The anus is lateral just below the line of the mantle brim and in the middle of the interhepatic space, the nephroproct is just in front of and above the anus. The genital aperture is below the third row of the right liver.

The glans penis is conical and unarmed.

The colour of the body is transparent pale purple with a single longitudinal lateral line of crimson along either side of the body. The cerata are tipped with crimson, and each has an encircling band of crimson dots just below the tip, which is dull white. The sides of the head lack any distinctive colouring as is present in the next species. The digestive glands of the cerata are pale fawn.

Locality: Torquay (1 specimen 29th March, 1959, F20,756).

Station: Under stone at extreme low tide.

Remarks: This specimen was collected along with several examples of *C. poenicia* (Burn), from which it differed on the following characters, (i) the foot corners are not as produced, (ii) the rhinophores are larger and more finely papillate, (iii) the cerata are shorter and have rounded ends, and (iv) the body colour is transparent and without lateral colour patches on the head. Actually the specimen differs very little from the type description of 1929.

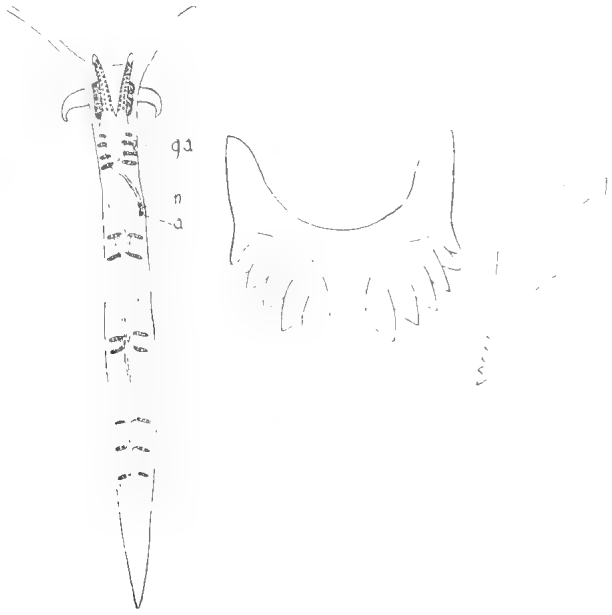
CORYPHELLINA POENICIA (Burn).

Text figs. 9-10.

Hervia poenicia Burn, 1957, *J. Malac. Soc. Aust.*, 1, p. 25, pl. 2, fig. 7-10.

Diagnosis: Body very long and slender, sides high and in some specimens separated from the dorsum by a shallow brim or flange. Dimensions up to

20 mm. in length and 2 mm. in breadth; usually specimens are about half this size. Foot corners long and narrowly tentaculiform. Cephalic tentacles long and slender. Rhinophores long, sometimes stout and sometimes slender, the posterior edge with three or more vertical rows of varying sized papillae. Liver system with four branches in the right liver and a similar number in the left partner. The second and third branches of the left liver on either side contain two single arms and finally there are three simple rows. The number of cerata in each row of the right side can be formulated as follows by counting from the anterior, 1.2.2.3 -3.3 3.3 3—2 -2, (the dots indicate the separate rows of each liver group, the dashes indicate the separate liver groups). The cerata are elongate fusiform in shape and are inserted singly in the simple rows. The anus is lateral in position emerging just in front of the second liver group on the right side. The nephroproct is just in front and a little dorsal of the anus. The genital apertures are below the second and third branches of the right liver.



Text figs. 9-10.—*Coryphellina poenicia* (Burn). 9—Liver system. 10—A median and a lateral tooth from the radula.

The radula has 34 series of teeth of the formula 1.1.1. The median tooth has a central cusp not markedly longer than its immediate lateral denticles; lateral denticles 6-7 in number, outer ones quite small. The lateral teeth have a broad base and slender cusp with four small denticles near the distal end of the cusp.

The penis is conical and unarmed.

The colour is distinct and striking to the eye. Body-colour pale purple or mauve without any markings; the cerata are bright red with white tips. The rhinophores are white or pale yellow-green. There is on either side of the head a dark purple kidney-shaped patch, this corresponds to the position of the buccal mass inside the body.

Localities: Portarlington (five specimens 28th October, 1956, F20,510); Torquay (three specimens 22nd November, 1957, F20,511; two specimens 7th December, 1957, F20,512; three specimens 27th April, 1958, F20,513; one specimen 30th October, 1958, F20,514). The type specimens were collected at Breamlea, Victoria. Others were taken at Blanket Bay, near Cape Otway.

Station: Under stones or crawling about on sea weed in rock pools at low tide level.

Remarks: Some variation takes place in the size and number of papillae on the rhinophores but they are never absent.

var. *aurantia* var. nov.

At Portarlington, 21st December, 1958, the author collected thirteen specimens of what appears to be a pure colour variety of *C. poenicia* (Burn).

Length of specimens 10 mm. Body-colour white with the purple patches either side of the head. The cerata are pale pink-orange in colour with white tips, in shape they are perhaps a little less elongate than in the typical form. The rhinophores showed the greatest amount of variation for some specimens had a similar number of large sized papillae as have typical specimens, and yet others had nearly bare rhinophores with only the slightest trace of papillation. The radula contains 28 series of teeth, the median tooth as usual, the laterals without the customary denticles. Because of the slight differences this form is here given the name *aurantia* var. nov.; the thirteen specimens are registered under the number F20,515.

This species and its colour variety are closely related to the type species of *Coryphellina, C. rubrolineata* O'Donoghue, 1929 but lack the strong body-colour and lateral markings, and have more cerata in each of the liver rows. This species is also larger. From the other eolids described below, this species is easily separated by the presence of papillae on the rear edge of the rhinophores and the very attenuated shape of the body.

Superfamily ACLEIOPROCTA.

EOLIDACEA which have the anus (and adanal nephroproct) emerging in the interhepatic space (i.e. between the first and second liver groups on the right side).

Family CUTHONIDAE.

Cerata in rows. Male and female genital apertures united or close together. Radula uniseriate, teeth with a projecting cusp (except in *Catriona*). Genital organs with an associated gland or sac on the male organ (except in the subfamily Tergipedinae).

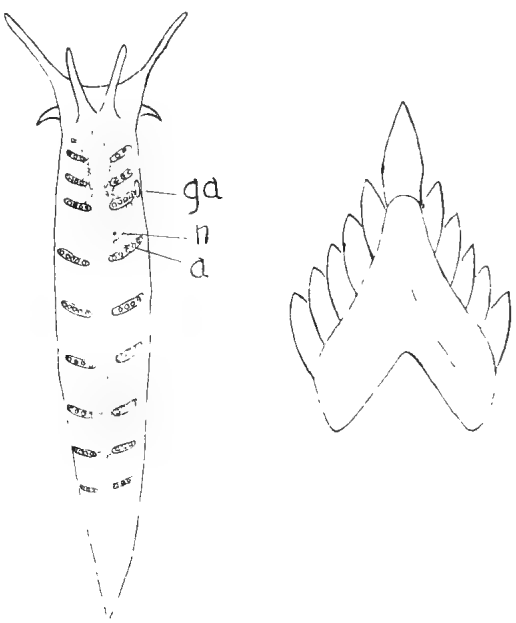
Genus *CUTHONA* Alder and Hancock, 1853.

Acleioproct Eolidacea; with a uniseriate radula in which the teeth are arched and possess a central cusp markedly longer than the lateral denticles, having the jaw process denticulate; with the right liver containing at least three branches, with the cerata inserted in single rows; having simple rhinophores and the foot corners tentaculiform.

CUTHONA BRACTEA sp. nov.

Text figs. 11-12.

Diagnosis: Body long and slender, up to 12 mm. in length and 1·5 mm. in breadth. Foot corners produced into narrow tentaculiform processes. Cephalic tentacles long and slender. Rhinophores simple although they appear to be wrinkled in some specimens. The liver system contains three short simple branches in the right liver and either three or four in its left partner. The remaining branches of the left liver, number six on each side and are all short and simple. The cerata formula is 2.3.4—5—4—4—4—3—3. The cerata are all inserted in single rows upon the liver branches; they are elongate and attain their largest diameter very near the apex and then terminate in a blunt point. In the live animal the cerata are shallowly curved upwards from the body and are far enough apart that one row does not touch the next; in active specimens they have been observed to move within themselves, i.e., twist and turn. The anus is just in front of the fourth row of cerata on the right side and is near the dorsal end of that row, the nephroproct is in front of the anus. The genital apertures lie at the lateral end of the third or posterior row of the right liver.



Text figs. 11–12.—*Cuthona bractea* sp. nov. 11—Liver system. 12—Radula tooth, dorsal view.

The radula has 27 series of teeth, each narrowly arched with an elongate spatuliform projection behind the central cusp. The central cusp is long, in actual fact about twice as long as the lateral denticles; these in turn are close together or over-lap one-another and are five in number.

The colour when alive is beautiful. The body is usually semi-transparent creamy-white; the cerata vary in colour from yellowish green (i.e. green gold) to burnished orange, always with a small white tip. Normally the rhinophores and cephalic tentacles are of the same colour as the body but in some specimens are white, while one specimen had a pale blue patch mid-way along the cephalic tentacles. Rarely pale blue patches may be present about the cerata bases.

Locality: Torquay (three specimens 22nd November, 1957, F20,518; six specimens 7th December, 1957, F20,519; two specimens 27th January, 1958; three specimens 27th April, 1958, type F20,516 and paratypes F20,517).

Station: Always under stones covered by fine sediment at low tide level. Many of the smaller specimens among the fine sediment on the underside of the stones, where they crawl about and feed.

Remarks: Unfortunately no trace of the beauty of the living animal remains in preserved material. The specific name was chosen because of the ' green gold ' or gold-plated colouring of the cerata. This is the first record of this genus from Australia and the next genus is closely allied.

Genus *CATRIONA* Winckworth, 1941.

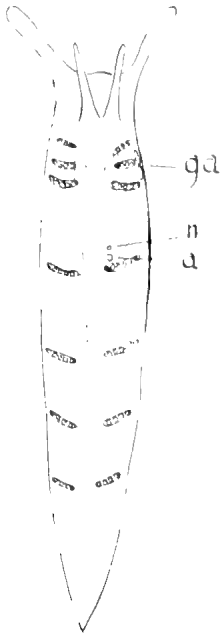
Acleioproct Eolidacea; with a uniseriate radula in which the teeth are arched, with a central cusp shorter than or not markedly longer than the lateral denticles; with the jaw process denticulate; with the rhinophores simple; having simple liver branches and at least three branches in the right liver, each with a single row of cerata; having the foot corners rounded.

CATRIONA VIRIDIANA sp. nov.

Text fig. 13.

Diagnosis: Body long and rather slender, length 8 mm. and breadth 1 mm. Foot corners rounded and expanded slightly beyond the width of the remainder of the foot. Cephalic tentacles short and claviform, the ends are rounded and a little swollen. Rhinophores simple, they appear to be slightly wrinkled but this may be muscular movement within themselves; bases close together. The liver system has three short simple rows in the right liver and its left partner. The remaining four branches of the left liver on either side are simple and short, all with the cerata inserted in a single row. The cerata are stoutly fusiform and terminate in a flattened tip; the formula is 3.4.5—5 (6)—4 (5)—4 —3 (4), the figures enclosed in brackets indicate the number of cerata in the corresponding rows on the left side. The anus emerges in the interhepatic

space just in front of the dorsal end of the fourth liver row; the nephroproct is slightly in front of this again. The genital apertures are contiguous and are situated either side of the lateral end of the second right liver branch.



Text fig. 13. *Catriona viridiana* sp. nov. Liver system.

The body is pale green-yellow and the rhinophores are yellow tipped. The cerata are dark green with white tips, all encased in a transparent yellowish skin.

Locality: Torquay (1 specimen 30th October, 1958, F20,520).

Station: Under stone at low tide level.

Remarks: The genus *Catriona* is distinguished from its congener *Cuthona* by the presence of rounded foot corners and a reduced central cusp on the radula teeth. The present specimen has retained much of the colour of the cerata but the body has become cream in tone. Without examining the radula, this species can easily be identified as a *Catriona* by the rounded foot corners and the position of the anus in the interhepatic space.

Subfamily TERGIPEDINAE.

This subfamily differs from the true Cuthonidae in that the right liver (and its left partner) contain at the most two branches. The genital organs do not have an associated gland or sac on the male organ. Probably the subfamily deserves family rank in the Acleioprocta.

Genus *TERGIPES* Cuvier, 1805.

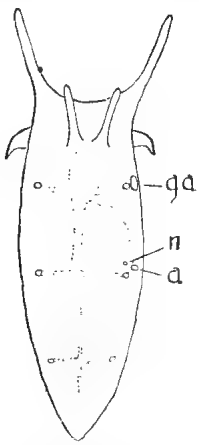
Acleioproct Eolidacea: with a uniseriate radula in which the teeth are arched with the central cusp longer than the lateral denticles, with a single row of denticles on the jaw processes; with the right liver (and left partner) containing a single row, each row terminating in a single ceras; with simple rhinophores and the foot corners rounded (? tentaculiform).

The other genus of this subfamily is *Embletonia* Alder and Hancock, 1851, which has a velum instead of cephalic tentacles. An internal examination of the present specimen may show that it should not be referred to *Tergipes* but to some other genus, possibly new. The presence of large tentaculiform foot corners substantiates this claim, although without internal examination little can be said.

TERGIPES PAUCULAS sp. nov.

Text fig. 14.

Diagnosis: Body short and plump, length 5 mm. and breadth 2 mm. In spirits, the foot corners are produced into stout tentaculiform processes. Cephalic tentacles very long and slender, much longer than shown in text figure 14, their actual length corresponds to that of the body, i.e., 5 mm. Rhinophores long and slender, simple, slightly wrinkled. The liver system is much reduced, the right liver and its left partner contains but one branch each and the posterior or left liver contains a further two simple branches either side. A single ceras surmounts the lateral extremity of each liver branch, thus the cerata formula is 1—1—1. The cerata are extremely elongate, fusiform, with the ends curled over; they tend to wave and move about when the animal crawls around. The anus emerges a little anterio-lateral of the second liver branch and the nephroproct is a little above and in front of the anus. The genital aperture is large, and situated below the right liver.



Text fig. 14.—*Tergipes pauculas* sp. nov. Liver system.

The body-colour is transparent orange with the central liver duct showing as a pale blue mid-dorsal line. The rhinophores are orange with yellow upper ends. The cephalic tentacles are pale blue. The cerata have the digestive glands

coloured bright orange, all enclosed in a very pale blue skin. The foot and mouth are orange. In spirits a number of pale whitish longitudinal lines are present along either side of the body, otherwise the colour is dirty brown.

Locality: Portarlington (one specimen 20th March, 1955, F20.521).

Station: Under stone at extreme low tide, among seaweed.

Remarks: From an examination of the sketches made of the living animal, it can be stated that the foot corners are rounded in life and are expanded considerably beyond the remainder of the foot. Contrary to this the foot corners of the spirit specimen are definately tentaculiform. Without further material it is perhaps better to accept the possibility of either rounded or tentaculiform foot corners in the specific (? and generic) diagnosis. The present specimen had lost all its cerata before being placed in spirits but should it be found again the paucity of cerata would at once provide the clue to its identity.

Superfamily CLEIOPROCTA.

Anus more or less within or behind the second group of cerata on the right side. Radula uniseriate.

Family FACELINIDAE.

Nephroproct abanal, generally separated from the anus by one or more rows of cerata. Right liver with three or more near-parallel branches and the left partner with a similar number. Radula teeth cuspidate.

Genus *FACELINA* Alder and Hancock, 1855.

Cleioproct Eolidacea: with a uniseriate radula in which the teeth are broadly arched with a central cusp, either denticulate or simple, and numerous lateral denticles; the jaw process with a single row of denticles; with five to fifteen parallel branches in the right liver, having the cerata inserted in single rows; with perfoliate or annulate rhinophores and tentaculiform foot corners.

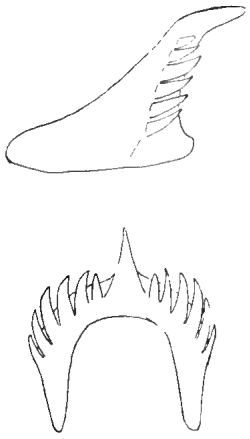
FACELINA NEWCOMBI (Angas).

Text figs. 15-16.

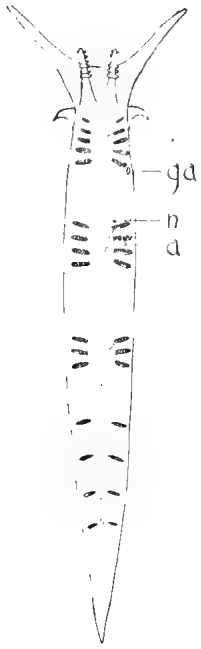
Flabellina newcombi Angas, 1864, *J. Conchyliol.*, 12, p. 68, pl. 6, fig. 8.

Diagnosis: Body very slender and attenuated, length about 20 mm. and breadth 2 mm. Foot corners narrowly tentaculiform. Cephalic tentacles stout, often distally curled in towards each other. Rhinophores with 4—7 annulae, all near the distal end. The liver system contains a great many branches. The right liver and left partner have five short simple rows; in the remainder of the left liver the second branches have four, the third have three, and finally there are four single rows either side. The cerata formula is 2.3.4.5.5—4.4.4.4—4.4.4—3—3—2—2. The cerata are stoutly fusiform and bluntly pointed. The anus emerges in the midst of the second liver group on the right

side, i.e., with two rows separating it from the interhepatic space. The nephroproct is near the dorsal end of the first row of the second group. The genital apertures are below and behind the posterior row of the right liver.



Text fig. 15.—*Facelina newcombi* (Angas). Lateral and dorsal views of a radula tooth.



Text fig. 16.—*Facelina newcombi* (Angas). Liver system.

The radula has nineteen series of teeth, each with a slender central non-denticulate cusp; most teeth have five strong lateral denticles but a few have a sixth below the normal five.

Body-colour pale cream maculated with large buff or fawn patches along the dorsum and laterally in front of the rhinophores. The rhinophore bases are brown, and usually the cephalic tentacles have a proximal and median brown patch. The cerata are black or dark brown internally, with white tips, the enveloping skin is sometimes spotted with silvery green dots.

Localities: Portarlington (one specimen 28th August, 1955, F20,522); Torquay (one specimen 9th March, 1957, F20,523; four specimens 22nd November, 1957, F20,524; three specimens 7th January, 1958, F20,525; two specimens 27th January, 1958, F20,526; one specimen 20th December, 1956, F20,527).

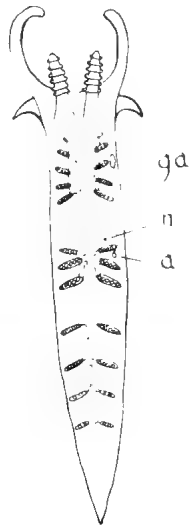
Station: Under stones or crawling on weed in rock pools left at low tide level.

Remarks: The maculated body and black or dark brown cerata immediately separate *F. newcombi* from all other species described here. The position of the anus and genital apertures separate this and the next species, *F. hartleyi* sp. nov.

FACELINA HARTLEYI sp. nov.

Text fig. 17.

Diagnosis: A very small species, slender and attenuated, length 5 mm. and breadth 1 mm. Foot corners broadly tentaculiform. Cephalic tentacles stout, and with the distal ends curled in towards each other as in *F. newcombi* (Angas). Rhinophores with 4—6 annulae, all near the top. The right liver and left partner contain five simple short rows, the second branches of the left liver three, and then there are four single rows either side. The cerata formula is 1.3.4.5.6—3.5.5—5—4—2—2. The cerata are rather elongate fusiform and attain their largest diameter just below the tip. The anus is behind the first row of the second liver branch; the nephroproct is in the interhepatic space a little more dorsal than the anus. The genital aperture is laterally below the third row of the right liver.



Text fig. 17.—*Facelina hartleyi* sp. nov. Liver system.

Body-colour white with an orange patch either side of the head in front of the the rhinophores. Cerata very dark red with white tips.

Locality: Flinders (three specimens 25th May, 1958, type F20,528 and paratypes F20,529).

Station: Under a single stone at low tide level.

Remarks: This is a very pretty species when alive and much of the colour is retained in spirits. Named after Mr. Denzil Hartley of Melbourne, in whose company the three specimens were collected by the author.

Family FAVORINIDAE.

Comprises those genera in which the right liver (and left partner) are in the form of arches, or exceptionally are simple. The cerata are inserted in either single or double (multiple) rows upon the liver branches.

Subfamily FAVORININAE.

The genera of this subfamily have the cerata inserted in single rows upon the liver branches.

Genus *FAVORINUS* Gray, 1850.

Cleioproct Eolidacea: with a uniseriate radula in which the teeth have a prominent central cusp, serrate along the edges and without lateral denticles; jaw processes with several rows of denticles or smooth; with the right liver and the more anterior branches of the left liver in the form of arches, cerata inserted in single rows; rhinophores smooth or wrinkled; with the foot corners produced into tentaculiform processes; having the penis short, conical and unarmed; with the nephroproct dorsal in front of the anterior limb of the adanal liver group.

FAVORINUS PANNUCEUS sp. nov.

Text fig. 18.

Diagnosis: A very small species, very slender, length 5 mm. Foot corners produced into narrow tentaculiform processes. Cephalic tentacles stout, ends curled in towards each other. Rhinophores long and slender, rear edge papillate; appear very large in comparison to the size of the body. Right liver and partner in the form of an arch. Second branches of the left liver on each side also arched and there are four posterior simple rows either side. The cerata in each group respectively number 5—3—2—2—1—1; in shape they are fusiform, short, sides more or less straight, the greatest diameter is attained about a third below the distal end and above this it terminates in a blunt point. The anus emerges a little behind the anteriar arm of the second arch on the right side and the nephroproct is dorsal from the anus in the interhepatic space. The genital apertures are situated towards the anterior arm of the right liver.

Text fig. 18.—*Favorinus pannuceus* sp. nov. Liver system.

Body-colour white, the buccal mass shows as a pink patch on either side of the head. The cerata are fawn with white tips.

Locality: Flinders (one specimen 25th May, 1958, F20,531).

Station: Under a stone at low tide level.

Remarks: When this species is collected again, the papillate rhinophores would enable quick identification. The presence of papillae on what should be simple rhinophores casts some doubt upon the correctness of placing *pannuceus* in *Favorinus*. Further material will perhaps clarify the situation. The specific name is given in allusion to the wrinkled appearance of the rhinophores although they are papillate.

Genus *CRATENA* Bergh, 1864.

Cleioproct Eolidacea: with a uniseriate radula in which the teeth have a prominent central cusp and strong lateral denticles; with the jaw processes irregularly denticulate; with the anterior liver groups in the form of arches in which the cerata are inserted in single rows; having linear cephalic tentacles and usually smooth rhinophores, foot corners rounded or produced into tentaculiform processes; having the penis unarmed and with associated glands; with the nephroproct in front of the adanal group of cerata.

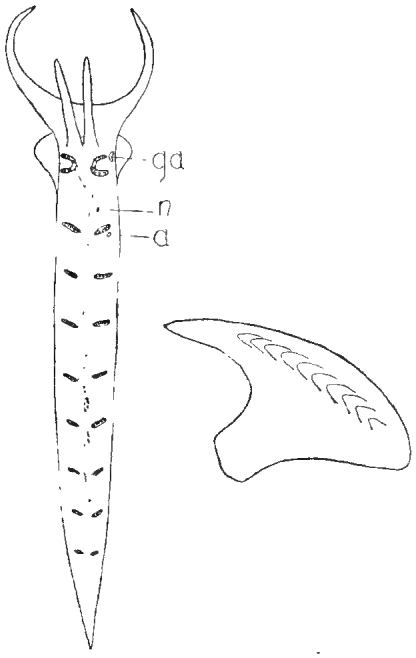
Remarks: The following two species necessitate the addition of this genus to the Australian list. Their remarkable colouring separate them from any others described here. The distribution of *Cratena* is world-wide but appears to be limited in the southern hemisphere to two or three species.

CRATENA MACPHERSONAE sp. nov.

Text figs. 19-20.

Diagnosis: Body very linear, tail narrow and long, length up to 20 mm. and breadth up to 2 mm. Foot corners expanded laterally and rounded in shape. Cephalic tentacles long and slender, distally curled upwards and inwards. Rhinophores long and smooth, bases approximating. The right liver and its left partner are in the form of narrow arches, the cerata are inserted in a single row on each arch. The remainder of the left liver is furnished with eight simple rows either side. The cerata in each group number respectively 7 (5) 5—6—5—5—4—4—3—2; in shape they are narrowly fusiform, pointed and strongly curved, so much so that they resemble sickles. The pericardium is very swollen and is much wider than the dorsal space between a pair of liver groups. The anus is at the rear of the most lateral ceras of the first simple liver branch on the right side; the nephroproct is dorsal about one-third the interhepatic space forward of the adanal liver row. The genital aperture is below the anterior arm of the right liver.

The radula contains 25 series of teeth, each with a prominent central cusp and 6—10 lateral denticles. In some aspects the teeth resemble those of *C. serrata*, in that viewed laterally the outermost denticles appear to be merely serrations of the upper edge of the tooth.



Text figs. 19–20.—*Cratena macphersonæ* sp. nov. 19—Liver system, 20—Lateral view of a tooth from the radula.

Body-colour pale green-tinted cream; cephalic tentacles and rhinophores yellow tipped. Cerata dark greenish-blue, each ceras with a yellow tip. Foot with a white sole.

Locality: Flinders (three specimens 16th May, 1959, collected J. H. Macpherson, type F20,790, paratypes F20,863).

Station: Collected from the weed growth on the piles of the jetty at the above locality.

Remarks: The beautiful blue and yellow cerata of this species at once distinguish it from any of the known Australian EOLIDACEA. The rounded foot corners are also a good character, but this species should not be confused with the smaller *Catriona viridiana* sp. nov. which has similarly rounded foot corners and green and white cerata. The species is named after Miss J. H. Macpherson of the National Museum of Victoria, to whom the author is indebted for much nudibranch material.

CRATENA SERRATA Baba.

Hervia serrata Baba, 1949, *Opisthobranchia of Sagami Bay,* p. 179, pl. 46, fig. 156-157, text fig. 142-143.

Diagnosis: Body rather plump, pinched in laterally near the rhinophores, length 15 mm. Foot broad, corners produced into short tentaculiform processes. Cephalic tentacles long and somewhat slender in comparison to the body. Rhinophores small, simple but wavy or wrinkled for most of their length. The liver has most of its branches in the form of arches; there are

six arches along either side including the right liver and left partner; two simple branches terminate the left liver posteriorly. The cerata are inserted in single rows upon the arches. The cerata are very elongate-fusiform, and terminate in a blunt point, they are capable of much movement within themselves. The anus is situated in the centre of the second arch on the right side with the nephroproct close by in the interhepatic space. The genital apertures are below the anterior arm of the right liver.

The radula of the present specimen contained only twelve series of teeth, each with about 25 small serrations along either edge of the cusp. The teeth are much crowded upon one another.

Body-colour cream, cerata pale pink with the digestive glands slightly darker.

Locality: Torquay (one specimen 7th January, 1958, F20,530).

Station: Under stone in a pool at low tide level.

Remarks: This record gives *C. serrata* a wide distribution in the western Pacific Ocean for its type locality is Japan. The pale pink colour of the cerata is without compare among the species tabulated here. The cream body and rather broad foot separate it from the greenish-bodied and narrow-footed *C. macphersonae*.

Subfamily FACALANINAE.

Favorinids with the cerata inserted in double rows upon the liver arches.

Genus *AUSTRAEOLIS* gen. nov.

Cleioproct Eolidacea: with a uniseriate radula in which the teeth have a prominent central cusp and 4—5 lateral denticles; the jaw processes denticulate. With most of the liver branches in the form of arches in which the cerata are inserted in double or multiple rows; with the nephroproct in front of the adanal liver group; having annulate rhinophores and tentaculiform foot corners; with a long finger-like penis, the glans of which is beset with a circlet of minute fleshy filaments.

Type species: *Flabellina ornata* Angas, 1864.

Remarks: This new genus is erected for what is probably the best known and most common of Australia's Eolidacea. The combination of the various characteristics given above separates *Austraeolis* from all other Eolidacean genera. The fleshy filaments of the glans penis are undoubtedly a mid-way development between those genera with an unarmed glans and those with a single hook or circlet of hooks on the glans. Specimens from the type locality, Sydney Harbour, have the filaments of the glans joined by a thin skin or web, much like the webbed foot of a duck.

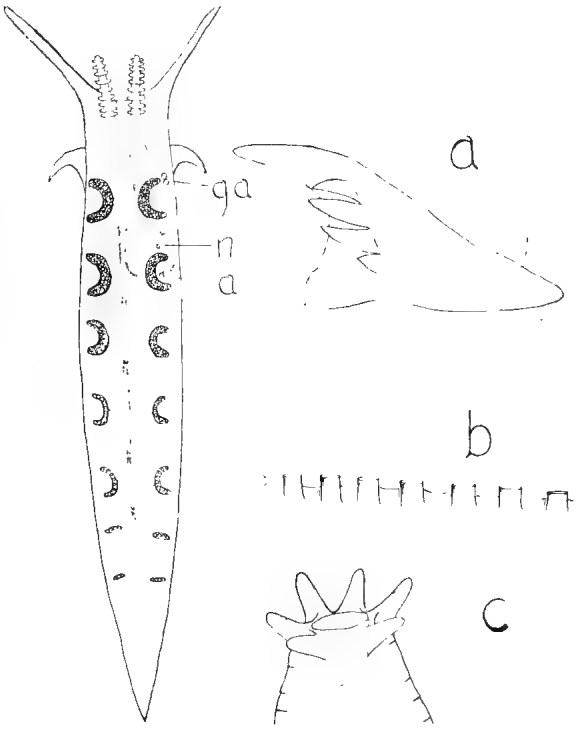
AUSTRAEOLIS ORNATA (Angas).

Text figs. 21-22.

Flabellina ornata Angas, 1864, *J. Conchyliol.*, 12, p. 67, pl. 6, fig. 7.

Diagnosis: Body elongate, plump, length up to 35 mm. Foot corners narrowly tentaculiform. Cephalic tentacles long and slender. Rhinophores with 9 annulae. Liver system with the five anterior branches in the form of arches and the two posterior branches in the form of simple rows. The cerata are inserted in multiple rows in the anterior two arches, i.e., right liver and left partner and adanal group and partner; the third groups have the cerata inserted in double rows, beyond this they are in single rows. The cerata are far too numerous and close together to count accurately; they are very slender fusiform, rather short; the digestive gland appears as a series of transverse patches; they are contractile and can shrink or can elongate to half as much again as normal. The anus is in the centre of the second right arch of the liver and the nephroproct is in the interhepatic space in front of the adanal liver group. Genital apertures below the anterior arm of the right liver. Penis long, finger-like and curved forward, transversely demarked by muscular ridges; glans beset with a circlet of six minute fleshy filaments, without any trace of chitonous or spicular hooks. The seminal tube through the penis follows a defined path, very much convoluted towards the glans; the tube is orange-yellow in colour.

The radula contains 20—22 series of teeth, each tooth with a prominent central cusp and four lateral denticles, the outer of which is little more than a knob. The jaw processes have a single row of about twenty distinctive knob-like denticles along each masticatory edge.



Text figures 21–22.—*Austraeolis ornata* (Angas). 21—Liver system; 22—a Lateral view of a radula tooth, b—Portion of the masticatory edge of the jaw, c—Detail of the glans penis.

Body-colour pale orange flecked and maculated with yellow or white. The cerata are dark internally with white tips. The transparent skin enveloping the cerata is usually flecked or spotted with orange, red, yellow, brown, green and blue. Only one of these colour or any combination may be present in specimens from any one locality; when all colours are present the animal is most beautiful and showy.

Locality: Torquay (very many specimens, collected in the period from March 1956 to March 1958); Flinders (8 specimens 10th March, 1958, F20,532; two specimens 25th May, 1958, F20,533).

Station: Under stones and crawling on seaweed at low tide level.

Remarks: Little need be said concerning the present species other than to note its great variability of colour. *A. ornata* is very common along the eastern coastline of Australia, from Cape Otway, Victoria to Long Reef, New South Wales and possibly this range can be further extended westward and northward if collecting is undertaken.

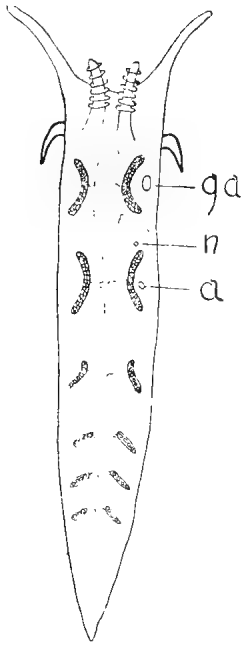
AUSTRAEOLIS FUCIA sp. nov.

Text figs. 23-24.

Diagnosis: Body plump, rather high, length 9 mm. and breadth 2 mm. Foot corners very narrowly tentaculiform and close to the body. Cephalic tentacles long and slender. Rhinophores short, with six annulae. Liver system with the two anterior branches in the form of broad arches, the third branch on partial arches, and the remaining three branches simple and short. The arches of the third branches have very short or reduced anterior arms but are not simple as are the posterior branches. The cerata are elongate-fusiform, and are set in double rows upon the arches, the remaining branches have single rows of cerata. The anus is in the middle of the arch of the second liver group and the nephroproct is in the interhepatic space just above the anterior arm of the adanal liver group. The genital apertures are below the middle of the right liver arch.

Text fig. 23.—*Austraeolis fucia* sp. nov. Lateral view of a radula tooth.

The radula contains nineteen series of teeth, each tooth has a prominent central cusp and five lateral denticles, the outer three of which are somewhat shorter than the sequent two. In some teeth the outer denticle on either side is reduced to a mere knob.



Text fig. 24. *Austraeolis fucia* sp. nov. Liver system.

Body-colour creamy-white. Cerata transparent, the digestive gland is dark red, with white tips.

Locality: Queenscliff (one specimen 20th November, 1956, F20,534).

Station: On seaweed in company with the Dendronotacean nudibranch *Melibe australis* (Angas), in rock pools at low tide level.

Remarks: No notes or sketches were made of this species other than it was collected with the nudibranch species mentioned above. From *A. ornata* (Angas) this species is separated by having fewer annulae on the rhinophores, fewer arches in the liver system, and five instead of four denticles on the radula teeth. The broad liver arches are probably a good specific character. In colour and type of rhinophores this species resembles *Facelina hartleyi* sp. nov. but the two species are separated by their very different liver systems.

Genus *ECHINOPSOLE* Macnae, 1954.

Cleioproct Eolidacea: with a uniseriate radula in which each tooth has a prominent central cusp with one or more denticles upon its lateral margins, and beyond this 3–4 lateral denticles; with the jaw processes denticulate; the right liver and most of the left liver in the form of arches in which the cerata are inserted in more than one row; with annulated rhinophores and the foot corners produced into tentaculiform processes; with an elongate finger-like penis, the glans of which is irregularly beset with a multiplicity of tiny spines; with an accessory gland entering the penial sheath; with the nephroproct dorsal in front of the anterior arm of the adanal liver group.

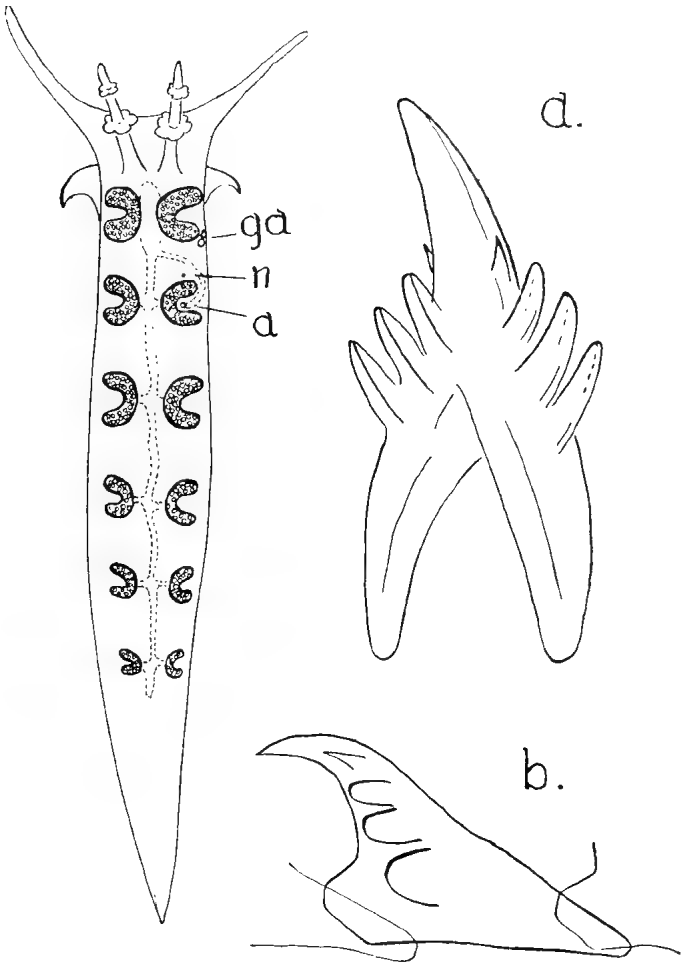
Remarks: This genus is here introduced into the Australian list for a single species which is somewhat dissimilar to the type *E. fulvus* Macnae, 1954. The very short, erect cerata of the present species are very much opposed to the long backward-lying cerata of *E. fulvus*. However the generic diagnosis accepts the present species, particularly in reference to the penial armature and the accessory gland.

ECHINOPSOLE BREVICERATAE sp. nov.

Text figs. 25-26.

Diagnosis: Body very long and slender, attenuating to a very fine tail, length up to 30 mm. and breadth up to 3 mm. Foot corners narrowly tentaculiform, at near right-angles to the body. Cephalic tentacles long and slender, stout at their bases; when alive these tentacles are always moving. Rhinophores have two large annulae, the shape of which is remarkable in that they are broadly crenulate about the edges, so much so that they resemble a flat flower with five or six round-ended petals. The liver system comprises six relatively narrow arches on either side in which the cerata are inserted in multiple rows anteriorly and double or single rows posteriorly. The anterior arches are broad in section and are elevated considerably above the surface of the body. The cerata are very short, fusiform; their bases are narrow and elongate so much so that they appear as stalks arising from the pedunculate liver arches; they stand erect and appear to be without cnidosacs in their distal ends. The anus emerges in the centre of the second liver arch of the right side, the nephroproct is in the interhepatic space in front of the adanal liver group. The genital apertures are below the rear arm of the right liver. The glans penis is beset with a double row of irregularly sized spicules or spines which are white in colour. A small accessory gland enters the penial sheath close to its aperture.

The radula contains only fourteen series of teeth but these are very large. The central cusp is rather long and bears a single small denticle on each side. The lateral denticles number three, they are short and strong. The masticatory edge of the jaws has a single row of irregularly sized and spaced denticles along its length.



Text figs. 25-26.—*Echinopsole breviceratae* sp. nov. 25—Liver system. 26a—Foreshortened ventral view of a radula tooth. 26b—Lateral view of 26a.

The body-colour is consistent. Body bright pink with three lateral rows of red spots below the cerata. Cerata vary from pink to creamy-white without any cnidosacs colouring the tips. The foot is pale pink. Dorsally there may occasionally be present red and blue spots. In one specimen there were blue patches present about the head.

Locality: Torquay (three specimens 25th October, 1957, F20,536; one specimen 7th January, 1958, F20,537; 1 specimen 27th April, 1958 holotype F20,535); Flinders (one specimen 25th May, 1958, F20,538).

Station: The first three specimens from Torquay were collected together within a six inch square, crawling on weed at extreme low tide level in the late evening. The others were all collected under stones at low tide level.

Remarks: The bright pink colour, the pedunculate liver arches and the peculiar annulae on the rhinophores distinguish this species from any others described here. *Flabellina* Cuvier,

1830, to which Australian species have been attributed in the past, has similar pedunculate liver branches but differs in that the radula is triseriate.

Family AEOLIDIIDAE.

This family contains those Cleioproct genera in which the radula is furnished with pectinate teeth and the anus is situated behind the first posterior liver group on the right. The cerata are usually in rows which are directed anterio-laterally. The masticatory edges of the jaws are smooth and the penis is unarmed.

Genus *AEOLIDIELLA* Bergh, 1867.

Cleioproct Eolidacea: with a uniseriate radula in which each tooth is pectinate, has a median cusp, and regularly graded lateral denticles; jaw processes, smooth; with the right liver either two rows in an elongate arch or with many rows; cerata inserted in single rows; having smooth rhinophores and short tentaculiform foot corners; with the penis unarmed, and the nephroproct pre-anal.

Remarks: Probably *Aeolidiella* should be divided into two subgenera on the basis of the right liver being either arched or many branched. The typical form is that with the right liver arched, and the author has in his possession a species from New South Wales which belongs to the second or many branched form. The species described below are typical forms.

AEOLIDIELLA FAUSTINA Bergh.

Aeolidiella faustina Bergh, 1900, *Zool. Jahrb.*, 13 (3), pp. 235-236, pl. 20, fig. 39-40.

Diagnosis: Body broad, plump, terminating in a blunt tail, length up to 30 mm. and breadth up to 6 mm. Foot as wide as if not wider than the body, edges very thin, corners short and tentaculiform. Cephalic tentacles long and slender. Rhinophores smooth but distinctly wrinkled into four folds which are lower on the rear edge than on the front. The liver system is very similar to that of *A. glauca* (Alder and Hancock, 1854) the type of the genus, in that the right liver is in the form of an elongate arch. The sequent four branches (left liver) are also in the form of elongate arches and posteriorly there are five simple rows each side. The cerata are stoutly fusiform, short, inserted very close together and hard to separate. The anus is behind the rear arm of the second liver group; the nephroproct appears to be between the two rows of that group. The genital apertures are separated and lie below and in front of the rear arm of the right liver.

The heart beats at the rate of 44 times per minute.

The radula contains some seventeen series of teeth, each of which has a small central cusp and 30–35 regularly graded lateral denticles. The inner denticles are short and broad but quickly lengthen and attain slenderness; the marginal denticles are short and slender.

Body-colour pale fawn or buff, sometimes greenish in hue. Occasionally the dorsum between the cerata is orange. Cerata vary from light brown to dark brown, with or without white spots, and always with white tips. One specimen from Torquay 17th January, 1959 had the pericardium coloured bright orange, in which it closely resembled *Proctonotus*(?) *affinis* Burn, 1958.

Localities: Torquay; Breamlea; Flinders; Sutherland's Bay, Phillip Island; Blanket Bay, Cape Otway.

Station: Very common under stones at or near low tide level.

Remarks: The drabness of colour and the closely packed cerata along either side of the body distinguish this species from the other species listed here. This is the first record of the species outside Tasmania where it was collected about the turn of the century. To the author's knowledge it has not been taken since that time.

AEOLIDIELLA MACLEAYI (Angas).

Eolis macleayi Angas, 1864, *J. Conchyliol.*, 12, p. 65, pl. 6, fig. 4.

This species closely resembles the last but differs considerably in the details of the general colouring of the living animal. The body-colour is palest pink with the dorsum, cephalic tentacles, rhinophores, head and pericardium heavily suffused with orange; both the rhinophores and cephalic tentacles are tipped with yellow. Cerata internally pale fawn, cnidosacs white, a broad band of yellow encircles each ceras near the tip and a secondary very much fainter and narrower band is generally present below the prominent distal one. Above, and on the anterior side only of the primary yellow band each ceras is suffused with orange. Behind the pericardium there is a little white speckling.

Other points of difference are (i) the rhinophores which are more strongly wrinkled on either side of an anterior median ridge, (ii) the narrower foot and relatively longer and sharper foot corners, (iii) the lesser number of cerata along either side of the body. The genital aperture opens in the area between the extremities of the right liver. The position of the anus at once separates this species from *A. faustina,* for it emerges in the space of the second liver arch on the right side, rather nearer the anterior arm than the centre. The nephroproct is preanal, separated from the anus by the preanal liver arm and situated very near the lateral end of that arm. As with *A. fautina* the right liver is in the form of a horseshoe, the succeeding three branches (left liver) of the right side are also horseshoes.

The dimensions of the present specimen are 14 mm. long and 4 mm. broad. The internal anatomy has not been examined.

Locality: Torquay (one specimen 31st December, 1959).

Habitat: Under stone at low tide.

Remarks: This single specimen agrees exactly with specimens from N.S.W. recently collected by the author which compared favourably with Angas' original description and figure. The brighter colouring of the body and the yellow banded and orange suffused cerata are the main pointers to be used in distinguishing this species from the drab *A. faustina.*

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ON THE NEW PLEUROBRANCH SUBFAMILY BERTHELLINAE (MOLLUSCA: GASTROPODA); A REVISION AND NEW CLASSIFICATION OF THE SPECIES OF NEW SOUTH WALES AND VICTORIA.

By Robert Burn.

Plates 1-2, Text figs. 1-5.

A recent holiday to Sydney, New South Wales, afforded the author opportunity to collect many opisthobranch specimens among which were two species of the pleurobranch subfamily Berthellinae nov. One of these agrees with one of three species of the subfamily that are here recorded from the Victorian coastline. Confusion surrounding the groups became very apparent. In this paper I hope to clarify the situation and to make it readily possible to identify each of the four species.

My thanks for pleurobranch material must be expressed to Mr. and Mrs. R. Plant of Frankston for dredgings from Westernport Bay. The National Museum of Victoria has also been very helpful in allowing me to search their molluscan collections for further material. All the material examined by myself during this study has been presented to the National Museum of Victoria, Melbourne.

The Classification of the Pleurobranchacea.

Together with the Umbraculacea, the Pleurobranchacea form an order of the Opisthobranchia known as the Notaspidea; every species is typified by the presence of an external right-lateral gill or ctenidium carried between the mantle or mantle-brim and the foot. The Pleurobranchacea is separated from the Umbraculacea by the presence of strong jaws composed of distinctly shaped plates, and by the internal position of the shell when present.

After Odhner (1926, pp. 21-24), the Pleurobranchacea comprise one family, Pleurobranchidae, with two subfamilies, the shelled Pleurobranchinae and the shell-less Pleurobranchaeinae. Thiele (1931, pp. 418-419) reiterated Odhner's classification. Later Odhner (1939, pp. 15-21) clarified certain of the northern European pleurobranch species, referring (p. 16) to the " small forms of the family, without a foot gland and with a simple, not tuberculate gill rhachis ", and treating them as a separate definable group. These genera, *Berthella, Berthellina* and

Berthellinops gen. nov. are here separated as the subfamily Berthellinae. Furthermore other changes are necessary within the suborder. Both Odhner's subfamilies should be raised to family rank, thus, Pleurobranchidae in its restricted sense of being a shell carrier and Pleurobranchaeidae without shell. The Pleurobranchidae comprises the two subfamilies, Pleurobranchinae with tuberculate gill rhachis and general large size, and Berthellinae with non-tuberculate gill rhachis and small size. It is also readily apparent that the former subfamily has a concentrated foot or pedal gland whilst the latter has none; this characteristic has been used by the Marcus (1955, p. 21) in transferring a recently described species of *Pleurobranchus* (*Oscanius*) to the genus *Berthellina*. Following the changes noted above, a synoptic key of the Pleurobranchacea is appended below; little change is necessary to Odhner's elaboration (1926, pp. 21-24) except for the elevation of his I.A. and I.B. to subfamily rank and I. and II. to family rank.*

I. Shell present (or very rarely absent). Mantle generally larger than foot, rhinophores anterio-median. Mandibular elements ensiform.

Family PLEUROBRANCHIDAE.

A. Gill rhachis smooth or transversely grooved. Pedal gland absent. Mantle smooth or porose. Either one or two seminal vesicules present.

Subfamily BERTHELLINAE.

(i) Teeth of the radula lamelliform, serrated on the posterior margin. Mandibular elements smooth or indistinctly denticulate. Shell small, narrowly triangular in shape, $\frac{1}{4}$ to $\frac{1}{5}$ of the body length, carried anteriorly. Anus at posterior end of gill membrane. With a prostate gland.

Berthellina Gardiner, 1936.
(= *Berthella* Vaysièrre, 1896, non Blainville, 1825).

(ii) Teeth of the radula hook-shaped. Mandibular elements denticulated. Without a prostate gland. Shell at least half length of body.

(*a*) Shell large, ovate. Rhinophores separate at their bases. Gill rhachis smooth, pinnae placed alternately.

Berthella Blainville, 1825.
(= *Bouvieria* Vaysièrre, 1896).

(*b*) Shell narrowly rectangular. Rhinophores arising from a common base. Gill rhachis transversely grooved, pinnae paired.

Berthellinops gen. nov.

* This classification of the Pleurobranchinae is based on the papers of White (1946-1952).

B. Gill rhachis tuberculate. Pedal gland present. Mantle generally papillate or tuberculose. Prostate gland present or not; with either one or two seminal vesicles.

Subfamily PLEUROBRANCHINAE.

(i) Mantle large, smooth or finely papillate; rounded in front. Genital apertures contiguous, surrounded by a flap of flesh. Mandibular elements ensate, a single lateral denticle present each side. Shell small, thin, calcareous. Prostate gland present.

Pleurobranchus Cuvier, 1805.
(= *Oscaniella* Bergh, 1897).

(ii) Mantle large but not larger than foot, tuberculate, rounded in shape, shallowly recessed in the front margin. Genital apertures separate from one another. Mandibular elements ensate, a single lateral denticle present each side. Shell large, very thin, membraneous, convex; nearly filling mantle cavity. Inner radular teeth (1—15) with a single denticle on the inner face. Prostate gland present.

Oscanius Leach, 1847.

(iii) Mantle very large, thick, covered with large and small tubercles, oval in shape, deeply recessed in the front margin. Genital apertures separated from one another by fleshy folds. Mandibular elements ensate, with several lateral denticles each side. Shell present or absent, when present very small, oval, calcareous, and very convex. Prostate gland absent.

Susania Gray, 1857.

II Shell absent. Gill rhachis tuberculate. Mantle generally smaller than foot, rhinophores stout and dorso-lateral. Pedal gland present or not. With or without prostate gland. Mandibular elements 4, 5, or 6 sided.

Family PLEUROBRANCHAEIDAE.

A. Mantle smaller than foot. Foot without pedal gland. Velum very large, with digitiform processes on the ventral side. Gill rhachis tuberculate or smooth. Anus mid-way along gill membrane. Radular teeth smooth. Prostate gland absent or insignificant.

Euselenops Pilsbry, 1896.
(= *Oscaniopsis* Bergh, 1897).

B. Velum without digitiform processes. Anus towards rear end of gill membrane. Prostate gland present.

(i) Mantle smaller than foot. Pedal gland present. Gill rhachis smooth. Radular teeth each with a single denticle.

Pleurobranchaea Leue, 1813.

(ii) Mantle larger than foot. Without pedal gland. Gill rhachis tuberculate. Radular teeth smooth.

Pleurobranchoides O'Donoghue, 1929.

There are very few pleurobranch species authentically recorded from the Australian coastline. The various museums of Australia have considerable collections of these animals but for

the most part they are at present unnamed, unidentified and unrecorded. It is hoped to consider these species in later papers. The remainder of this paper deals with the Berthellinae in general and the Australian species of the subfamily in detail.

The subfamily BERTHELLINAE.

There are three factors to be used as criteria in the separation of the genera of this new subfamily, (i) the serrated or hooked teeth in the radula, (ii) the small or large size of the shell, and (iii) the presence or absence of a prostate gland.

(1) *Berthellina* Gardiner, 1936. A genus of few distinct species and of world-wide distribution. Vaysièrre (1898) treated it fully but under the name *Berthella,* and since then little has been written about it. Two valid species have been added in the last fifty years. Gardiner (1936, pp. 195-198) and later Odhner (1939, pp. 15-23) clarified the nomenclatural position of the genus and its northern European species, but those of the Indo-Pacific have had no real study. The wide synonymy of the Australian species *Berthellina citrina* (Rüppell and Leuckart, 1828 = *B. punctata* Quoy and Gaimard 1832) proves this.

Unknowingly Vaysièrre himself (1898, p. 256) redescribed Quoy and Gaimard's species as *Berthella brocki* and gave as one of the localities Jervis Bay, N.S.W. His specimens were from the collections of the ' Astrolabe ' and it is possible, as Vaysièrre was unable to trace the types of *Pleurobranchus punctatus,* that he did examine their specimens and renamed them, as they were not labelled with any of Quoy and Gaimard's specific names, nor was the anatomy of their species known. Recently collected specimens examined here agree closely with his description of *B. brocki* both in radular and genital characters. Other localities given for *B. brocki* are Mauritius, Amboina and Java.

O'Donoghue (1924, p. 536) recorded the same species as *Berthella plumula* (non Montagu, 1803) from the Abrolhos Islands, Western Australia. Smith (1884, p. 88) redescribed it as *Pleurobranchus angasi* from Sydney Harbour, New South Wales. As *Berthella gotoi,* Hirase (1933, pp. 177-181) described it from Japan, and later Baba (1949, p. 37) realizing that it was identical with *Pleurobranchus delicatus* Pease (1861, p. 242) recorded it as *Berthellina delicata.*

Possibly other so-called species should be reduced to the synonymy of *Berthellina punctata.* Certain of the Red Sea–Suez Canal species (O'Donoghue 1929, pp. 788-795) show definite

specific characteristics, such as the curved shell in *Berthellina oblonga* (Savigny–Audouin, 1825), and the chitonous, terminally extended shell and paucidenticulated radular teeth in *Berthellina saidensis* (O'Donoghue, 1929). Chitonous folds or extensions to the complete or portion of the margin of the shell are not known in other species of the genus in question, but many cases are to be found among the genus *Pleurobranchus* (Vaysièrre, 1898, pl. 21, fig. 97, 104, 108; pl. 23, fig. 131; pl. 24, fig. 153, 157). O'Donoghue's type specimen of *B. saidensis* had an " extremely thin and non-calcereous " shell with an entire marginal extension of chiton, particularly developed post-laterally. These extensions give the shell an opposite appearance to the shells of other species of the genus, which are either (i) narrowly triangulate, (ii) narrow and curved, or (iii) narrowly elongate oval; in each case with the protoconch at the narrower end. The Australian species, *B. citrina,* belongs with the narrowly triangulate shelled forms.

The only departure from the usual multidenticulate radular teeth of the genus is again noticed in *B. saidensis,* where the innermost laterals have but three denticles, the first two merely a bifurcation of the tooth tip and the third some considerable distance away from the tip. All the teeth of this species exhibit a much broader basal portion than is usual; the greater part of the base is on the opposite side of the tooth to the denticulate edge. Unfortunately O'Donoghue failed to give the complete radular formula of his unique specimen. It is also worthy of mention that the mandibular elements of *B. saidensis* are proportionately a little broader than is usual.

The South African *Berthella granulosa* Krauss (Vaysièrre 1898, p. 268) is very close to *B. brocki* (loc. cit., p. 256) from Mauritius, as is also *B. citrina* (Rüppell et Leuckart, 1828), (O'Donoghue 1929, p. 788) from the Gulf of Suez, Red Sea. In the opinion of the writer both these species should be added to the synonymy of *B. brocki.* As *B. citrina* appears to be the earliest name for the Indo-Pacific species, it has priority over all the other names mentioned, including the Australian *B. punctata* (Quoy et Gaimard). With the exceptions of *B. oblonga* and *B. saidensis, B. citrina* is the only *Berthellina* known to the writer from the whole Indo-Pacific.

The genus is represented in the Atlantic by three or four species, *B. edwardsi* (Vaysièrre) 1896, *B. engeli* Gardiner, 1936, *B. quadridens* (Mörch, 1863) and its probable synonym *B. amarillius* (Mattox, 1953).

The six valid species of *Berthellina* are briefly diagnosed as follows:—

(i) *B. engeli* Gardiner (1936, p. 195). Radular formula 60—75 x 140—155.0.140—155, teeth with 7—11 denticles. Mandibular elements smooth, apically broadly pointed. Shell ovate, broader than in *B. citrina*. "Colour pale yellowish to orange. Length 30 mm." (Odhner 1939, p. 21). Distribution: European coast of North Atlantic, Mediterranean.

(ii) *B. edwardsi* (Vaysièrre, 1896, p. 122). Radular formula 100 x 230—260.0.230—260, teeth with 4—12 denticles. Mandibular elements smooth, apically narrow. Shell as in (i), but narrower posteriorly. Colour ? yellowish white. Length 43 mm. Distribution: Azores, Cape Verde.

(iii) *B. quadridens* (Mörch, 1863, p. 29). Radular formula 70 x 75.0.75, teeth with three or more denticles. Shell ovate. Colour yellowish. Length ? 5 mm. Distribution: St. Thomas and Guadeloupe.

(iv) *B. oblonga* (Savigny-Audouin, 1825, p. 20). Radular formula 70—72 x 150.0.150, teeth with 8—16 denticles. Mandibular elements smooth with the exception of one lateral denticle on one or both sides. Shell narrowly curved. Colour translucent grey. Length 20—30 mm. Distribution: Upper Red Sea, Suez Canal.

(v) *B. saidensis* (O'Donoghue, 1929, p. 793). Radular formula 92—94 x ?.0.?, teeth with 3—13 denticles, basal portions broad. Mandibular elements stout, bluntly pointed, with 1—3 indistinct lateral denticles. Shell ovate with post-lateral chitonous extentions. Colour opaque white. Length 24 mm. Distribution: Gulf of Suez.

(vi) *B. citrina* (Rüppell et Leuckart, 1828, p. 20). Radular formula 60—95 x 120—200.0.120—200, teeth with 6—18 denticles. Mandibular elements with 1—3 indistinct lateral denticles. Colour greenish-yellow to orange, with or without white punctae and reticulations. Length up to 50 mm. alive. Distribution: Red Sea, Cape of Good Hope, Mauritius, Java, Amboina, Western Australia, Japan, Sandwich Islands (Hawaii), New South Wales, Victoria.

(2) *Berthella* Blainville, 1825.

The second genus of the Berthellinae is *Berthella* Blainville, 1825, which equals *Bouvieria* Vaysièrre, 1896, and following him O'Donoghue (1924, 1929), Odhner (1926), and Hirase (1937). Previously it has not been recorded in its correct sense from Australia, and furthermore, the two species described here have not been compared with the several species of the genus which occur in New Zealand and are recorded under the names of European species. Numerous species have been described from the Atlantic Ocean and quite a few more from the Indo-Pacific. Odhner (1926, p. 22) has separated the species of *Berthella* into three groups, based upon the position of the anus relative to the gill and its attachment to the body wall. These positions are (i)

behind the posterior end of the gill membrane, (ii) at and above the rear part of the gill membrane, and (iii) above the anterior half of the gill membrane, (it may be as far rearwards as half way along the gill membrane in this last case).

Of the two species described here, *B. postrema* belongs to (ii) and *B. medietas* to (iii). In conjunction with the posterior position that occurs in (ii), there appears to be only the one seminal vesicle present along the female ducts from the mucus gland mass. This is noticeable in my single specimen of *B. postrema* and also in *B. tupala* Marcus, (1957, fig. 69, *s*), but other features of the genital organs distinguish the two. A further character common to both species is the rounded, somewhat inequal mandibular elements with a few (2—3) lateral denticles. The second cusp on the outer teeth of *B. tupala* is not repeated in the new species. Possibly those species with one seminal vesicle and rounded mandibular elements deserve subgeneric distinction.

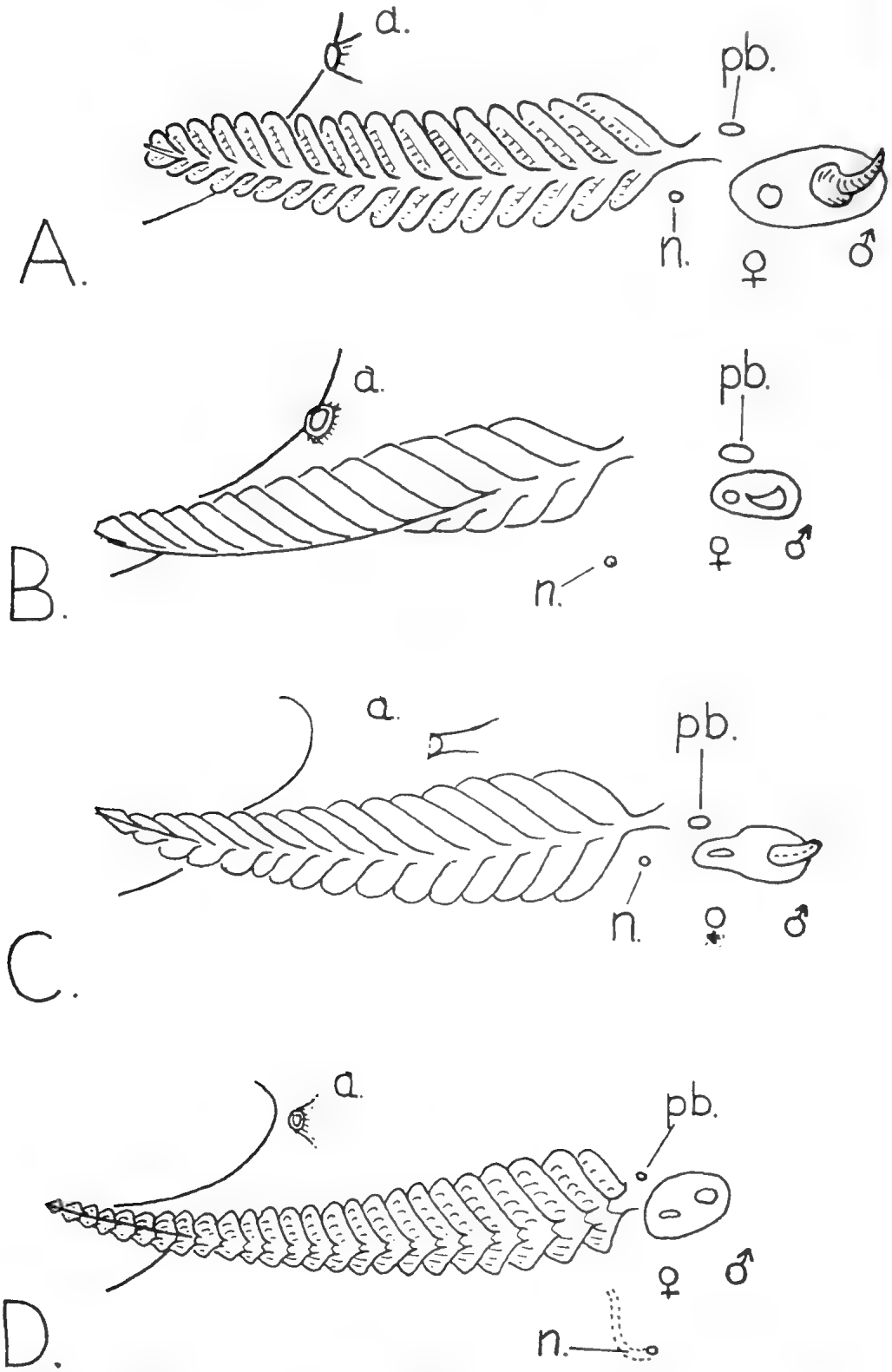
Finally it must be stated that the species of *Berthella* are paler coloured than those of the preceding genus but are never as pale as the following one. *Berthellina* varies from yellow to bright orange, *Berthella* from pale lemon-yellow to rosey-yellow to dull yellow, and in *Berthellinops* the colour is cream, or pure white with purple trim.

(3) *Berthellinops* gen. nov.

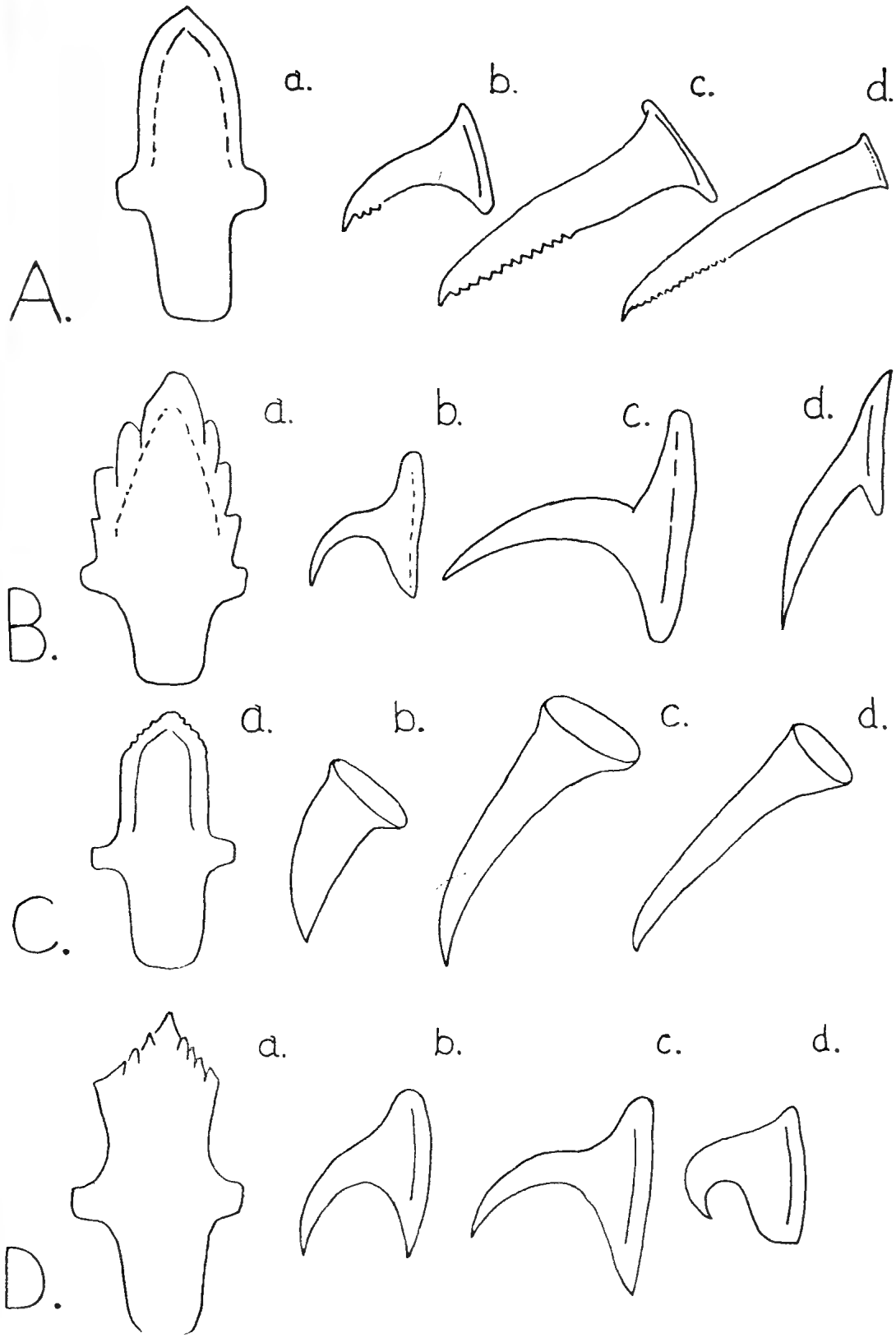
This new genus is proposed for the reception of a single cold-temperate water species at present known only from the central western coastline of Victoria.

Affinities with *Berthella* but in that genus the shell is very much broader, the rhinophores arise separately from the head, the gill pinnae are alternately placed, and the mandibular elements are smooth-tapered or rounded as they attain the apex. The present generic (perhaps only specific) characteristicaly shaped mandibular elements, rather like the ancient short sword, are without parallel in either of the two genera mentioned above; that the denticles should be restricted to such a small portion of the upper edges of the elements is also worthy of notice.

The paired pinnae of the gill present what is probably the greatest deviation from either *Berthellina* or *Berthella* and for that matter the remainder of the Pleurobranchacea. I can offer no suggestions for the purpose of the pairing, although because of these pairings it is easy to explain the transverse grooves immediately in front of each pair of pinnae; they aid the diversion of the sea water into the interstices of the pinnae. The genus can best be diagnosed as follows: Pleurobranch genus of the non-tuberculate gill rhachis group (Berthellinae) but with transverse grooves across the rhachis, and the



Text fig. 1.—Schematic diagnosis of the four species by reference to the right side. A.—*Berthellina citrina* (Rüppell et Leuckart); B.—*Berthella postrema* sp. nov.; C.—*Berthella medietas* sp. nov.; D.—*Berthellinops serenitas* sp. nov.



Text fig. 2.—Schematic diagnosis of the four species by reference to the mandibular elements and radula teeth. a—typical mandibular element; b—inner lateral from a half row of the radula; c—typical lateral from half way along the half row; d—the outer lateral or marginal tooth from the half row. A.—*Berthellina citrina* (Rüppell et Leuckart); B.—*Berthella postrema* sp. nov.; C.—*Berthella medietas* sp. nov.; D.—*Berthellinops serenitas* sp. nov.

gill pinnae in pairs; the rhinophore bases are common, and the anterio-lateral corners of the cephalic velum very much produced forward; radular teeth strongly curved, mandibular elements short, broad and denticulate; shell narrow, at least half length of preserved body, anus at rear end of gill membrane; without a prostate gland; colour white.

Type species: *Berthellinops serenitas* sp. nov.

The internal anatomy of this genus has yet to be investigated.

BERTHELLINA CITRINA (Rüppell et Leuckart).

Plate 1 fig 1. Plate 2 figs. 1, 2. Text figs. 1A, 2A, 3.

Pleurobranchus citrina Rüppell et Leuckart, 1828, p. 20, pl. 1, fig. 1.
Pleurobranchus punctatus Quoy et Gaimard, 1832, p. 299, pl. 22, fig. 14.
Pleurobranchus granulatus Krauss, 1848, p. 61.
Pleurobranchus delicatus Pease, 1861, p. 242.
Pleurobranchus angasi Smith, 1884, p. 88, pl. 6, fig. *k*.
Berthella brocki Vaysière, 1898, p. 256, pl. 16, fig. 1-13, pl. 27, fig. 180-181.
Berthella citrina (Rüppell et Leuckart): Vaysière, 1898, p. 261, pl. 13, fig. 1, pl. 17, fig. 31-34.
Pleurobranchus punctatus Quoy et Gaimard: Vaysière, 1898, p. 339, pl. 13, fig. 10-11.
Berthella granulata Krauss: Vaysière, 1898, p. 268, pl. 16, fig. 14-16.
Pleurobranchus delicatus Pease: Vaysière, 1898, p. 341, pl. 13, fig. 12.
Pleurobranchus angasi Smith: Vaysière, 1898, p. 346, pl. 13, fig. 13.
Berthella granulata Krauss: Bergh, 1907, p. 40, pl. 4, fig. 27-28, pl. 5, fig. 1-4.
Berthella plumula O'Donoghue, 1924, p. 536, pl. 29, fig. 29-30; non Montagu, 1803, *Testacea Brit.*, 1, p. 214, pl. 15, fig. 9.
Berthella citrina (Rüppell et Leuckart): O'Donoghue, 1929, p. 788, fig. 215.
Berthella gotoi Hirase, 1933, p. 177, fig. 1-7.
Berthellina delicata (Pease): Baba, 1949, p. 37, pl. 10, fig. 33, text fig. 29-30.
Pleurobranchus punctatus Quoy et Gaimard: Allan, 1950, p. 206, pl. 28, fig. 4.
Berthellina delicata (Pease): Utinomi, 1958, p. 96, pl. 48, fig. 8.

Body elongate oval, the mantle curled tightly over towards the foot, highly convex. Dimensions up to 50 mm. in length, 25 mm. in breadth and 20 mm. in height. The foot extends well behind the posterior mantle but does not usually show laterally; without a pedal gland. The rhinophores and velum extend a little in front of the mantle margin in front, the rhinophores are stout, short, rolled in the usual way, i.e., lateral slit and they arise from a common base upon the anterior side of the head. The eyes are outside and level with the juncture of the rhinophores. The velum is broad anteriorly, the lateral edges thickened and deeply grooved. The gill extends posteriorly nearly as far as the tail of the foot, the posterior part is curled outwards from the body and shows beyond the right lateral margin of the mantle; it is attached for more than half its length to the body wall by a strong membrane at and above the posterior end of which emerges the large anus. The gill has a smooth rhachis with 16-17 pinnae arranged alternately either side. The prebranchial aperture is just in front and above the base of the gill rhachis; the nephroproct (renal pore) is well below and behind the gill rhachis base; it is very small. The genital apertures are in front of and below the prebranchial aperture.

The shell is nearly flat, small, about $\frac{1}{5}$ of the preserved body length in size, triangular in shape with the narrow base forming the outer edge. Apical whorls about $1\frac{1}{2}$ in number. Sculpture often corroded over, Hirase (1933, fig. 7) shows it to be square punctate, with which the present specimens agree.

The mandibular elements are smooth edged in the present specimens but generally there are 1-3 indistinct denticles near the apex; in shape each element is ensiform with one edge considerably worn towards the tip. Radular formula 90 x 160.0.160 which is the mean of this species. The inner teeth are small and bear 6-8 denticles; the pleurals are long and stout and bear between 12 and 18 denticles; the marginals are very long and needle-shaped with 11 to 15 very fine denticles.

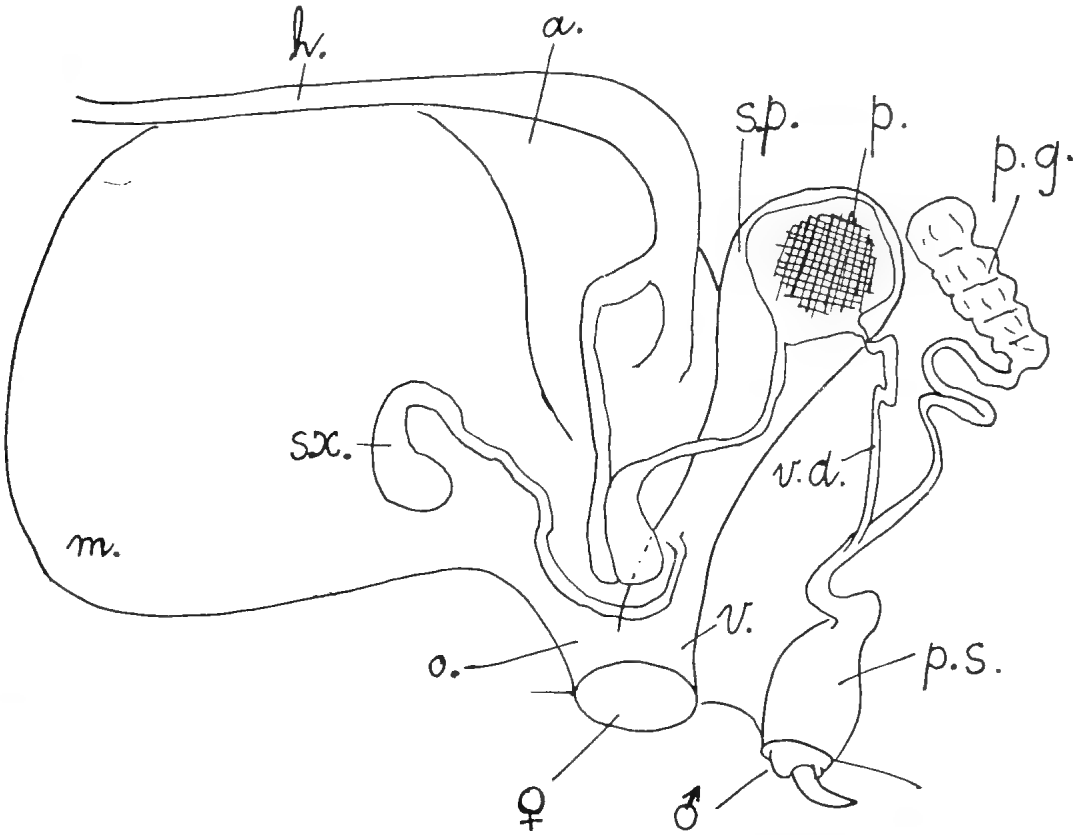


Fig. 3.—*Berthellina citrina* (Rüppell et Leuckart). Distal genital mass.

The genital organs open externally through two apertures, the rear and larger contains both the vagina and the oviduct, while the anterior presents the small penis. The male duct arises from the ampulla just before that duct enters the albumen and mucus glands. It is narrow and long until it enters a swelling with muscular walls; this probably serves as a fertilizing chamber. From this chamber the duct emerges still of the same diameter and it continues on a short way until it reaches the large black-coloured, thin-walled prostate gland. This gland is spread over the larger of the seminal vesicles which lies very close by the mucus gland. The male duct continues as the vas deferens until it is joined by the duct from the penial gland and they both enter together into the strongly muscled penial sheath. The penial gland is very long and is distally swollen with the walls of the swollen portion much indented. The penis is short, curved, transversely ridged by contracted muscles; it points forward. The female apertures, the vagina and oviduct are probably open to one another for a little way inside the main aperture, the spermatocyst enters the vagina very close to the mouth of the oviduct. The spermatheca is very large and pyriform; the spermatocyst is a small sac at the distal end of

a long, very narrow duct; the vagina is short and of considerable diameter. The hermaphrodite duct is slightly swollen into an ampulla before it enters the genital mass. The mucus gland is olive green in colour and the albumen gland orange.

The body colour is bright orange (apricot) to yellow orange, sometimes with white spots regularly or irregularly spread over the mantle. The undersides are generally yellowish.

Localities: Manly, North Harbour, Sydney Harbour, N.S.W., two specimens 15th November, 1958; Long Reef, Collaroy, N.S.W., one specimen 16th November, 1958, two specimens 29th November, 1958: registered numbers F20,141, F20,142, F20,143 respectively. Records of Victorian specimens are very few and far between, the earliest being a single specimen dredged off Rhyll, Westernport Bay, 1911. This specimen, F17,489, was presented to the National Museum of Victoria as part of the G. O. Sayce Collection. Although well preserved it has been in formalin so long that all trace of the shell has gone. Very recently, March–April, 1959, a further two specimens (F20,755) were dredged off Hastings, Westernport Bay, and were forwarded to me along with other opisthobranch material, by the collectors, Mr. and Mrs. R. Plant of Frankston, Victoria. All these specimens were dredged in depths of 5—10 fathoms. The length of each specimen is about 12 mm.

Station: Under rocks in pools at or near low tide level, usually in pairs; dredged in depths down to 10 fathoms.

Remarks: When alive this species sometimes has a caudal vent or furrow in the posterior margin of the mantle. Of the eight specimens examined here, only two showed any trace of white spots on the mantle and these were very faint. Utinomi (1958, pl. 48, fig. 8) gives an excellent coloured photograph of a living Japanese specimen, it agrees exactly with the present Sydney specimens when alive.

As yet this species has to be collected from the shore in Victoria. Conjecture on the dredged habitat mentioned above suggests that this species retreats to the shallow depths along the colder coastlines and is purely littoral in warmer seas. The northernmost dredged record of *Pleurobranchus citrina* is the type locality Jervis Bay, N.S.W., but until more localities between the extremes of coastline mentioned here are examined, it is impossible to state where the species becomes benthal.

BERTHELLA POSTREMA sp. nov.

Plate 1, fig. 2. Plate 2, figs. 3-4. Text figs. 1B, 2B, 4.

The body is elongate oval, the mantle margin overlaps the foot all around, its edges are thin, not thick as in the preceding species. The dimensions are 14 x 7 x 5 mm. in length, breadth and height respectively. The foot extends a little beyond the posterior mantle, without pedal gland. The rhinophores only protrude in front of the anterior mantle; they are long and slender, not joined medianly at their bases. The head is indistict and takes the shape of a low swelling at the body end of the velum; eyes large, on the upper side of the rhinophore base swellings but close to the body. The velum is broad anteriorly, the lateral margins thickened and grooved; the lateral thickenings are produced forward a short distance. The gill is small, attached to the body

wall for ⅔ of its length, with 14 pinnae arranged alternately either side of the smooth rhachis. The anus emerges just forward of the posterior end of the gill membrane. The prebranchial aperture is forward of and in a direct line with the gill rhachis base. The genital apertures are immediately below the prebranchial aperture. The nephroproct (renal pore) is well below and behind the genital apertures.

The shell measures 7·5 x 4·5 x 1·75 mm. Of one and ⅔ whorls, the protoconch elevated above the remainder of the shell. Colour pale fawn, protoconch white. In shape it is elongate oval, evenly rounded either end. The sculpture consists of regular incremental lines with faint raised spiral bars between; generally the sculpture is weak.

The mandibular elements are broadly ensiform, with three denticles either side of the apex. The radular formula is 58 x 40.0.40. The inner lateral is very narrow and strongly curved, the succeeding teeth have long cusps and as the outer half of the half row is reached the cusps shorten and take on a sharper curve. The marginals are very sharply angled away from the tooth base.

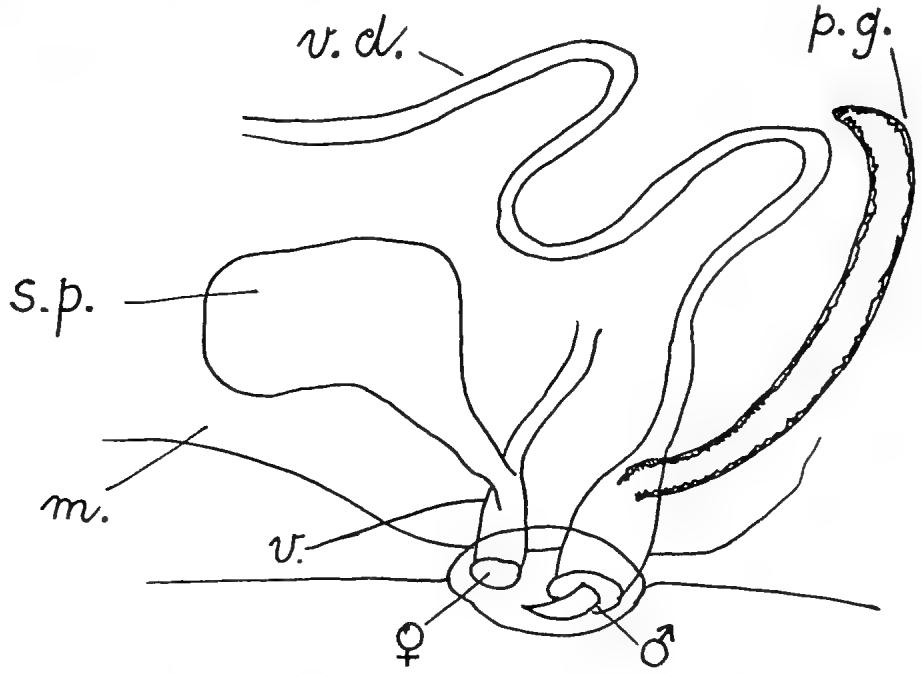


Fig. 4.—*Berthella postrema* sp. nov. Distal portion of distal genital mass.

The genital organs are without a prostate gland. The penial gland is small, short and uniform in diameter for its length. The vagina and penial sheath open into a common aperture, the small penis points rearwards. The vagina has but the one seminal vesicle, the spermatheca; its shape is pyriform with a distal twist to the rear. The vas deferens is long, narrow and intricately coiled in its path across the genital mass from the ampulla.

The body colour is pale lemon-yellow without any markings upon the mantle.

Locality: Long Reef, Collaroy, N.S.W., one specimen 16th November, 1958, F20,145. There are further specimens from northern N.S.W. localites in the Australian Museum, Sydney; these were variously labelled *Pleurobranchus punctatus* and *Pleurobranchus* sp. nov.

Station: Under a stone in a pool left at low tide.

Remarks: This is by far the most common side-gilled slug along the Victorian coastline. It can be easily distinguished from *B. postrema* by the position of the anus, the stronger sculpture of the shell, the shape of the mandibular elements, and the form of the radular teeth. The specific name is given because of the median position of the anus along the gill membrane.

BERTHELLINOPS SERENITAS sp. nov.

Plate 1, fig. 4, Plate 2, figs. 5-6. Text figs. 1D, 2D, 5.

The body is broadly oval, the mantle nearly circular, rather flat, the dimensions when alive up to 20 x 15 x 8 mm. The foot is a little longer than the posterior mantle, the rhinophores and velum extend far in front of the anterior mantle. The rhinophores are stout, very short, sharply divergent from one another, arising from a common base on the anterior side of the head. The eyes are on the side of the head just behind the anterior mantle. The velum is long, anteriorly broad and posteriorly narrow, with the convex neck and head running out from the body and on to it; anterio-lateral corners produced into long horns. The gill protrudes a little way beyond the posterior right-lateral mantle, attached for ½ to ⅓ its length by a thin transparent membrane. At the most there are 23 pinnae either side of the rhachis; there is a shallow transverse groove across the rhachis in front of each pair of pinnae; each pinnule is marginally square. The anus is at the posterior end of the gill membrane. The prebranchial aperture is minute and opens just above the gill rhachis base. The genital apertures are immediately in front of the rhachis base, the male opening is raised into a papilla with a rear-lateral slit connecting it to the female aperture. The nephroproct (renal pore) emerges far below and to the rear of the prebranchial opening.

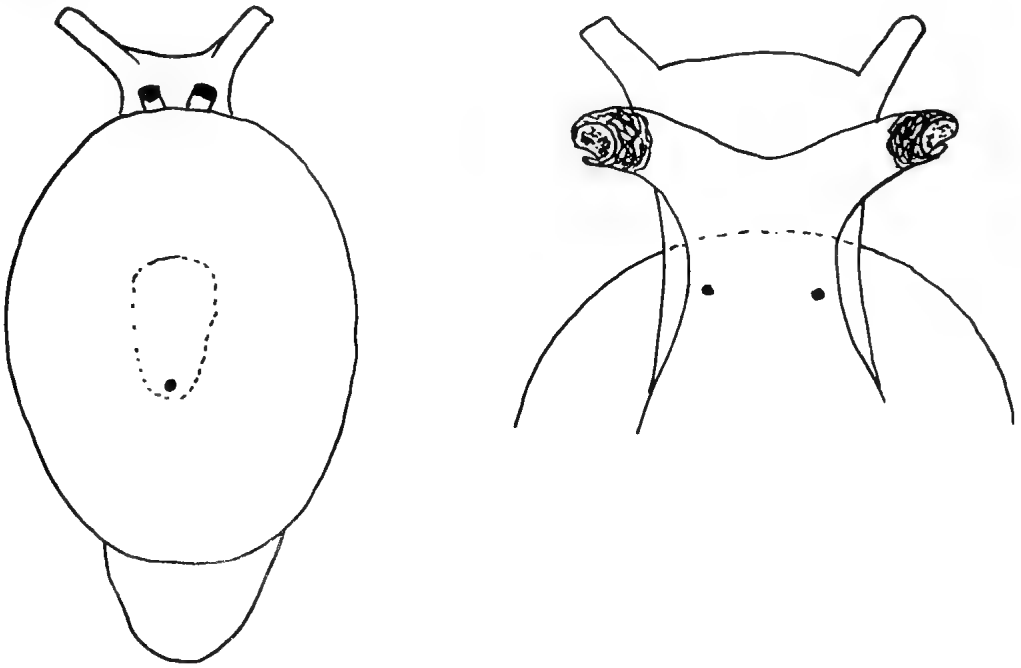


Fig. 5.—*Berthellinops serenitas* sp. nov. Dorsal view of holotype and detail of head, rhinophores and velum.

Remarks: This species can be separated from the preceding by the following characters (1) the pale lemon-yellow colour, (2) the larger shell covering most of the viscera, (3) the rhinophores arising from separate bases, and (4) the non-denticulate radular teeth. The specific name alludes to the posterior position of the anus upon the gill membrane.

BERTHELLA MEDIATAS sp. nov.

Plate 1, fig. 3; Plate 2, figs. 7-8. Text figs. 1c, 2c.

= *Pleurobranchus punctatus* Burn, 1957, p. 15; non Quoy et Gaimard 1832.

The body is broadly oval, rather flat. The dimensions in spirits may attain 30 x 20 x 10 mm. in length, breadth and height respectively. The foot does not extend rearwards beyond the posterior mantle and there is no pedal gland. The rhinophores and velum extend considerably in front of the anterior mantle; the rhinophores are very long and narrow, arising from a slightly raised head with the bases widely separated. The eyes are on the outer sides of the rhinophore bases. The velum is narrow at the body but widens considerably towards the anterior edge, laterally thickened and grooved with the thickenings produced noticeably forward. The gill is small, attached for more than half its length, with 14-16 marginally rounded pinnae arranged alternately either side of the smooth rhachis. The anus is at the mid-length of the gill membrane. The prebranchial aperture is just in front of and below the gill rhachis base. The genital apertures are below and in front of the prebranchial aperture. The nephroproct (renal pore) is close to but below and behind the prebranchial aperture.

The shell measures 11·25 x 7·5 x 1·25 mm. Of 1¼ whorls with the protoconch sunken into the shell. Colour pale fawn, protoconch pink. Shell broadly rectangular in shape, narrower towards the nucleus, the upper outer edge expanded beyond the columellar side which is usually straight in juveniles. The sculpture consists of small raised points in spiral series, broken only by the incremental lines; narrow spiral bars connect the raised points between the incremental lines.

The mandibular elements are not noticeably denticulate; instead the edges are merely coursely roughened. The radular formula is 56 x 52·0·52. The inner laterals are short and broad, the succeeding teeth are longer and shallowly curved, the marginals needle-shaped. All teeth are rather erect.

The genital organs lack a prostate gland. The penis is short, in shape curved-conical, bluntly pointed and pointing forward.

The colour varies from yellow to cream, often with white spots irregularly placed about the mantle.

Localities: Flinders, Victoria, one specimen (holotype) F20,146 and two paratypes F20,147, 2nd December, 1955; five specimens 10th March, 1958, three specimens 25th May, 1958. Breamlea, Victoria, one specimen, 14th March, 1955, one specimen 13th June, 1955. Portarlington, Port Phillip Bay, Victoria, five specimens 30th October, 1954, eight specimens 7th April, 1958. Other localities at which this species has been taken by the author are Blanket Bay, Cape Otway; Lorne; Barwon Heads; and Shoreham, Westernport Bay; all these localities are along the central Victorian coastline.

Station: Under stones below mid-tide level, generally in pairs.

The shell is nearly elongate rectangular in shape with the long sides respectively convex and concave, slightly narrower towards the protoconch. It measures 6·5 x 3·5 x 0·8 mm., and is of 1½ whorls with the protoconch elevated. The colour is white, the nucleus pinkish-brown. The sculpture consists of elongate raised bars in spiral series broken by fine incremental lines; towards the margin of the shell the sculpture is fainter. The long axis of the shell is concave whereas transversely it is convex.

The mandibular elements have two slightly concave sides coming together apically to form a sharp point, each side with 3 or 4 denticles. The radular formula is 88 x 65·0·65. The inner laterals are small and strongly curved, the succeeding laterals are larger and not so strongly curved; the outer nine teeth become progressively smaller and the marginal tooth is minute, broad and very strongly curved.

The genital organs lack a prostate gland.

The holotype specimen was pure white in colour with a single purple spot over the protoconch of the shell, the rhinophores were distally tipped with purple. The paratypes were also pure white, somewhat translucent, with minute cream reticulations on the mantle, and a few scattered dull-white spots. The eyes were black and the viscera brown.

Localities: Flinders, Victoria, one specimen (holotype) 10th March, 1958, F20,144. The Breakwater, Warrnambool, Victoria, three specimens 14th March, 1960, in the author's collection.

Station: Under stones in muddy or sandy positions, low tide level.

Remarks: The absence of a pedal gland conclusively places this species as a member of the Berthellinae. When alive all the above specimens exhibited the habit of moving with the mantle upturned all round, in fact they resembled an inverted umbrella in shape.

List of Abbreviations Used in Text Figures.

a.—anus.
e.—albumen gland.
h.—hermaphrodite duct.
m.—mucus gland.
n.—nephroproct (renal pore).
o.—oviduct.
p.—prostate gland.
p.b.—prebranchial aperture.
p.g.—penial gland.
s.—penial sheath.
sp.—spermatheca.
sx.—spermatocyst.
v.—vagina.
v.d.—vas deferens.
♂—male aperture or penis.
♀—female aperture.

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EXPLANATION OF PLATES.

Plate 1.

1. *Berthellina citrina* (Rüppell et Leuckart)—specimen from Long Reef, N.S.W., 29th November, 1958; Reg. No. F20, 142. x 3.
2. *Berthella postrema* sp. nov.—type specimen, Long Reef, N.S.W., 16th November, 1958; Reg. No. F20, 145. x 5.
3. *Berthella medietas* sp. nov.—type specimen, Flinders, Vict., 2nd December, 1955; Reg. No. F20, 146. x 5.
4. *Bethellinops serenitas* sp. nov.—type specimen, Flinders, Vict., 10th March, 1958; Reg. No. F20, 144. x 3·5.

Plate 2.

1. *Bethellina citrina* (Rüppell et Leuckart) shells of two specimens, the larger from Manly Baths, N.S.W., 15th November, 1958; Reg. No. F20, 143; the smaller from Long Reef, N.S.W., 16th November, 1958; Reg. No. F20, 141. x 5, dorsal view.
2. *Ibid.* Ventral view.
3. *Berthella postrema* sp. nov., shell of type specimen. x 5·6, dorsal view.
4. *Ibid.* Ventral view.
5. *Berthellionops serenitas* sp. nov., shell of type specimen. x 6, dorsal view.
6. *Ibid.* Ventral view.
7. *Berthella medietas* sp. nov., shell of largest known specimen, Portarlington, Vict., 30th October, 1954; Reg. No. F20, 148. x 6, dorsal view.
8. *Ibid.* Ventral view.

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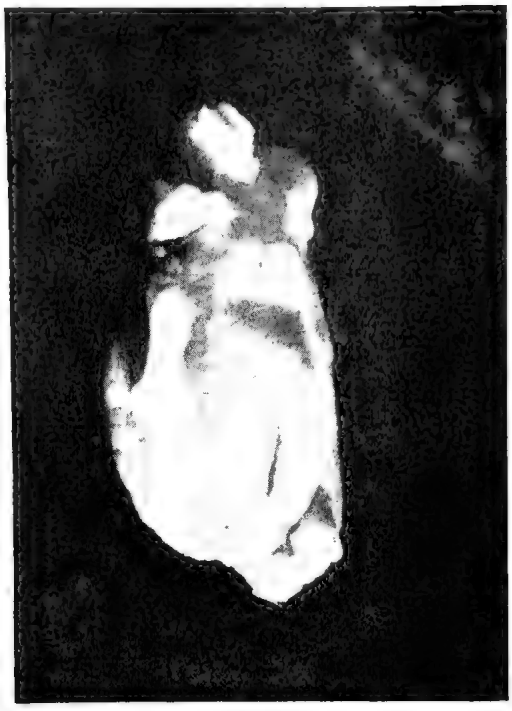

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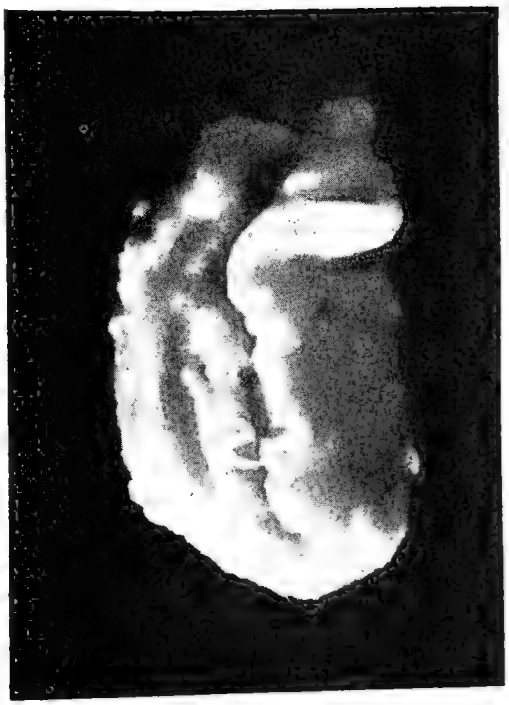

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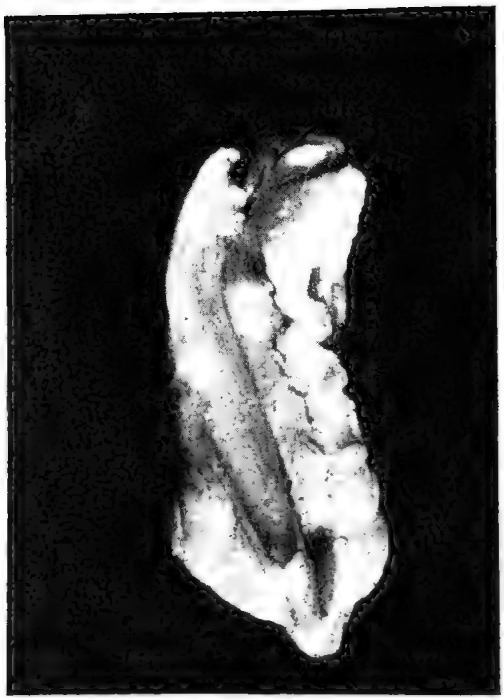

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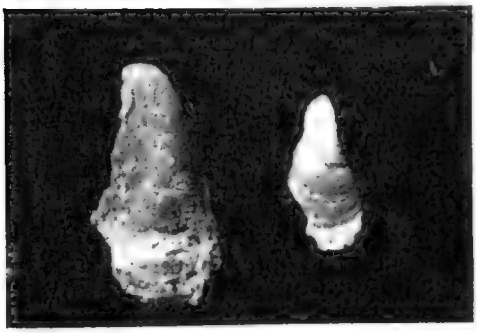

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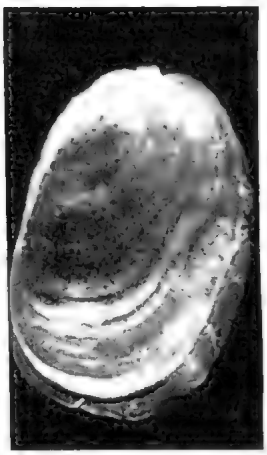

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NOTES ON A COLLECTION OF NUDIBRANCHIA (GASTROPODA: DORIDIDAE AND DENDRODORIDIDAE) FROM SOUTH AUSTRALIA WITH REMARKS ON THE SPECIES OF BASEDOW AND HEDLEY, 1905.

By Robert Burn.

Plate 1, Text figures 1-16.

Introduction.

Although only eleven species are represented in the present collection, three appear to be new to science and two are new records for South Australia. Coupled with the species of Basedow and Hedley's paper of 1905, the families Doridiidae and Dendrodoridiidae are known by fifteen species, all from the general area of the Gulfs of that State. Only three other nudibranch species are recorded from the area, respectively representing the families Polyceridae, Arminidae and Scyllaeidae.

For this collection, the author wishes to thank the following persons. Mr. and Mrs. D. I. Hartley, Malvern, Victoria and Mr. and Mrs. R. Hall, Prospect, South Australia, for a parcel of specimens collected jointly at Coobowie, South Australia. Mr. D. Howlett of Ceduna forwarded several specimens collected at Ceduna Bay, and Mr. P. Trenberth of Tumby Bay forwarded specimens collected at Fiddlers Bay, Spencer Gulf. Miss J. H. Macpherson, National Museum of Victoria, Melbourne made available a single specimen of a remarkable species from Peak Bay, Spencer Gulf.

All the material examined and described here has been presented to the National Museum of Victoria, Melbourne, Victoria. Registered numbers for this material have been included here after the locality, date and collector.

Remarks on the Species of Basedow and Hedley.

In 1905, Basedow and Hedley presented the first and until now the only original paper on the members of this group from South Australia. Fortunately the figures and descriptions are very good and clear, for the specimens upon which they are based are either lost, destroyed, or in an unknown repository. Basedow, in 1904, presented several species to the Australian Museum, Sydney, among which is one labelled *Halgerda graphica* that must be regarded as a paratype of this species. The other species presented at the same time are at the moment incorrectly named and need careful examination before their specific identities are certain.

A summary of Basedow and Hedley's species is given here to show any necessary nomenclatural changes, and to clear up certain facts about them:—

Archidoris varia (Abraham). This widely distributed southern Australian species is actually an *Aphelodoris* Bergh, 1879, and should now be known as *Aphelodoris varia* (Abraham). The genital organs of the species at once separate the species from Basedow and Hedley's generic placement.

Archidoris staminea sp. nov. O'Donoghue (*Trans. Zool. Soc. Lond.*, 22 (6), 1929, p. 813) was the first to doubt that this species was really an *Archidoris* but did not advance any suggestions for its correct genus. The author (1957, p. 22) transferred the species to *Dendrodoris* and here further removes it to *Doriopsilla*.

Staurodoris pustulata (Abraham). This species proves to be another of Abraham's species, which from the examination of the type in the British Museum, Odhner considered it to be an *Austrodoris*. The species is represented in the present collection and the name for it is *A. peculiaris* (Abraham).

Alloiodoris marmorata Bergh is here transferred to the recently described species *A. nivosus* Burn 1958, and is shown to belong to a different section of the genus to the true *A. marmorata*.

Halgerda graphica sp. nov. Not represented in the present collection but recently recorded from Victoria by the author. The previously mentioned specimen in the Australian Museum, Sydney, is here designated as a paratype, its registered number is C. 1816.

Hypselodoris epicuria sp. nov. From the brief description of the radular teeth, this species should, in accord with Odhner's interpretation of the problem, be transferred to *Chromodoris* Alder et Hancock 1864. Apparently very rare as it has been collected only once.

Albania ? verconis sp. nov. Probably belongs to the "*Glossodoris*" group of genera and until it is again collected it must remain as an unknown quantity.

Ceratosoma brevicaudatum (Abraham). A very common species well represented in the present collection.

Ceratosoma adelaidae sp. nov. The juvenile form of the above species and as such it must be reduced to a synonym.

Doriopsis aurea (Quoy et Gaimard). Here shown to be a *Doriopsilla*.

Doriopsis carneola (Angas). Another *Doriopsilla*.

The three other species tabled by the two authors are *Scyllaea pelagica* Linne of cosmopolitan distribution, *Armina cygnea* (Bergh) formerly *Pleurophyllidia*, with a wide range across southern Australia, and *Tambja verconis* (Basedow et Hedley) formerly *Nembrotha ?* which has recently been made the type species of the Polycerid genus *Tambja* Burn (*Mem. nat. Mus. Vic.*, ante p. 98).

The remainder of this paper deals with the eleven species of the present collection of South Australian Nudibranchia. These species are systematically listed as follows:—

Family DORIDIDAE.

Subfamily CHROMODORIDINAE.

Hypselodoris saintvincentius sp. nov.

Subfamily MIAMIRINAE.

Ceratosoma brevicaudatum Abraham.

Subfamily DORIDINAE.

Alloiodoris nivosus Burn.
Austrodoris peculiaris (Abraham).

Subfamily DISCODORIDINAE.

Anisodoris flindersi sp. nov.

Subfamily ASTERONOTINAE.

Asteronotus (Tumbia) trenberthi subgen. et sp. nov.

Subfamily KENTRODORIDINAE.

Jorunna hartleyi (Burn).

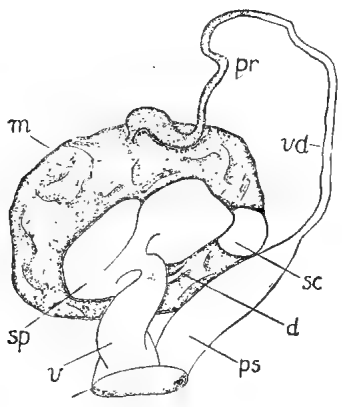
Family DENDRODORIDIDAE.

Dendrodoris nigra (Stimpson).
Doriopsilla staminea (Basedow et Hedley).
Doriopsilla aurea (Quoy et Gaimard).
Doriopsilla carneola (Angas).

HYPSELODORIS SAINTVINCENTIUS sp. nov.

Plate 1, figs. 1-2. Text figs. 1-2.

Diagnosis: Body broadly elongate ovate, mantle-brim wide, overlapping the head and foot except at the posterior end. Dorsal surface smooth, as preserved slightly wrinkled. Rhinophoral and branchial cavities with low smooth-rimmed sheaths. Rhinophores perfoliate. Branchiae twelve in number, simply pinnate, in a circle about the anal papillae. Oral tentacles represented by broadly triangular lobes either side of the mouth, each lobe with a low ridge on the ventral side and immediately away from this there is a deep pit angled towards the outer edges of the foot. Foot transversed anteriorly by a deep furrow, both lips notches medianly. The dimensions of the preserved type specimen are 14 x 8·5 x 7 mm. in length, breadth and height respectively, the larger paratype measures 18 x 10 x 7·5 mm. In life the specimens are about twice as long as the preserved length.



Text fig. 1.—*Hypselodoris saintvincentius* sp. nov. Distal genital organs.

The genital organs are quite typical of the Chromodoridinae. The penis is unarmed, the penial sheath strong and elongate. The prostate gland is a thickened portion of the proximal vas deferens, brown in colour; the remainder of the vas is narrow and short. The vagina is stout, short and yellowish in colour, the spermatheca is large and rounded, the spermatocyst elongate pyriform and twisted back upon itself. The uterine duct is short and narrow.

Text fig. 2.—*Hypselodoris saintvincentius* sp. nov. Various radula teeth.

The radular formula is 70 x 65.0.65, all teeth simply bifid at the tips. The extreme marginal tooth in each half row is simply hamate. Unfortunately the labial cuticle was lost before it could be examined.

The body colour in living specimens is reported to be spectacular, as preserved it has faded greatly. The body is bluish-grey, dark towards the margins and lighter medianly, everywhere marked with small yellow patches and dark blue or black dots. Underside of mantle and sides of foot similar to but lighter than dorsum; ridges on oral tentacles white; sole of foot bluish. Distal parts of rhinophores and branchiae pale pink. The living specimens are reported to have large patches of yellow along the margins and median part of the mantle; the rhinophores and branchiae have bright red or scarlet tips, and the oral tentacles are elongate digitiform.

Locality: Coobowie, west coast of Gulf St. Vincent, (three specimens, Dec. 1957, collected Hartley–Hall, type F20,757, paratypes F20,758).

Station: Under stones at low tide level.

Remarks: This species is undoubtedly the Flindersian Region representative of the Peronian species, *H. obscura* Stimpson 1855, which is also the type of the genus *Hypselodoris* Stimpson. The colouring of the two species is somewhat similar and the radular formula and shape of the teeth are very close. *H. saintvincentius* has probably developed independently through localization in the relatively warm waters of the Gulfs of South Australia.

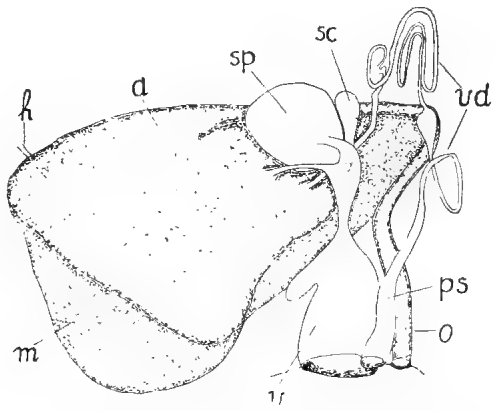
The use of the genus *Hypselodoris* is based upon the observations of Odhner (1957, p. 250-253), although when the full results of examination of the type of the genus *Glossodoris* Ehrenberg 1831 are known, a reconsideration of genera may be necessary. It would indeed be interesting to refind *H. epicuria* Basedow et Hedley 1905 from South Australia, to see if their generic placement is correct. This is doubtful as their brief remarks about the radula indicate the shape of the teeth is wrong for the present genus.

CERATOSOMA BREVICAUDATUM Abraham.

Text fig. 3.

Ceratosoma brevicaudatum Abraham, 1876, *Ann. Mag. Nat. Hist.*, (4), 18, p. 142, pl. 8, fig. 6.

This very common species is represented in the present collection by seven specimens from two localities. Basedow and Hedley have excellently described and figured the living animal from South Australia. O'Donoghue 1924 described and pictured the species from the Abrolhos Islands, Western Australia. In neither instance were the genital organs described or figured. This discrepancy is here rectified from an examination of the present material.



Text fig. 3.—*Ceratosoma brevicaudatum* Abraham. Distal genital organs.

The genital complex occupies most of the anterior of the body cavity and passes under the œsophagus to the left side. The mucus and albumen glands are large and elongate pyramidiform; the former gland is yellowish and the latter pink. The spermatheca is large and rounded, the spermatocyst much smaller and elongate pyriform; their position is vaginal (i.e. both vesiculæ debouch together into the top or upper portion of the vagina). The uterine duct is short and narrow; the vagina is very broad near its aperture and soon narrows to a brief constriction before again enlarging, but not to its apertural size, just below the vesiculae seminales. Below the constiction in the vagina there opens on the posterior side a short sac-like pouch, somewhat reminiscent of the reduced bursa copulatrix in certain of the DENDRONOTACEA. The oviduct is long, stout, and red in colour. There is no glans penis, the male aperture being merely a brief thickening of the distal vas deferens. Above this thickening the vas is muscular for quite some way and passes into a bulbous swelling and the intricately coiled and narrow prostatic portion.

The species in Victoria attains lengths of well over six inches (150 mm.), thus surpassing the dimensions given by Basedow and Hedley for their dredged material.

Localities: Coobowie, Gulf St. Vincent, (six specimens, Dec. 1957, collected Hartley–Hall, F20,759); Fiddlers Bay, Spencer Gulf, (one specimen, Dec. 1958, collected P. Trenberth, F20,760).

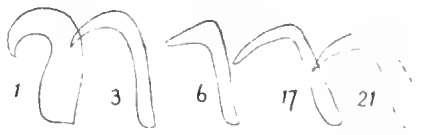
Remarks: This is a dominant species of the littoral marine fauna of the whole of southern Australia, from Sydney Harbour in the east to the Abrolhos Islands in the west. It is only rarely that minute and juvenile specimens are found and these do not truely resemble the adult species. Such was the case when Basedow and Hedley described *C. adelaidae,* a small species 8 mm. in length. A very large series at once establishes this to be the juvenile of *C. brevicaudatum* without the development of the colourful "brevicaudatum" or short tail of the mantle. Burn (1957, p. 18) has already placed *C. adelaidae* in the synonymy of the present species.

ALLOIODORIS NIVOSUS Burn.

Text figs. 4-6.

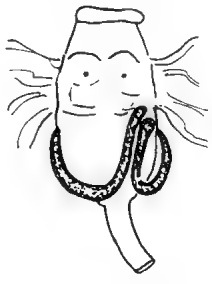
A. nivosus Burn, 1958 *J. Malac. Soc. Aust.*, 2, p. 29, pl. 2, fig. 14, text figure 6.
=*A. marmorata* Basedow et Hedley, 1905, *Trans. Roy. Soc. S. A.*, 29, p. 152, pl. 8, figs. 1-2, (non Bergh 1904).
=*A. marmorata* Burn, 1957, *J. Malac. Soc. Aust.*, 1, p. 19, (non Bergh 1904).

Although well described externally, this species has, particularly in South Australia, been known under several names including *A. hedleyi* O'Donoghue 1924, (from the Abrolhos Islands, Western Australia). Burn (1958, p. 29) discussed the problems of nomenclature surrounding this South Australian species, but as at the time there were no specimens available for examination he could not supply the answer to the problem. From the two specimens in the present collection, it can be safely stated that they are the same as the Victorian species, *A. nivosus* Burn, 1958. Details of the internal anatomy are given here.



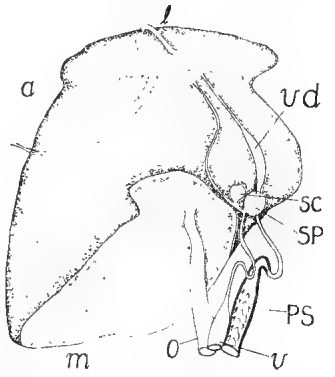
Text fig. 4.—*Alloiodoris nivosus* Burn. Various radular teeth.

The radular formula varies from 33 to 44 rows of teeth by 19-21.0.19-21. All teeth are simply hamate, the inner laterals have very short cusps as also have the marginals, the median laterals are large and stout. The labial cuticle is smooth and varies from very thin to quite strong, no armature is present.



Text fig. 5.—*Alloiodoris nivosus* Burn. Salivery glands, relationship to buccal mass, &c.

The salivary glands (text fig. 5) present a specific characteristic in their peculiar shape and position. They are long and slender, the left gland being always a little longer than the right one. From their points of origin on the buccal mass below the cerebral ganglia they pass backwards until level with the point of emergence of the œsaphagus from the buccal mass where both glands turn in towards each other, thus forming a complete U-turn. The left U-turn is broader than the right and so the distal portion of each gland is well to the right of the median line and lie parallel and very close together. In four specimens examined (two from Victorian localities) this position of the salivary glands upon the buccal mass was observed.



Text fig. 6.—*Alloiodoris nivosus* Burn. Distal genital organs.

The genital organs are simple in form. The vas deferens arises high up upon the genital mass and does not have a prostate gland. The penial sheath is strong, internally with about four vertical rows of 4-6 minute and simple hooks. The vagina is long and narrow with the spermatheca placed right at the top; the spermatocyst is very close by but not quite vaginal in position. The oviduct is long and rather slender. The spermatheca is, in relation to the size of the genital mass, very small, it is rounded in shape; the spermatocyst is pyriform and about half the size of the spermatheca. The hermaphrodite gland is a discrete mass and not spread over the liver.

Locality: Ceduna, Great Australian Bight, (two specimens, larger measuring 22·5 x 11 x 5 mm., 1958, collected D. Howlett, F20,761).

Station: Under stones at low tide, often in more sheltered positions.

Remarks: This species is closely related to *A. hedleyi* O'Donoghue, 1924 from the Abrolhos Islands, Western Australia and *A. inhacae* O'Donoghue, 1929 from Inhaca Island, South Africa. These three species when grouped together form a separate section of the genus, differing from the type in that they each lack denticulate radular teeth. The type, *A. marmorata* Bergh, 1904 from Ulverstone, Tasmania, has a very closely allied congener in *A. lanuginata* (Abraham, 1877) from New Zealand but they are sufficiently distinct so as to retain the two specific names.

After careful examination of a topotype specimen of *A. marmorata* Bergh at the Australian Museum, N.S.W., the author is convinced that O'Donoghue (1924, p. 249) is incorrect when he says that the outer two marginals on each side of the radula are denticulate, for here they were observed to be simple and the inner laterals denticulate. Whereas Bergh, 1904 did not observe a labial armature in his specimens of *A. marmorata*, the present writer noted the presence of a vestigial lining similar to that of *A. lanuginata* (Abraham).

A key to the five species of *Alloiodoris* can thus be tabulated:

A. Inner lateral radular teeth denticulate. Labial armature present but often vestigial.

(i) Colour grey with a number of brown spots. Dimensions 45 x 25 x 13 mm. Radular formula 35 x 40—42.0.40—42.

A. MARMORATA Bergh, 1904.

(ii) Colour reddish grey with numerous brown spots. Dimensions 50 x 33 x 16 mm. Radular formula 26 x 40—45.0.40—45.

A. LANUGINATA (Abraham, 1877).

B. All radular teeth strongly hamate. Labial armature generally absent.

(i) Colour dark muddy-fawn with numerous roughly circular ringshaped brown markings on the dorsum. Dimensions 52 x 34 x 23·5 mm. Radular formula 33—35 x 55—57.0.55—57.

A. HEDLEYI O'Donoghue, 1924.

(ii) Colour dirty yellowish-grey, dorsally with numerous irregular indefinite brown-black blotches and lines, mostly about the margin of the body. Dimensions 47 x 31 x 12 mm. Radular formula 67 x 67.0.67, (a row of rhachidial plates may be present). A very narrow labial armature is reported to be present.

A. INHACAE O'Donoghue, 1929.

(iii) Colour white or pale grey, when pale grey usually with a few large brown circular ring-like patches, each with a white centre. Dimensions 22·5 x 11 x 5 mm., (specimens up to 30 mm. in length have been collected but not examined). Radular formula 44 x 21.0.21.

A. NIVOSUS Burn, 1958.

The genus *Alloiodoris* is apparently an austral one limited to the temperate and cool-temperate seas of South Africa and Australasia. The internal anatomy of each of the five species known is remarkable in that the hermaphrodite gland is formed into a compact mass and not spread over the liver as in all other Doridiidae.

AUSTRODORIS PECULIARIS (Abraham).

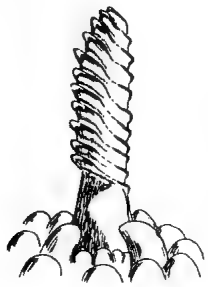
Text figs. 7-9.

Doris peculiaris Abraham, 1877, *Proc. Zool. Soc.*, p. 211, pl. 29, figs. 15-17.

= *Staurodoris pustulata* Basedow et Hedley, 1905, *Trans. Roy. Soc. S. A.*, 29, p. 151, pl. 9, fig. 3, (non *Doris pustulata* Abraham, 1877).

= *Archidoris varia* Burn, 1957, *J. Malac. Soc. Aust.*, 1, p. 20, (non *Doris varia* Abraham, 1877).

Basedow and Hedley came very close to the correct genus when they placed their species, *Staurodoris pustulata,* in that genus but their specific designation is unmistakably incorrect. Similarly Burn, 1957, finding the same species, was misled by Basedow and Hedley's reference to the genus *Archidoris* Bergh, 1878, and, in turn, used a specific name which is now known to refer to a species of *Aphelodoris* Bergh, 1879. By careful examination of both external and internal anatomy, the species proves to be one described by Abraham, 1877 from Port Lincoln, South Australia.



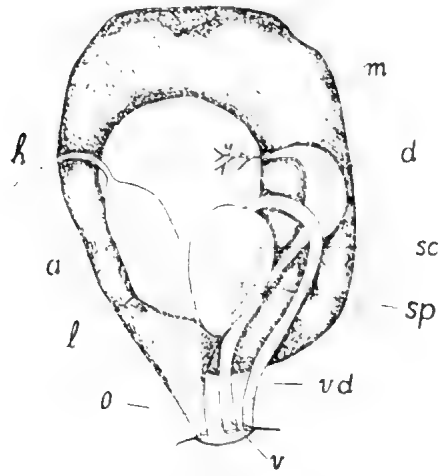
Text fig. 7.—*Austrodoris peculiaris* (Abraham). Lateral detail of the left rhinophore and sheath showing the large rear lateral pustule and its median partner.

Examination revealed the following points of interest about the species.

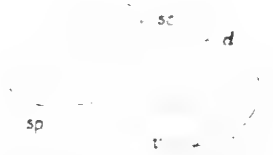
The pustules of the mantle are largest preanally and all have darkened centres. The rhinophores (text fig. 7) are each surrounded by a circlet of pustules, the largest rear-lateral and the second largest rear-median. The branchial sheath is finely pustulated along its margin, a row of eight varying sized pustules form a semicircle around the anterior edge of the sheath. Branchiae five in number and well separated, anus protrudes between rear two plumes; the branchial cavity is very close to the posterior end of the body. The tail extends beyond thte mantle, persisting even in preserved material. The oral tentacles are very tumid and indistinct.

As a specific characteristic of spirit specimens, one might add that in most of the material examined there is present an underlying purple patch just in front of the branchial cavity; this is the blood gland. It is only rarely that this patch is not present.

The radular formula is 25—37 x 65—68.0.65—68. All teeth are simply hamate, increasing gradually in size from the rhachis outwards, outermost few diminishing a little. Without a labial armature.



Text fig. 8.—*Austrodoris peculiaris* (Abraham). Genital organs viewed dorsally *in situ*.



Text fig. 9. *Austrodoris peculiaris* (Abraham). Detail of the position of the vesiculae seminales in relation to the vagina and uterine duct.

The genital organs are as usual in *Austrodoris*. The vagina is short and stout with the vesiculae seminales vaginal in position. The lower vas deferens is strongly cross ridged by muscles while the remainder is slender and without sign of any prostatic swelling. The ampulla is broad and flat. The spermatheca is large and round, the spermatocyst much smaller and pyriform.

One specimen of this species is among the present material, the dimensions are 19 x 8 x 5 mm. in length, breadth and height respectively.

Locality: Ceduna, Great Australian Bight, (one specimen, 1958, collected D. Howlett, F20,762).

Station: Similar to that of *Alloiodoris nivosus* Burn, on the reef at Ceduna Bay.

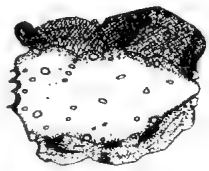
Remarks: Abraham's figures of this species agree very closely with the present specimen although here the pustules of the mantle are a little coarser. Odhner 1934 mentions that he had examined the type specimen of *Doris peculiaris* Abraham and was inclined to class it as an *Austrodoris*. Pruvot-Fol. (1951, p. 41 and footnote p. 40) claims that this species is a *Dendrodoris* and of Mediterranean origin, and that perhaps it is a *Doriopsilla* closely related to an insufficiently described species from Portugal. But as Abraham gave the type locality, Port Lincoln, in his description, there can be no doubts that the present specimen is in fact his species. Odhner's brief remarks substantiate the use of the genus *Austrodoris*.

Each of the references cited in the synonymy give good descriptions of the external characters of this species.

ANISODORIS FLINDERSI sp. nov.

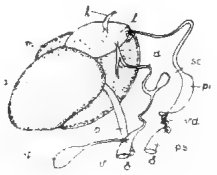
Plate 1; figs. 6-7; Text figs. 10-12.

Diagnosis: Body broadly oval, rather flat, as preserved the specimen is strongly curled but when flattened the dimensions are length 40 mm., breadth 15 mm. and height 8 mm. The mantle margin is undulating in outline; beyond the body the mantle is thick and muscular, above the body it is thinner and not so tough; everywhere covered by low soft pustules, small and close together near the margins, somewhat larger and sparser over the body. Dorsally along either side of the body there is a row of five large elevated pustules, spaced well apart, commencing in front of the rhinophores and ceasing in a pair behind the branchial cavity. A short distance in front of the branchial cavity is a secondary pair of large pustules placed nearly evenly between the two lateral rows of pustules. The rhinophores are well forward and close together, perfoliate with at least seven fine lamellae; sheaths elevated, much more so than the pustules of the two lateral rows, each sheath is composed of four or five distinct pustules. Branchial cavity is large and elliptic; margin thin, irregularly crenulate and lowly elevated; the branchial plumes number six and each is tripinnate. The postbranchial measurement is 8 mm. The foot is narrow, contracted and curled in towards the centre, at present it is about one-third the width of the mantle; the edges are thickened, the sole is faintly grooved; the tail is quite long but does not extend beyond the posterior mantle, anteriorly the foot is bilabiate and medianly indented (not notched). The underside of the mantle and the sides of the foot show very fine white muscular fibrillae, similar to that of *Doriopsilla* spp. The oral tentacles are short, digitiform, as preserved they are severely contracted.



Text fig. 10.—*Anisodoris flindersi* sp. nov. Dorsal view of preserved type specimen, ends strongly curled under.

Internally the salivary glands (text fig. 12A) are long, narrow and band-like, the distal ends are slightly swollen and curved in towards each other until they nearly touch.



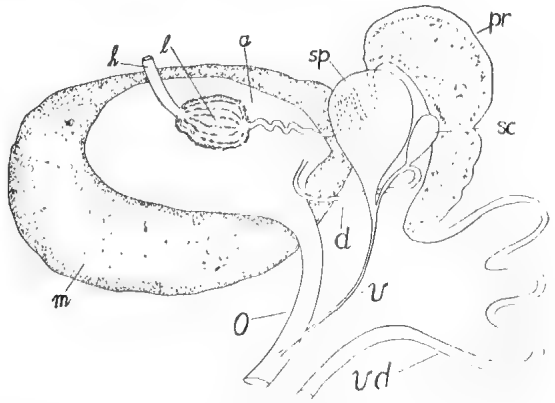
Text fig. 11.—*Anisodoris flindersi* sp. nov. Distal genital organs.

The genital organs (text-figure 11) show a very remarkable departure from that which is typical of the genus, particularly in respect to the female ducts and seminal vesicles and the ampulla of the hermaphrodite duct. The ampulla is very large, flat and somewhat cushion-shaped, not thick and twisted as in other species (vide Odhner 1926, fig. 70; Marcus 1959, fig. 97, 103, 107). The hermaphrodite duct enters the ampulla at the top centre, the male and female ducts debouch peripherally on the right side. The female duct bifurcates shortly away from the ampulla, one branch, short in extension, connecting to the mucus gland, the other forming the uterine duct. The male duct is long

ASTERONOTUS (TUMBIA) TRENBERTHI subgen. et sp. nov.

Plate 1, figs. 3-5. Text figs. 13-14.

Diagnosis: Body broadly elliptic, flattened, dimensions 33 x 17 x 8 mm. The mantle edges are very thin and grossly undulate, unevenly indented and folded over all round. The median part of the mantle over the body is ornamented by one strong mid-dorsal crest and two weaker indistinct lateral crests. The main crest commences in front of and between the rhinophores and terminates a little in front of the branchial cavity; it consists of a row of irregularly sized and spaced low hard pustules surmounting a low ridge. The lateral crests are much shorter than the median one and are lower and far more irregular in size and spacing. Between the crests the skin is wrinkled into a reticulate or stellate pattern, the low pustules of each crest forming the centres for the stellate patterning, a few simple elevated pustules are present between the three crests and these form the centres for secondary stellate reticulations. Beyond the body proper, the mantle is everywhere covered by small elevated pustules which are larger towards the body where a few intermix with the reticulations of the body surface. All the pustules of the mantle contain a circlet of short spicules which in places briefly protrude. The rhinophore sheaths are slightly elevated, the margin is composed of a circlet of low dentations or teeth. Rhinophores perfoliate. The branchial cavity is large and somewhat transversely elliptic, the margin is slightly raised; the branchiae number two, one on either side of the anal papilla, bipinnate; the rhachis of each plume is strong and broad, the minute pinnae of the edges few and small. Ventrally the foot is narrow, about one-third the width of the mantle (6 mm. broad in the type specimen) and very nearly as long as the overall length of the mantle. The foot edges are thin and very much undulated, the sole is shallowly grooved. Anteriorly it is bilabiate, the upper lamina being broadly and deeply cleft. The oral tentacles are cylindro-conical or digitiform and are rather linear. The underside of the mantle particularly near the edges is minutely granular. The genital orifice is large, high up under the mantle, and just behind the line of the rhinophores.

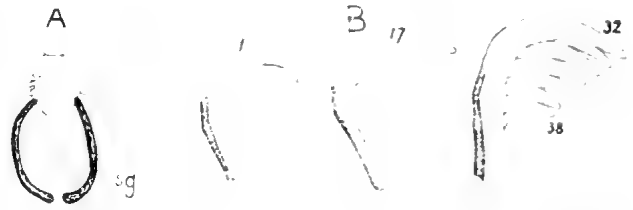


Text fig. 13.—*Asteronotus (Tumbia) trenberthi* subgen. et sp. nov. Distal genital organs.

The genital complex is large and occupies most of the anterior of the body cavity, in fact the buccal mass is pushed far to the left against the left wall of the cavity. The mucus and albumen glands are very large, the former

and narrow and swells to form an elongate prostate gland, beyond which, as usual, the vas deferens is very narrow, short and inticately twisted before it enters the shallowly curved, swollen, unarmed penial sheath. The female duct has the spermatocyst of the usual pyriform shape with its entry into the uterine duct through a constricted portion. The spermatheca enters the female duct at the part regarded by the author as the vagina, it is a pyriform pouch at the end of a long narrow tube the base of which is minutely swollen upon the vagina.

If one did not interpret correctly the positions of the seminal vesicles, the spermatheca at the end of its long duct might appear to be a dart sac or penial gland as in the Kentrodoridinae (vide *Jorunna hartleyi*, text fig. 16, *pg*). The peculiar ampulla and its connection to the mucus gland through the upper uterine duct may be merely an abnormality in the single specimen available for study. Further material will either confirm or deny the present position.



Text fig. 12. *Aniodoris flindersi* sp. nov. A. Salivery glands in relation to buccal mass, sg—salivery glands. B. Various teeth from a half row of the radula.

The radular formula is 25 x 38.0.38, all teeth hamate, the innermost more strongly curved than the medians and marginals. The innermost teeth are the smallest and then gradually ascend in size until the sixth or seventh from the margin, after which they decrease slightly. The labial cuticle is smooth and lacks all armature.

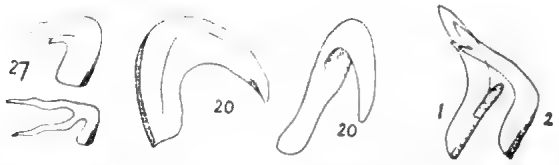
The body-colour is dark greyish brown; laterally the mantle is yellow and fawn in alternating patches; the large pustules of the dorsum are yellow. The branchiae are dark grey-brown, the rhinophores fawn. Ventrally the body is pale yellow with the whitish muscular fibrillae everywhere. The sole of the foot is yellow and the margins orange. As no colour notes are available, the living animal may be quite different to that as preserved, although it is now in a solution of formalin.

Locality: Peak Bay, Spencer Gulf, (one specimen, 16th February, 1956, collected J. H. Macpherson, F17,482).

Station: In the littoral zone.

Remarks: This species represents a new genus in Australian seas, the presence of a prostate gland distinguishing it from externally similar genera of the Doridinae (i.e. *Archidoris* and *Austrodoris*). The very narrow foot, two rows of well spaced large pustules, and colour scheme separate *A. flindersi* from any other Australian Doridiidae described to date. It is possible that *A. flindersi* is of fortuitous occurrence in South Australia and that its true locale is further westward in the much warmer waters of Western Australia.

surrounding the latter for the most part. The oviduct is long and broad, the vagina enters the oviduct close to its aperture. The spermatheca is small, rounded or subpyriform, red in colour; the spermatocyst is even smaller than the spermatheca, elongate pyriform and yellow-cream in colour; it is connected to the short and narrow uterine duct by an extremely narrow tube. The vas deferens is simple, briefly undulated and without a penial swelling or armature; it emerges from the large partially divided black prostate gland which is spread thinly over the right dorso-lateral side of the buccal mass just behind the cerebral ganglia. The upper part of the prostate is the larger and is separated from the lower portion by a yellowish transverse band inside the gland. Between the prostate and the ampulla the male duct is stout and convoluted. The ampulla is irregular in shape and composed of a sponge-like glandular mass; it is cream in colour.



Text fig. 14.—*Asteronotus* (*Tumbia*) *trenberthi* subgen. et sp. nov. Various teeth from the radula.

The radular formula is 19 x 27.0.27. All teeth are hamate, the median laterals strongly so, the largest tooth is the seventh or eighth from the margin. The two inner laterals either side of the rhachis are bifid at or very near the tip. Similarly bifid is the marginal tooth of each row. In the two partially formed rows of the radular strip the inner and outer six or so teeth are bifid with extremely long and curiously undulatory cusps; in the third row the lower cusp has degenerated into a small denticle on the lower side of the tooth and the upper cusp has thickened and lost its undulations. Most of the outer and inner median laterals exhibit a shallow groove just behind the tip of the cusp, apparently a carry-over from the junior rows with their long cusps. The inner lateral has one other characteristic which is very apparent in lateral view; this is the strong diverging shoulder of the basal portion of the tooth. The labial cuticle is smooth and thickened on the walls of the anterior opening. The oral tube from the mouth aperture to the radular or buccal mass is long and strongly muscled, narrow at the mouth, and greatly constricted by a muscular ring immediately in front of the radula. The inner wall of the oral tube is provided with six or eight tough longitudinal flesh ridges, each ridge armed with a number of large, strong papillae which are almost strap-like in appearance. As mentioned above the buccal mass is pushed right to the left of the body cavity by the genital complex; the radula instead of protruding downwards as in other Doridiidae is here observed to protrude from the left-ventral side of the buccal mass. The cerebral ganglia of the nervous system is situated not above the buccal mass but medianly near the prostate gland.

The colour of the living animal, according to the collector, is " outstanding, a triumph for the beauty of nature ". In preservative, the colour of the mantle medianly is dark brown-grey, the stellate reticulations are fawn as are also the pustules between the crests; laterally the mantle is yellowish-fawn with numerous small red or orange patches showing through from the underside of the mantle. The pustules of the median and lateral crests are all black capped, usually surmounted on reddish flesh. All the lateral pustules of the mantle contain a circlet of black spicules, this providing a noticeable black

ring on the top of each pustule. The branchial cavity is surrounded by minute black and yellow alternating patches. The rhinophores and the ramifications of the branchiae are purple-brown. About the margin of the mantle underside are numerous large irregular patches of pale orange, (when alive these are bright red). The remainder of the undersurface is pale pinkish-grey; the sides of the foot and head are heavily flecked about the edges with fine black spots, which higher up become large and sparser and disappear completely at the turn of the foot into the mantle. Sole of foot yellowish-orange, without any markings.

Locality: Fiddlers Bay, south of Cape Bolingbrook, Spencer Gulf, (two specimens, Dec. 1958, collected P. Trenberth, type F20,763, dissected paratype F20,764).

Station: Collected by torch-light at night in shallow water on the grape weed, *Hormosira banksii*.

Remarks: The two specimens are excellently preserved, the colour has faded very little and no distortion has occurred at all. This record adds another genus to the list of Doridiidae of South Australia and is the fourth species of the genus known from Australia.

The remarkable bifid radular teeth may be merely an aberration but until further material is available for examination this point cannot be checked. In case the species is found to be consistent, then the subgeneric name *Tumbia* subgen. nov. is here provided for it. Other characteristics of the species, i.e. long oral tube with papillae, buccal mass to the left of the body cavity, and genital organs with divided prostate gland, are the same or similar to described species of *Asteronotus*. The bifid undulations of the junior rows of teeth, particularly in the case of the marginal one, are very similar to *A. madrasensis* O'Donoghue 1932 although there the marginal has only the one cusp.

JORUNNA HARTLEYI (Burn).

Text figs. 15-16.

Rostanga hartleyi Burn, 1958, *J. Malac. Soc. Aust.*, 2, p. 28, pl. 2, figs. 12-13, text fig. 5.

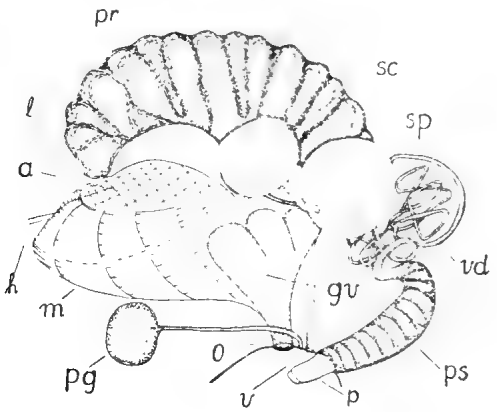
Little need be added to the original concerning external features but here the radula is refigured as that originally described and figured is quite wrong.

As originally stated the rhinophore sheaths are large, they are also rather elevated, the branchial sheath is not so much elevated. The villous papillae of the mantle are very strong, flat topped and somewhat sparsely spaced.

In preserved material the oral tentacles are short, stout and digitiform; the anterior of the foot is shallowly bilabiate with an incised upper lip; the colour is reddish-brown, foot pinkish and orals white.

Text fig. 15.—*Jorunna hartleyi* (Burn). A half row of teeth from the radula.

The distal genital organs are very complex and compact. The male portion is provided with a large and curiously shaped prostate gland with both the vas deferens and upper male duct from the albumen gland debouching from and entering into a common arm or branch of the prostate. The vagina is narrow and equipped with a large spherical spermatheca; the uterine duct debouches separately into this vesicule, and the nearly as large spermatocyst issues into the uterine duct a short distance away from the spermatheca. The ampulla is large, elongate and narrowly constricted at either end. The penial gland has a long slender duct connecting it to the genital atrium, the upper end is swollen into a spherical sac; no dart or stylet was found. The oviduct has a set of three vestibular glands on its dorsal side and not far from the aperture. The distal part of the vas deferens is slightly swollen into a penial sheath with strong transversely muscled walls; between the prostate and the penial sheath it is very long and narrow, and intricately coiled and wound. The penis is short, cylindrical and unarmed, apically a little constricted and narrower.



Text fig. 16.—*Jorunna hartleyi* (Burn). Distal genital organs; the penial gland (pg) has been moved to the left to show the vesiculae seminales.

The radular formula is 22 x 18—22.0.18—22. Inner lateral simply hamate, narrow and elongate. Succeeding five laterals lie over each other towards the rhachis. Except for the outer five or six slender curved teeth, all the teeth are simply hamate but the cusps are not long in relation to the base as that of the inner lateral. There is no labial armature, the cuticle is quite smooth.

Locality: Coobowie, St. Vincent Gulf, (one specimen, Dec. 1957, collected Hartley–Hall, F20,765).

Station: Under stone at low tide level.

Remarks: The presence of a large prostate gland and a penial gland necessitates the transfer of this species from *Rostanga* Bergh, 1879 to *Jorunna* Bergh, 1880. The flat topped villous papillae of the mantle and the form of the radula add further to the weight of this transfer. The genus *Jorunna* has not previously been recorded from Australia. The species is not an uncommon one at various localities in Victoria where the type locality is Breamlea.

Family DENDRODORIDIDAE.

This family contains two genera, *Dendrodoris* Ehrenberg, 1831 and *Doriopsilla* Bergh, 1880, the latter has formerly been regarded as a subgenus of the former. It is most probable that *Dendrodoris* should be further divided into subgenera or perhaps even genera on the basis of either (i) the presence of strong compound tubercles on the dorsum and very large size of animal, e.g. *D. tuberculata* (Quoy et Gaimard, 1832) or (ii) the presence of low smooth blister-like pustules on the dorsum, e.g. *D. nigra* (Stimpson, 1855). Other separative characters might be the two forms of rhinophores, straight or bent at near right-angles at mid-length.

Together with the Phyllidiidae, the Dendrodorididae constitutes the section POROSTOMATA of the Doridacean Nudibranchia (Marcus, 1957, p. 446), both families characterized by the absence of radula and jaws, the Phyllidiidae further by the lack of branchiae about the dorsal anal aperure.

Genus *DENDRODORIS* Ehrenberg.

The members of this genus are usually large, soft and slimy. The dorsum is often ornamented by large soft, either rounded or tuberculose warts, or sometimes it is covered by large or small soft blisterlike pustules, or more rarely it is smooth. The body length varies from 20 mm. to in excess of 150 mm., the ratio between breadth and length is 1:2 or 1:3. The mantle edge is thin and often strongly and grossly undulate, similarly the foot margin is undulate but usually less strongly. The foot is very broad, as wide at least as the body proper, ends rounded but more narrowly in front. The head is exceedingly small but is always noticeable; the oral tentacles are merely lobiform thickenings of the sides of the head. The branchiae are always large, tri- or polypinnate, very bushy and varying in number from 4 to 8. The perfoliate rhinophores are of either of two forms, the first and more common being simply conical-clavate, the second having the clavus bent rearwards at near right-angles to the stem. Both rhinophores and branchiae are retractile within large simple rimmed cavities. There is no radula or labial armature; instead of these there is a suctorial complex. The genital complex is as usual in the DORIDIDAE; the penis is armed by rows of strong spines or hooks.

There are about a dozen species of *Dendrodoris* at present known from the Australian coastline. These are listed below along with their present known distribution.

D. gunnamatta Allan, 1932———New South Wales.

D. mammosa (Abraham, 1877)———Western Australia: probably this species needs a new name as the same name is also used for a New Zealand *Dendrodoris*. The type specimen has no locality.

D. rainfordi Allan, 1932———Queensland.

D. tuberculata (Quoy and Gaimard, 1832)———Queensland. (= *D. morulifer* Allan, 1932———Queensland).

D. vadisi nom. nov.———Victoria: this new name is necessary for *D. davisi* Burn, 1957 which is generically separate from *Doriopsilla davisi* (Allan, 1933), a species originally designated as a *Dendrodoris*, and which is found along the N.S.W. coastline but not in Victoria. The type specimen of *D. vadisi* is in the National Museum of Victoria, registered number F20,974, locality Portarlington; station common under stones at low tide level, particularly so if the stones have a muddy sediment covering their undersurfaces. For description of species see Burn, 1957.

D. albobrunnea Allan, 1933———Queensland.

D. guttata (Odhner, 1917)———Western Australia.

D. nigra (Stimpson, 1855)———New South Wales, Victoria, South and Western Australia.

D. maugeana Burn, 1961 (ante p.)———Victoria.

D. denisoni (Angas, 1864)———New South Wales, Queensland.

D. albopurpura Burn, 1957———Victoria.

Probably many more species will be recorded from the Australian Region in future years as careful and systematic collecting is undertaken at previously untouched parts of the coastline. The *Dendrodoris* in the present collection is a common species with a distribution throughout the whole of the Indo-Pacific.

DENDRODORIS NIGRA (Stimpson).

Doris nigra Stimpson, 1855, *Proc. Acad. Nat. Sci. Philad.*, 7, p. 380.

This cosmopolitan and well described species is here added to the South Australian fauna, thus completing the distribution of the species throughout the southern states. Previously it has been recorded from Western Australia (O'Donoghue, 1924), New South Wales (Allan, 1932, 1947), and Victoria (Burn, 1957).

The present specimens are quite typical, black all over except for a narrow red band around the mantle-brim. The largest specimen measures 17 mm. in length and is very much contracted.

Locality: Coobowie, St. Vincent Gulf, (six specimens, Dec. 1957, collected Hartley–Hall, F20,766).

Station: Under stones at low tide level.

Remarks: The ever apparent body-colour of *D. nigra* does away with any necessity to examine the anatomy in relation to other species of *Dendrodoris*. The amount of colour variation in specimens from different localities is very considerable, but always the body-colour is black.

Genus *DORIOPSILLA* Bergh.

The species referred to this genus all have hard mantles, either granular (to varying degrees) or ornamented with a few low soft and simple papillae. The presence of calcareous spicules creates the hardness of the mantle. The body length rarely exceeds 50 mm., the smallest species is about 10 mm.; the breadth is generally more than half the length. The foot is broad, often wider than the body proper; the edges are thin and evenly undulate, the ends taper quickly and are narrowly truncate. The head is minute, in fact little more than the mouth aperture is apparent. The branchiae are few in number, usually 4 or 5, small and tripinnate; retractile. The rhinophores are conical-clavate, perfoliate and retractile. Rhinophoral and branchial cavities with simple edges. There is no radula or labial armature, but the presence of the buccal ganglia close behind the pedal ganglia differentiates the buccal complex from that of *Dendrodoris* where the distance between the two ganglia is considerable. The penis is armed with strong hooks, in some cases in spiral rows.

The three species here referred to *Doriopsilla* are in each case separable by their body-colour which generally remains even in preserved material. A simple key to the four Australian species can be laid out as follows:—

1. Mantle with scattered low soft papillae.
   - (i) Colour bright (chrome) yellow, sometimes white. Length up to 45 mm.—*D. staminea* (Basedow and Hedley, 1905).
   - (ii) Colour entirely red or orange, often with a few scattered white punctae. Length up to 40 mm.—*D.aurea* (Quoy and Gaimard 1832).
   - (iii) Colour varying from bright orange to pale orange, more often than not with white punctae or splashes over the dorsum. Length up to 35 mm.—*D. davisi* (Allan, 1933), (N.S.W.).
2. Mantle granular
   Mantle dark red or brown, sole of foot yellow or white. Length up to 25 mm.—*D. carneola* (Angas, 1864).

Beyond Australia, *Doriopsilla* is represented by six or seven species, two or three of which are from the Atlantic, the remainder from the Indo-Pacific.

DORIOPSILLA STAMINEA (Basedow and Hedley).

Archidoris staminea Basedow and Hedley, 1905, *Trans. Roy. Soc. S. A.*, 29, p. 151, pl. 6, figs. 3-4.

This is a very common South Australian species extending well eastwards along the Victorian coastline. In the present collection there are ten specimens from the Gulfs of South Australia, the dimensions range from 15 x 12 x 7 mm.

to 35 x 18 x 11 mm. The prominence of the low dorsal papillae varies from specimens to specimen; in some specimens they are very prominent and clearly defined, in others very low or contracted, so much so that they may appear merely as pale smooth patches of skin. The branchiae are five in number, coarsely and sparsely tripinnate; the anal papilla is between the rear two plumes, all retractile within a deep, low and smooth margined cavity. The rhinophores have similar low smooth margined sheaths. Anteriorly the foot tapers to a fine rounded point, the apex of which is very shallowly sinuate; above this sinus is the minute head with its thickened anterio-lateral margins in place of distinct oral tentacles.

The colour of this species varies from chrome yellow to pale cream or white. The rhinophores and branchiae are always pale brown or fawn. As in other species of the genus, the underside of the mantle shows a tracery of narrow fibrillae, which in this case gave rise to the specific name *staminea*.

Localities: Fiddlers Bay, Spencer Gulf, (7 specimens, Dec. 1958, coll. P. Trenberth, F20, 767); Coobowie, St. Vincent Gulf, (3 specimens, Dec. 1957, coll. Hartley—Hall, F20, 768).

Station: At the former locality the species is collected in conjunction with a sponge of a similar colour, the latter specimens were taken under stones at low tide level.

Remarks: Basedow and Hedley (1905, p. 151) described this species as an *Archidoris*, apparently being misled by the presence of papillae upon the mantle, and further on (p. 157) included a form of *D. staminea* with *"Doriopsis" carneola* (Angas, 1864). O'Donoghue (1929, p. 812) was the first to realise that the species was not an *Archidoris* but failed to rectify the situation. Recently the author has recorded the species from Victorian localities and at that time regarded it as a *Dendrodoris*, but now he finds that it is a true *Doriopsilla*. Probably it is very closely related to the type of the genus, *D. areolata* Bergh, 1880, from the Atlantic Ocean and Mediterranean Sea, and may in fact prove to be synonymous with that species.

DORIOPSILLA AUREA (Quoy and Gaimard).

Doris aurea Quoy and Gaimard, 1832, *Voy. "Astrolabe"*, Zool. 2, p. 265, pl. 19, figs. 4-7.

This and the next species are very similar to one another but generally this is the larger and less brittle. The head is minute, the mantle is tough and has a very few low soft papillae scattered over it. Dimensions of the present specimen are 19 x 8 x 3 mm.

The colour is pale pink as preserved. When alive the colour is either orange or red, sometimes with white punctae scattered over it, usually these are surmounted on the papillae. The rhinophores and branchiae are reddish-brown.

Locality: Coobowie, St. Vincent Gulf, (1 specimen, December 1957, coll. Hartley–Hall F20, 855).

Station: Under stone at low tide.

Remarks: The next species differs from this in that the mantle and foot are always of different colours, whereas here the whole body is the one colour.

DORIOPSILLA CARNEOLA (Angas).

Doris carneola Angas, 1864, *J. Conchyliol,* 12, p. 48, pl. 4, fig. 7.

This species always retains the striking dark red or maroon colour of the mantle, the somewhat paler red underside of the mantle and the yellow, cream or white foot. The rhinophores and branchiae are a similar dark red or maroon as is the mantle. Dimensions of the larger specimen in the collection are 24 x 15 x 6 mm. The mantle is very hard and minutely granular.

Locality: Coobowie, St. Vincent Gulf, (2 specimens, Dec. 1957, collected Hartley–Hall, F20, 856).

Station: Under stones at low tide.

Remarks: The dimensions mentioned above are very rarely exceeded by this species. It is apparently quite common all along the southern Australian coastline, extending as far eastwards as Sydney Harbour. Angas in his type figure shows large rhinophoral sheaths, a feature not so noticeable in any of the many specimens examined by the author.

List of Abbreviations used in Text Figures.

(Text figs. 1-16).

a—albumen gland.
d—uterine duct.
gv—vestibular glands.
h—hermaphrodite duct.
l—ampulla.
m—mucus gland.
o—oviduct.
p—penis.
pg—penial gland.
pr—prostate gland.
ps—penial sheath.
sc—spermatocyst.
sp—spermatheca.
v—vagina.
vd—vas deferens.
♀—female aperture.
♂—male aperture.

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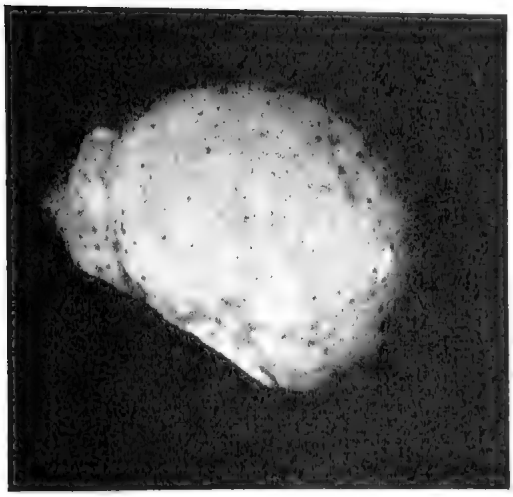
PLATE 1.

Fig. 1. *Hypselodoris saintvincentius* sp. nov. dorsal view.
Fig. 2. *Hypselodoris saintvincentius* sp. nov. lateral view.
Fig. 3. *Asteronotus* (*Tumbia*) *tremberthi* sp. nov. dorsal view.
Fig. 4. *Asteronotus* (*Tumbia*) *tremberthi* sp. nov. lateral view.
Fig. 5. *Asteronotus* (*Tumbia*) *tremberthi* sp. nov. ventral view.
Fig. 6. *Anisodoris flindersi* sp. nov. dorsal view.
Fig. 7. *Anisodoris flindersi* sp. nov. lateral view.



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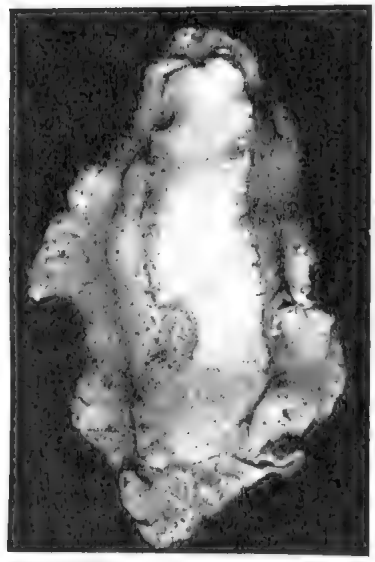

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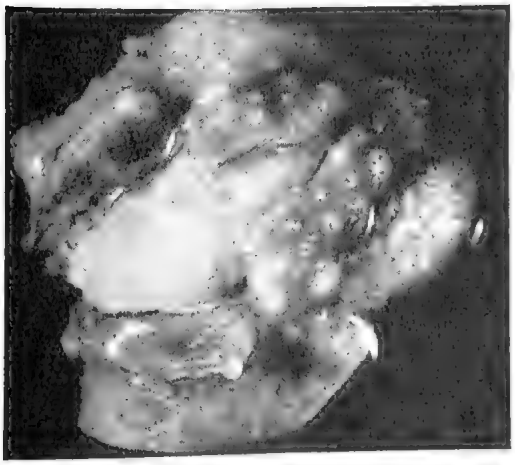

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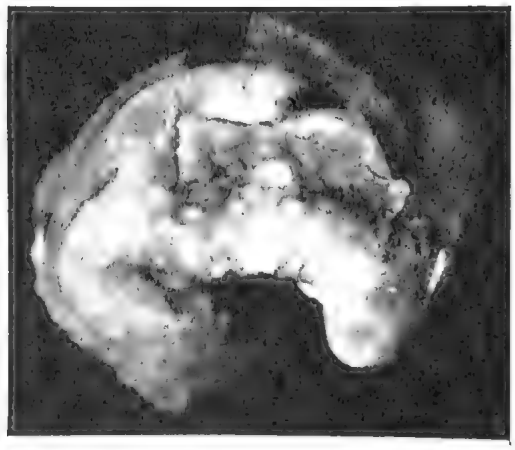

7

TROCHUS OBTUSA CONFUSION.

By J. Hope Macpherson, M.Sc. Curator of Molluscs National Museum of Victoria.

The present author in 1958 received a series of *Chrysostoma* from the W. Australian Museum for identification. The specimens had been collected by B. R. Wilson and G. Kendrick on the South Jervois Groin, Naval Base, Cockburn Sound, West Australia. The checking with *Chrysostoma* specimens already in the National Museum collection revealed that some purchased from Hugh Cuming in 1868 were labelled *Chrystostoma obtusum* Chemnitz, Swan River. These shells were certainly conspecific with the present Cockburn Sound specimens and seemed to correspond very well with the Chemnitz description and figure of *Trochus obtusus* (Conch. Cab. XI. 1795, p. 167, pl. 196. figures 1894–5). (Chemnitz being non-binomial the species is attributed to Dillwyn, 1817).

However, Hedley had decided, 1917, (Pro. Linn. Soc. N.S.W. 1916, p. 700) that this name should be used for the shell previously known as *Monodonta constricta* Lamarck (South-eastern Australia). He stated that " guided by a suggestion in Pilsbry's Monograph " he sent specimens to Lynge at the Copenhagen Zoological Museum where the Chemnitz type is situated. Lynge compared them with the type and said that Hedley's shells were identical.

Pilsbry's reference to Chemnitz in the Monograph, is through a figure by Philippi. This is certainly of the Chemnitz shell but the delineation is such that it could be mistaken for the *Monodonta.* It seemed, after due consideration, that both Hedley and his advisor, Lynge, could have been misled. In order to confirm or discount this, specimens both of the south-eastern shells known as *Austrocochlea obtusa* and the West Australian *Chrysostoma* were sent from this museum to Dr. H. Lemche at the Zoological Museum, Copenhagen, for critical comparison with the Chemnitz type.

The following is an extract of Dr. Lemche's reply:—

" In reply to your inquiry of April 1st concerning *Trochus obtusus* Chemnitz I am to inform you that comparison of your specimens to the type of the said species clearly shows the two larger specimens of yours* to be out of question as conspecific to the type.

* The south-eastern *Monodonta.*

The smallest specimen,** in its general habitus, is similar to that of the type, although your specimen is somewhat smaller and the spire less elevate. The upper zone of the last whorl in your specimen carries less coloured striae than the flat and more outwards directed second zone which, again, has the same number of coloured striae as the remaining parts of the surface. In the type, all of the coloured striae are almost as broad as those of the upper zone in your specimen, and they are continuous over all three areas. In the lower one, the striae continue obliquely downwards and toward the aperture in exactly the same manner as in your specimen—with the exception of the last fourth of the last whorl where there is a sudden break in the colouration as a consequence of a very pronounced growth-stop. Outside the break, the striae run parallel to the border of the aperture in the upper half of the zone, to bend round once more on the lower half of this zone—as indicated also on the figure 1895 given by Chemnitz.

The size of your specimen corresponds exactly to the regularly coloured part of the type, i.e. your specimen lacks the final, irregularly coloured part shown by the type.

Your specimen has a distinct, shallow groove separating the upper and the second zones. In the type, the groove is represented by a more pronounced concavity in this place.

The surroundings of the umbilicus differ, the type showing a distinct although narrow umbilicus not covered by the umbilical callus; also, the slight tooth-like protrusion at the base of the aperture differs slightly in shape. The difference, however, is hardly such as to be of systematic significance.

The type is labelled "East Indies." Probably, your specimen represents the same species—but it might be that it belongs to a different geographical subspecies."

From the foregoing it appears to be obvious that the south-eastern *Monodonta* was confused by Hedley with the Chemnitz *Trochus obtusus* and must now revert to

AUSTROCOCHLEA CONSTRICTA (Lamarck, 1822).

Trochus obtusus of authors (non Dillwyn).

Monodonta constricta Lamarck, 1822; (White Form) Anim. s. vert. 7, p. 36.

Monodonta zebra Menke, 1829; (striped form) Verg. Malak. Conch. Samml., p. 17.

Trochus taeniatus Quoy & Gaimard, 1834 (striped form) Voy. Astrolabe III p. 249, pl. 63, f. 15–17.

** Western *Chrysostoma.*

Trochus constrictus Quoy & Gairmard, 1834, (unicoloured and striped) p. 251, pl. 63, f. 26–27.

Labio porcatus A. Adams, 1851 (small striped form) Proc. Zool. Soc. Lond., p. 179.

Trochocochlea multicarinata Chenu, 1859 (striped form) Man. de Conch. I, p. 360, fig. 2676.

Trochocochlea extenuatus Fischer, 1876 (new name for *porcatus*) Icon. Coq. Viv. p. 178, pl. 59, f. 2 and pl. 60, f. 4.

Austrocochlea torri Cotton & Godfrey, 1934 (white form) S. Austr. Nat. 16, page 1.

Austrocochlea constricta shows considerable variation in colour pattern according to geographical distribution and habitat. Some authors consider the unicoloured and striped form to be different species, but Mrs. Jean Carter (personal communication) who is in process of making a revision of the genus has been unable to find any anatomical differences between animals with shells of various colour patterns.

Hedley's suggestion that Lamarck had the unicoloured form is confirmed by Dr. E. Binder of the Museum d'histoire naturelle, Geneva, who writes: " It is difficult to be sure about the stripes on Lamarck's specimens of *Monodonta constricta* because they are discoloured, rather worn, and covered with a white crust. The best seems to be an uneven grey, but I can distinguish no stripes resembling those pictured by Quoy & Gaimard on *Troque multicarene.* I should consider these specimens (they are three) to be the unstriped form."

Therefore should it be necessary to distinguish between the unicoloured and striped forms the latter will revert to *zebra* Menke. The stunted salt-marsh form of this being known as *porcatus* A. Adams.

The West Australian specimens sent to Dr. Lemche were compared with the remainder of the Western Australian Museum series and the latter varied in two particulars. Most specimens in the series were smaller, and elevation of the spire was higher in some specimens.

I agree with Dr. Lemche that they are conspecific with the Chemnitz shell but I am not prepared to follow his suggestion that they be subspecifically separated on geographic grounds until a series of specimens from the type locality is available to illustrate variation.

I therefore propose to call the Western Australian shell *Chrysostoma obtusa* (Dillwyn, 1817).

Trochus obtusus Dillwyn, 1817, Descriptive Cat., II, 1817, p. 809 (not of authors).

Trochus obtusus Chemnitz, 1795, (non-binomial) Conch. Cab. XI, p. 167, tab. 196 of 1884–5.

Trochus obtusus Philippi, 1846. Syst. Conch. Cab. (Martini & Chemnitz), Bd. II, Abth. 3, p. 19, Taf. 4, fig. 3, 4.

The collectors give the following information on habitat "Living on and around a small stone in six feet of water, surrounded by *Posidonia*. Twenty-five yards south Jervois Groin, Naval Base, Cockburn Sound, W. Australia."

NEW NAME FOR *MUREX ESPINOSUS MACP.*

J. Hope Macpherson, M.Sc. Curator of Molluscs National Museum of Victoria.

Murex espinosus Macp. was described in Memoirs, National Museum, Melbourne No. 24, December, 1959, p. 55 but the name is preoccupied by Hutton, 1886 (Trans. N. Zeal. Instit., vol. 18, p. 333) who used it for a Pleistocene fossil. Therefore I propose to replace it by *Murex tweedianus*.

ADDITIONS TO THE MARINE MOLLUSCAN FAUNA OF SOUTH EASTERN AUSTRALIA INCLUDING DESCRIPTIONS OF NEW GENUS PILLARGINELLA, SIX NEW SPECIES AND TWO SUBSPECIES.

Charles J. Gabriel, Honorary Associate in Conchology, National Museum of Victoria.

Introduction.

It has always been my conviction that the spasmodic and haphazard collecting so far undertaken has not exhausted the molluscan species to be found in the deeper waters of South-eastern Australia. Only two large single collections have been made; first by the vessel " Challenger " in 1874 at Station 162 off East Moncoeur Island in 38 fathoms. These collections were described in the " Challenger " reports by Rev. Boog. Watson (Gastropoda) and E. A. Smith (Pelecypoda). In the latter was included a description of a shell *Thracia watsoni* not since taken in Victoria though dredged by Mr. David Howlett off St. Francis Island, South Australia.

In 1910 the F. I. S. " Endeavour " made a number of hauls both north and south of Gabo Island and off Cape Everard. The results of this collecting can be found in the " Endeavour " reports.

T. Iredale, 1924, published the results of shore and dredging collections made by Roy Bell.

Since this time continued haphazard collecting has been carried out mostly as a hobby by trawler fishermen either for their own interest or on behalf of interested friends. Although some of this material has reached the hands of competent workers, over the years the recording of new species has probably been delayed. Also with this type of collecting the large and more spectacular shells are retained, and the smaller often rarer species discarded because of the difficulty of sorting them from the rubbish of the trawl. It is therefore with special gratitude that I express my thanks to Mr. W. S. Ayres of Lakes Entrance for taking the time and trouble to make collections from this rubbish and for placing his finds either in my hand or that of the National Museum of Victoria. Similarly to Mr. N. Buckland of Eden who over a number of years has been happy to give specimens of rare or new species to the National Museum for their records. The results of this generosity is recorded in the following pages under the species concerned.

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Watson, Boog., 1886, *ibid.* Vol. 15, part 42, Scaphopoda and Gastropoda.

GASTROPODA.

FISSURELLIDAE.

Notomella gabensis sp. nov.

(Plate figs. 10-12).

Shell cream coloured, large, much elevated; apex posteriorly situated, about one fourth the length of shell; anterior slope convex, posterior slope slightly curved; fissure short and narrow about 5·5 mm. from the anterior extremity; the sides of the shell are arcuate allowing the anterior and posterior ends only, to rest on a flat surface. Margins crenulated through the radial sculpture which consists of radiating ribs in two series, about forty, very prominent, standing out of the surface of shell, and the other, much smaller, each alternating with those of the larger series. Furrow well defined and crossed by numerous, somewhat irregular imbricating scales. The shell is further ornamented with numerous, fairly regular concentric ridges traversing the whole area and giving the shell a more or less latticed appearance.

Size of Holotype. Length 25 mm., breadth 18 mm., height on a plane surface 12 mm.

Radula (fig. 12) has a series of seven central cusps which diminish in width from the centre; each cusp has a slightly over-turned cutting edge. The single pair of laterals are very large, with an overturned bicuspid tip. There are a large number of fine wheat-ear-like marginals.

Locality. 50 fathoms off Gabo Island. (N. Buckland).

Reg. No. Holotype F20840 (anterior end slightly fractured).

Paratype. F.20841.

Observations: A large representative of the genus, of similar dimensions to *N. superba* (Hedley and Petterd, 1906) but readily distinguished by its greater height, narrower furrow and longer slit.

TROCHIDAE.

Clanculus leucomphalus (Verco, 1905).

1905. *Clanculus leucomphalus* Verco, Trans. roy. Soc. S. Aust., XXIX., p. 168, pl. 31, figures 9, 10, 11.

1938. *Clanculus* (*Euclanculus*) *leucomphalus* Cotton and Godfrey, Malacol. Soc. S. Aust., Publication No. I. A Systematic List of the Gastropoda . . . of South and Central Australia, p.5.

Size. Height 8 mm., diameter of base 9·75 mm.

Locality. 20 fathoms off Lakes Entrance (W. S. Ayres).

Observations: The identity of this finely granulated species was confirmed by comparison with a topotype originally received from the author.

Minolops emendata (Iredale, 1924).

1924. *Minolia pulcherrima emendata* Iredale, Proc. Linn. Soc. N.S.W., XLIX, p. 229, pl. 35, fig. 12.

1929. *Minolops emendata* Iredale, Rec. Aust. Mus., XVII, No. 4, p. 169, pl. 39, figure 5.

Size. Breadth 5 mm., height 2·5 mm.

Locality. 25 miles South-East of Lakes Entrance, 30 fathoms (W. S. Ayres).

Observations: This is the type of genus *Minolops*. In the 1929 reference the author remarked " As suggested at the time of description, this form appears to be of specific rank, five prominent keels being counted on the penultimate whorl, all of equal strength." Compared with topotypic Twofold Bay specimens received from the author.

Ethminolia probabilis (Iredale, 1924).

1908. *Monilea apicina* Hedley, (non Gould) Proc. Linn. Soc. N.S.W., XXXIII., p. 464.

1918. Hedley, (non Gould) J. roy. Soc. N.S.W., LI, (for 1917), p. M.44.

1921. *Minolia angulata* May, (non Adams) Check List Moll. Tas., p. 40.

1923. May, (non Adams) III. Index Tas. Shells, pl. 18, fig. 21.

1924. *Ethminolia probabilis* Iredale, Proc. Linn., Soc. N.S.W., XLIX, Pt. 3, p. 228, pl. 35, figures 7-9.

1955. *Ethminolia mayi* Kershaw, Proc. roy. Soc. Tas., LXXXIX., p. 291.

Size. Breadth 7·5 mm., height 4 mm.

Locality. 20 fathoms off Lakes Entrance (W. S. Ayres).

Observations: This shell, the type of *Ethminolia,* is very variable in colour, generally light brown with irregular spots and blotches. Closely-set concentric lines are visible in the adult whorls, but only with the aid of lens.

Kershaw, 1955, stated that Tasmanian shells differed from Twofold Bay shells named *probabilis* by Iredale, and he proposed the name *mayi* for the shell illustrated, and called *Minolia angulata* (Adams, 1853) by May, 1923. As it was necessary to decide which name to attach to the Victorian shells they were compared, by courtesy of the South Australian Museum, with material named *angulata* and later altered to *probabilis* by May, and with topotypic specimens of *probabilis* received from Iredale. The three lots from estuary of the Derwent River, Tasmania, Twofold Bay, N.S.W., and Lakes Entrance, Victoria are indistinguishable and therefore conspecific.

Observations: It occurs on the continental shelf of New South Wales, the type being recorded from 65–70 fathoms off Sydney.

Colpospira guilleaumei (Iredale, 1924).

1924. *Colpospira guillaumei* Iredale, Proc. Linn. Soc. N.S.W., XLIX., Pt. 3, p. 248, pl. 36, figs. 4, 15.

1925. *Colpospira guilleaumei* Iredale, Rec. Aust. Mus., XIV., No. 4, p. 267.

1955. *Platycolpus guillaumei* Iredale, Kershaw, Proc. roy. Soc. Tas., LXXXIX., p. 310.

1958. *Colpospira guillaumei* Iredale, Macpherson, May's III. Index Tas. Shells, Revision, pl. 28, fig. 11.

Size of Type: Length 15 mm., breadth 5 mm.

Locality. 45 miles East of Lakes Entrance, 50 fathoms (W. S. Ayres).

Observations: In the original description of the species the name was spelt *guillaumei* but the writer concludes it was a typographical error as it is spelt with an (e) (*guilleaumei*) in the explanation of plate and in a later paper (loc. cit.).

MATHILDIDAE.

Glyptozaria euglypta (Iredale, 1929).

1929. *Mathildona euglypta* Iredale, Rec. Aust. Mus., XVII., No. 4, p. 186, pl. 40, fig. 6.

1951. *Glyptozaria euglypta* Laseron, Rec. Aust. Mus., XII, No. 4, p. 333, fig. 85.

Size. Length 20 mm., breadth 7 mm.

Locality. 65 fathoms off Cape Everard (N. Buckland).

Observations: This is the second representative of the genus recorded from Bass Strait. The only other species of the genus is *G. opulenta* (Hedley, 1907) a narrower form of smaller proportions being 6 x 2 mm.

CERITHIDAE.

Ataxocerithium applenum (Iredale, 1936).

1936. *Ataxocerithium applenum* Iredale, Rec. Aust. Mus., XIX, No. 5, p. 291, pl. 21, fig. 19.

Size of Type. Length 14 mm., breadth 7 mm.

Locality. 20 fathoms off Lakes Entrance (W. S. Ayres).

Observations: This appears to be a frequent species all along the continental shelf of New South Wales, and is easily separable from *A. scruposum* Iredale by its much broader form: it is the type of sub-genus *Geminataxum* Iredale, 1936.

RISSOIDAE.

Lironoba archensis (May, 1912).

1912. *Rissoa archensis* May, Proc. roy. Soc. Tas., p. 47, pl. 2, fig. 5.
1921. *Linoroba archensis* May, Check List Moll. Tas., p. 49.
1923. May, III. Index Tas. Shells, pl. 23, fig. 8.
1955. Kershaw, Proc. roy. Soc. Tas., LXXXIX, p. 308.
1958. Macpherson, May's III. Index Tas. Shells, Revision, pl. 23, fig. 8.

Size of Type. Length, 2·3 mm., breadth, 1·3 mm.

Locality. 45 miles East of Lakes Entrance, 50 fathoms (W. S. Ayres).

Observations: Resembles *Rissoa lockyeri* Hedley, 1911, but its broader shape and bicarinate spire are sufficient to separate it.

RISSOINIDAE.

Rissoina lintea (Hedley and May, 1908).

1908. *Rissoina lintea* Hedley and May, Rec. Aust Mus., VII, p. 117, pl. 23, fig. 11.
1921. May, Check List Moll. Tas., p. 53.
1923. May, III. Index Tas. Shells, pl. 25, fig. 10.
1955. Kershaw, Proc. roy. Soc. Tas., LXXXIX, p. 309.
1958. Macpherson, May's III. Index Tas. Shells, Revision, pl. 25, fig. 10.

Size of Type. Length 7 mm., breadth 2·5 mm.

Locality. 18 miles East of Lakes Entrance, 5–15 fathoms (W. S. Ayres).

Observations: This record is based on a single specimen. Easily distinguished from its nearest ally *R. rhyllensis* Gatliff and Gabriel, 1908, by its channelled suture and closely-set spiral threads which are visible on all the whorls with the aid of a lens.

Stiva ferruginea (Hedley, 1904).

1904. *Stiva ferruginea* Hedley, Proc. Linn. Soc. N.S.W., XXIX., Pt. 1, p. 192, pl. 9, figures 23–25.
1918. Hedley, J. roy. Soc. N.S.W. LI., (for 1917), p. M.55.

Size. Length 18 mm., breadth 7 mm.

Locality. 65 fathoms off Cape Everard (N. Buckland).

Observations: *Stiva* Hedley, 1904; with *S. ferruginea* as the type, is a curious genus representend by two species from the Peronian province, the above locality being the first record of its existence in Victorian waters. The author's description emphasizes the *Scala*-like contours of this shell

TURRITELLIDAE.

Gazameda decoramen (Iredale, 1936).

1936. *Gazameda decoramen* Iredale, Rec. Aust. Mus., XIX., No. 5, p. 292, pl. 21, fig. 20.

Size. Length 18 mm., breadth at base 6·5 mm.

Locality. 18 miles South-East of Lakes Entrance, 5–15 fathoms (W. S. Ayres).

Ataxocerithium scruposum (Iredale, 1936).

1936. *Ataxocerithium scruposum* Iredale, Rec. Aust. Mus., XIX., No. 5, p. 291, pl. 21, fig. 18.

Size of Type. Length 12 mm., breadth 6 mm.

Locality. 20 fathoms off Lakes Entrance (W. S. Ayres).

Observations: This species, like *A. applenum* Iredale, is recorded all along the continental shelf of New South Wales. It is readily distinguished from that species by its narrower form and finer sculpture.

STILIFERIDAE.

Stilapex lactarius (Iredale, 1925).

1910. *Stilifer brazieri* Gatliff and Gabriel (non Angas, 1877) Proc. roy. Soc. Vic., XXIII., (NS.), Pt. 1, p. 91.

1921. *Stilifer brazieri* May (non Angas) Check List Moll. Tas., p. 101.

1923. May, III. Index Moll. Tas., pl. 45, fig. 24.

1925. *Stilapex lactarius* Iredale, Rec. Aust. Mus., XIV., No. 4, p. 270, pl. 43, fig. 20.

1955. *Stilifer brazieri* Kershaw (non Angas) Proc. roy. Soc. Tas., LXXXIX., p. 312.

1955. *Stilapex lactarius* Laseron, Aust. Zool., XII., p. 99, (Text fig.), (after Iredale), 78.

1958. *Stilifer brazieri,* Macpherson (non Angas), May's Illust. Index Tas. Shells Revision, pl. 45, fig. 24.

Size. Length 8 mm., breadth 5 mm.

Localities. 65 fathoms off Cape Everard (N. Buckland); Bass Strait, "Endeavour"; Shoreham, (Gatliff Coll.).

Observations: A shining white, globose species. The Victorian record of *S. brazieri* Angas, by Gatliff and Gabriel (loc. cit.) was based on a shell obtained in Bass Strait by the "Endeavour". It is apparent, on re-examination of "Endeavour" material and the present specimen that they are both of the same species as the shell figured by May, 1923, but differ from *S. brazieri* which, as pointed out by Iredale, has a much narrower shell. It seems likely that Iredale's deduction that this species is free living, is incorrect as three specimens were obtained by the "Endeavour" off a starfish in 40 fathoms, Bass Strait. The type locality of *Stilapex lactarius* is 70 fathoms, 20 miles East of Babel Island.

PYRAMIDELLIDAE.

Puposyrnola tasmanica (Tenison Woods, 1887).

1877. *Styloptygma tasmanica* T. Woods, Proc. roy. Soc. Tas. (for 1876), p. 151.
1901. *Syrnola tasmanica* Tate and May, Proc. Linn. Soc. N.S.W., XXIV., p. 382.
1921. May, Check List Moll. Tas, p. 98.
1923. May Ill., Index Tas. Shells, pl. 44, fig. 13.
1955. *Puposyrnola tasmanica* Kershaw, Proc. roy. Soc. Tas. LXXXIX., p. 312.
1958. Macpherson, May's Ill., Index Tas. Shells, Revision, pl. 44, fig. 13.

Size. Length 4 mm., breadth 1 mm.

Locality. 18 miles East of Lakes Entrance, 5–15 fathoms (W. S. Ayres).

Observations: A white, polished, elongately fusiform shell with protoconch somewhat roundish and whorls obsoletely radially striate.

Pyrgiscus varicifera (Tate, 1898).

1898. *Turbonilla varicifera* Tate, Trans. roy. Soc. S. Aust., XXII., p. 85, pl. 4, fig. 7.
1905. Hedley, Rec. Aust. Mus., VI., p. 42.
1909. *Turbonilla varicifera* Hedley, Aust., Assoc., Adv., Sci., p. 359.
1918. Hedley, J. roy. Soc. N.S.W., LI., (for 1917), p. M.99.
1951. *Pyrgiscus varicifera* Laseron, Rec. Aust. Mus., XXII., No. 4, p. 323, fig. 62.

Size. Length 15 mm., breadth 4 mm.

Localities. 15–20 fathoms West of Lakes Entrance (W. S. Ayres), 65 fathoms off Cape Everard (N. Buckland).

Observations: The species has a rather wide distribution, being recorded from South Australia through Bass Strait to Queensland, a typical specimen in the collection of the writer being obtained by a trawler off Eden.

LIPPISTIDAE.

Icuncula torcularis (Tenison Woods, 1878).

1878. *Cingulina torcularis* T. Woods, Proc. Linn. Soc. N.S.W., II., p. 263.
1899. *Rissoa torcularis* Tate, Trans. roy. Soc. S. Aust., XXIII., p. 234.
1901. *Trichotropis torcularis* Hedley, Rec. Aust. Mus., IV., No. 1, p. 22, fig. 2, (in text).
1915. *Lippistes torcularis* May, Proc. roy. Soc. Tas., p. 77.
1918. Hedley, J. roy. Soc. N.S.W. (for 1917), p. M.60.
1921. May, Check List. Moll. Tas, p. 62.
1923. May, Ill. Index Tas. Shells, XXII., pl. 28, fig. 21.
1931. *Icuncula torcularis* Cotton & Godfrey, S. Aust. Nat. XII., No. 4, p. 61, pl. 2, fig. 9.

1955. Kershaw, Proc. roy. Soc. Tas., LXXXIX., p. 313.

1958. Macpherson, May's Ill. Index Tas. Shells, Revision, pl. 28, fig. 21.

Size. Length 3·5 mm., breadth 1·5 mm.

Locality. 25 miles South-East of Lakes Entrance, 30 fathoms (W. S. Ayres).

Observations: No difficulty should be experienced in identifying this shell which is a singular species distinguished by a prominent keel on the centre of each whorl, giving it a screw-like appearance. The base bears three rounded keels. Occurs also in New South Wales.

XENOPHORIDAE.

Xenophora peroniana (Iredale, 1929).

1918. *Xenophora tatei* Hedley (non Harris), J. roy. Soc. N.S.W. (for 1917), p. M.63.

1927. *Xenophora* Sp. Allan, Aust. Mus. Mag. III., p. 57, (fig. in text).

1929. *Onustus peronianus* Iredale, Rec. Aust. Mus., XVII., No. 4, p. 172.

Size. 50 mm.

Localities. 20 fathoms off Lakes Entrance; 50 fathoms North of Deal Island (E. Paddon).

Observations: The only representative of the genus in Victoria and readily recognized, the whole surface of the shell being almost covered by extraneous objects such as pebbles and other shells. It somewhat approaches the New Zealand "Carrier" shell, but is not so tall and the obvious means of distinguishing should be the shells carried by the two forms. Recorded also from Eden, New South Wales.

NATICIDAE.

Tanea luculentus (Iredale, 1929).

1929. *Natica luculenta* Iredale, Rec. Aust. Mus., XVII., No. 4, p. 179, pl. 40, fig. 10.

1956. *Notocochlis luculentus* Woolacott, Proc. roy. Zool. Soc. N.S.W., for 1954–55, p. 75, fig. 2 (operculum) fig. 5 (shell).

Size. Height 24 mm., breadth 21·5 mm.

Localities. 18 miles East of Lakes Entrance, 5–15 fathoms (W. S. Ayres).

Observations: A very globose, cream-coloured shell regularly spotted with splashes of brown. The single specimen obtained was identified by comparison with specimens from off Eden, New South Wales. Woolacott, 1955, placed this species in *Notocochlis* but stated that the operculum has two marginal grooves, a feature which immediately places it in *Tanea* Marwick, 1931.

Polinices (Conuber) ayresi sp. nov.

Plate 1. Figs. 8-9.

Shell small, thin, smooth, shining; conoid-globose; whorls 4½ rapidly increasing; colour whitish with a narrow fawn-coloured subsutural band and a much wider peripheral band occupying about half of the body-whorl. Aperture semi-circular, outer lip somewhat sharp, columella slightly arcuate; umbilicus small covered by a pad which almost fills the umbilical region. Operculum horny, semilunate, slightly smaller than the aperture.

Size of type: Height 6·25 mm. breadth 7·3 mm.

Radula (fig. 9) with a tricuspid central tooth on a wide base with paired tentaculiform backward facing lateral projections; lateral teeth simple, in three rows.

Locality: 18 miles East of Lakes Entrance, 5–15 fathoms (W. S. Ayres).

Reg. No. Holotype shell & radula F. 20828. Paratype shell & radula F. 20829.

Observations: A distinctive shell. The fawn-coloured peripheral band which is also clearly visible from within, provides a useful recognition mark. This feature and its more exsert spire immediately separates it from any of the small Peronian species.

Named in honour of Mr. W. S. Ayres the discoverer.

CASSIDAE.

Xenogalea nivea (Brazier, 1872).

1872. *Cassis nivea* Brazier, Proc. zool. Soc. Lond., p. 616, pl. 44, fig. 1.
1900. Pritchard and Gatliff, Proc. roy Soc. Vict. XII., (New Series), p. 189, (in part).
1921. May, Check List Moll. Tas., p. 65 (in part).
1927. *Xenogalea nivea* Iredale, Rec. Aust. Mus., XV., No. 5, p. 344, pl. 32, fig. 13.
1955. Kershaw, Proc. roy. Soc. Tas., LXXXIX., p. 314.

Size. Length 51 mm., breadth 44 mm.

Locality. Portland.

Observations: This is a pure white shell, usually with a double row of tubercles at the shoulder of body-whorl, a very variable feature which at times may be almost absent. Pritchard and Gatliff and May (loc. cit.) have included it in the synonymy of *X. pyrum* (Lamarck, 1822), but I am inclined to concur with Iredale in regarding it as worthy of specific distinction. Its distribution is from Tasmania through Bass Strait to South Australia.

CYMATIIDAE.

Cabestana waterhousei frigidulum (Iredale, 1929).

1929. *Cymatium waterhousei frigidulum* Iredale, Rec. Aust. Mus., XVII., No. 4, p. 177, pl. 41, fig. 2.

Size. Length 75 mm., breadth 35 mm.

Locality. Eastern Victoria (T. Worcester).

Observations: The figure depicts a much narrower shell than *C. waterhousei* (Adams & Angas, 1864). The colour is given by the author as pale straw; otherwise there is little difference between the two forms.

Cymatiella peroniana (Iredale, 1929).

1929. *Cymatiella peroniana* Iredale, Rec. Aust. Mus., XVII., No. 4, p. 176, pl. 40, fig. 9.

Size of Type. Length 16 mm., breadth 7·25 mm.

Locality. 20 fathoms off Lakes Entrance (W. S. Ayres).

Observations: In size and shape resembling *C. gaimardi* Iredale, 1929, but with a long canal and more open mouth. Previously recorded from New South Wales off Montague Island, 50–60 fathoms.

TONNIDAE.

Tonna cerevisina (Hedley, 1919).

1849. *Dolium variegatum* Reeve (non Lamarck) Conch. Icon., V., pl. 5, fig. 7a.
1867. Angas (non Lamarck) Proc. zool. Soc. Lond., p. 197.
1885. Tyron (non Lamarck) Manual Conch., VII., p. 262, pl. 3, figs. 13, 14.
1903. Hedley (non Lamarck), Mem. Aust. Mus., IV., p. 341.
1907. *Tonna variegata* Hedley (non Lamarck) Proc. Linn. Soc. N.S.W., XXXII., pt. 3, p. 483.
1919. *Tonna cerevisina* Hedley, Rec. Aust. Mus., XII., No. 11, p. 330, pls. 39–41, figures 1–3.

Size. Length 240 mm., major diam. 210 mm., minor 160 mm.

Localities. 3 miles off Marlo, 12 fathoms (W. S. Ayres); 6 miles off Lakes Entrance, 20 fathoms (W. S. Ayres).

Observations: This species could only be confused with the New South Wales *T. tetracotula* Hedley, 1919 from which it differs by its more globose form and in the absence of the smaller intermediate spiral ribs.

MURICIDAE.

Litozamia rudolphi (Brazier, 1894).

1894. *Peristernia rudolphi* Brazier, Proc. Linn. Soc. N.S.W., XIX., p. 166, pl. 14, figure 1.
1918. *Trophon rudolphi* Hedley, J. roy Soc. N.S.W. (for 1917), p. M.92.
1921. May, Check List Moll. Tas., p. 86.
1923. May, Ill. Index Shells Tas. pl. 40, fig. 7.
1955. *Litozamia rudolphi,* Kershaw, Proc. roy. Soc. Tas., LXXXIX., p. 315.
1958. Macpherson, May's Ill. Index Tas. Shells, Revision, pl. 40, fig. 7.

Size. Length 6·5 mm., breadth 4 mm.

Locality. On reef 6 miles South of Lakes Entrance, 20 fathoms (W. S. Ayres).

Observations: "May be known by the large dark reddish brown spots below the suture and nearly on the angle of the whorls."

Emozamia licinus (Hedley & Petterd, 1906).

1906. *Murex licinus* Hedley and Petterd, Rec. Aust. Mus., VI., Pt. 3, p. 219, pl. 37, fig. 6.
1921. *Trophon licinus* May, Check List Moll. Tas., p. 85.
1923. May, Ill. Index Tas. Shells, pl. 40, fig. 3.
1929. *Emozamia licinus* Iredale, Rec. Aust. Mus., XVII., No. 4, p. 185.
1955. Kershaw, Proc. roy. Soc. Tas., LXXXIX., p. 315.
1958. Macpherson, May's Ill. Index Tas. Shells, Revision, pl. 40, fig. 3.

Size of Type. Length 17 mm., breadth 13 mm.

Locality. Off Lakes Entrance; east of Cape Everard, 63 fathoms.

Observations: This Victorian occurrence is based on a specimen obtained by Mr. J. Walker in 1953 followed by another example collected by Mr. J. Cleasby and presented to the National Museum, Melbourne by Mr. N. Buckland. The peculiar squat form and characteristic sculpture provide ready means of identification. This is the type of genus *Emozamia*.

Ollaphon molorthus (Hedley & May, 1908).

1908. *Trophon molorthus* Hedley & May, Rec. Aust. Mus., VII., p. 122, pl. 24, fig. 23.
1921. May, Check List Moll. Tas., p. 85.
1923. May, Ill. Index Shells, Tas., pl. 40, fig. 4.
1958. *Ollaphon molorthus* Macpherson, May's Ill. Index Tas. Shells, Revision, pl. 40, fig. 4.

Size. Length 10·5 mm., breadth 4·5 mm.,

Locality. 25 miles South-East of Lakes Entrance, 30 fathoms (W. S. Ayres).

THAIDIDAE.

Dicathais vector (Thornley, 1952).

1952. *Dicathais vector* Thornley, "Marine Zoologist", Incorp. in Proc. roy. zool. Soc. N.S.W., p. 43, figs. 1a, 1b.

Size. Length 30 mm.

Locality. Off Lakes Entrance (Mrs. H. Newman).

Observations: The Victorian record is based on specimens obtained from a glass fishing float. The type with others was found on a log of Silky Oak at Hawkes Nest Beach, New South Wales.

COLUMBELLIDAE.

Dentimitrella axiaerata (Verco, 1910).

1910. *Pyrene axiaerata* Verco, Trans. roy. Soc. S. Aust., XXXIV., p. 129, pl. 29, fig. 4.
1921. May, Check List Moll. Tas., p. 83.
1923. May, Ill. Index Shells, Tas., pl. 38, fig. 21.
1955. *Zemitrella axiaerata* Kershaw, Proc. roy. Soc. Tas., LXXXIX., p. 316.
1958. *Dentimitrella axiaerata* Macpherson, May's Ill. Index Tas. Shells, Revision, pl. 38, fig. 21.

Size. Length 10·4 mm., breadth 3·7 mm.

Locality. 20 fathoms off Lakes Entrance (W. S. Ayres).

Observations: A species easily identified by the very elate spire and pinkish apex which is a fairly constant feature. The amber-coloured axial bands referred to in the original description show much variation which is evident in both Victorian and Twofold Bay examples, and from each of these localities appear specimens absolutely devoid of this ornamentation.

BUCCINIDAE.

Cominella kingicola (Tate & May, 1900).

1900. *Cantharus kingicola* Tate and May Trans. roy. Soc. S. Aust. XXIV., p. 91.
1901. *Cominella kingicola* May, Check List Moll. Tas., p. 80.
1923. May, Ill. Index Tas. Shells, pl. 38, fig. 2.
1955. Kershaw, Proc. roy. Soc. Tas., LXXXIX., p. 316.
1958. Macpherson, May's Ill. Index Tas. Shells, Revision, pl. 38, fig. 2.

Size of Type. Length 18 mm., breadth 9 mm.

Locality. Queenscliff (Taken alive, R. Burn).

Observations: A solid, whitish, fusiformly-oval shell bearing well developed longitudinal ribs which are crossed by fairly regular spiral lirae. Originally described from King Island, Bass Strait.

NASSIDAE.

Radulphus royanus (Iredale, 1924).

1924. *Radulphus royanus* Iredale, Proc. Linn. Soc. N.S.W., XLIX., Pt. 3, p. 270, pl. 34, fig. 8.

Size: Length 15 mm., breadth 7 mm.

Locality. 20 fathoms off Lakes Entrance (W. S. Ayres).

Observations: Dredged in Disaster Bay and Twofold Bay, N.S.W., 10–25 fathoms, it is the type of the genus *Radulphus*.

Reticunassa compacta (Angas, 1865).

1865. *Nassa compacta* Angas, Proc. zool. Soc. Lond., p. 154.
1887. *Nassa* (*Hima*) *tringa* Gatliff (non Souverbie, 1864) Field Nat. Club Vic., p. 2.
1898. *Nassa rufocincta* Pritchard and Gatliff (non Angas, 1851). Proc. roy. Soc. Vic., X., (N.S.), Pt. 11, p. 279.
1918. *Nassarius pauperus* Hedley (non Gould, 1850), J. roy. Soc. N.S.W., 51, (for 1917), p. M.88
1921. May, Check List Moll. Tas., p. 82.
1923. May, Ill. Index Tas. Shells, pl. 38, fig. 14.
1951. *Reticunassa paupera* Macpherson and Chapple (non Gould), Mem. Nat. Mus. Vict., XVII., p. 132.
1955. Cotton, Proc. roy. Soc. S.A., Mal. Sect.
1955. Kershaw, Proc. roy. Soc. Tas., LXXXIX., p. 317.
1958. Macpherson, May's Ill. Index Tas. Shells, Revision, pl. 38, fig. 14.

For many years this species was known as *N. rufocincta* A. Adams (loc. cit.) from Honduras; but from the description and locality it is hard to reconcile our shell as being that species and Australian Conchologists, now accept it as a mis-identification. It was recorded in the first Victorian list of Marine Mollusca by J. H. Gatliff (loc. cit.) as *Nassa* (*Hima*) *tringa* Souverbie with *compacta* Angas, 1865, and *rufocincta* A. Adams, 1867 as synonyms. Pritchard and Gatliff in their catalogue of Marine Shells of Victoria (loc. cit.) selected *rufocincta* A. Adams, 1851, as the correct appellation and included *N. tringa* Souverbie and *N. compacta* Angas in the synonymy. Hedley (loc. cit.) adopted *Nassarius pauperus* Gould for the New South Wales shells, and May (loc. cit.) used *N. tringa* Souverbie with *N. compacta* Angas and *N. rufocincta* Angas as synonyms. From the above, these Molluscs appear to be in a tangled condition, and the present writer is convinced that *rufocincta* A. Adams may be discarded as non-Australian, and that an error exists in lumping the two species *paupera* Gould and *compacta* Angas both of which appear in the Peronian region. The whorls of the former are ornamented with concentric ridges, the body-whorl possessing about ten, between which appear 8–10 microscopic concentric threads and about sixteen prominent longitudinal ribs while the latter is lacking the microscopic spiral threads.

Reticunassa compacta benthalis Subspecies Nov.

Plate Figure 1.

Shell small, rather solid, creamy with bands of darker colouration on the spire whorls, one above and one below the suture with three very distinct ones on the body-whorl, the third just below the periphery; the colour is not constant, some specimens being almost uniform white. Whorls six including a 2½ coiled protoconch. Sculpture showing well developed longitudinal ribs, about twenty

appearing on the ultimate whorl; surface further ornamented with numerous microscopic longitudinal threads over and between the radial ribs. Aperture ovate, colour bands easily discernible from within; outer lip varixed bearing numerous fine denticles near the inner edge.

Size: Length 8 mm., breadth 4 mm.

Localities. 65 fathoms off Cape Everard (type locality) (N. Buckland); off Lakes Entrance 20 fathoms (W. S. Ayres).

Reg. No. Holotype F.20838. Paratype F.20839.

Observations: This shell belongs with *compacta* but its closer radials and more numerous concentric ridges present a much finer latticed appearance worthy of subspecific distinction and *benthalis* is here proposed.

OLIVIDAE.

Belloliva brazieri (Angas, 1877).

1877. *Olivella brazieri* Angas, Proc. zool. Soc. Lond., p. 172, pl. 26, fig. 6.
1918. *Olivella leucozona brazieri* Angas, Hedley, J. roy. Soc. N.S.W., LI., (for 1917), p. M.74.
1922. *Belloliva brazieri* Angas, Peile, Proc. Malacol. Soc. Lond., XV., Pt. 1, p. 18, fig. 7 (radula).
1924. Iredale, Proc. Linn. Soc. N.S.W., XLIX., Pt. 3, p. 259.

Size. Length 12·5 mm., breadth 5 mm.

Locality. 20 fathoms off Lakes Entrance (W. S. Ayres).

Observations: Peile (loc. cit.) discusses the radula of *brazieri* when erecting his new genus *Belloliva* making this species the type. The shell is not common in Victoria but is recorded from several localities in New South Wales.

Alocospira fusiformis (Petterd, 1886).

1886. *Ancillaria fusiformis* Petterd, Proc. roy. Soc. Tas., (for 1885), p. 342.
1899. *Ancilla petterdi* Pritchard & Gatliff (non Tate), Proc. roy. Soc. Vict., XI., (New Series), p. 196.
1924. *Baryspira fusiformis,* Iredale, Proc. Linn. Soc. N.S.W., XLIX., Pt. 3, p. 261, pl. 36, fig. 10.

Size. Length 20 mm., breadth 9 mm.

Localities. Apollo Bay; dredged off Portsea, Port Phillip (Self); off Gabo Island (T. Iredale); 20 fathoms off Lakes Entrance (W. S. Ayres).

Observations: This species shows considerable variation in breadth and callus, the broader, more heavily calloused shells have been mistakenly identified in Victoria by Pritchard and Gatliff (loc. cit.) as *A. petterdi* (Tate, 1893). However, a series shows them to intergrade and two specimens of the true *petterdi* Tate in the Nat. Mus. Vic. collection confirms Iredale's 1924 recognition of it as a distinct species. With its peculiar fusiform shape and chestnut colour, no difficulty should be experienced in distinguishing the shell.

Alocospira gaza (Iredale, 1924).

1924. *Baryspira fusiformis gaza* Iredale, Proc. Linn. Soc. N.S.W., XLIX., Part 3, p. 261, pl. 36, fig. 9.

Size: Length 18·4 mm., breadth 6·7 mm.

Localities. 30 fathoms off Lakes Entrance (W. S. Ayres); off Cape Everard 65 fathoms (N. Buckland).

Observations: I agree with the author that it is an elongate form and with this feature, so consistent in the specimens before me, it is regarded as worthy of specific rank.

MITRIDAE.

Eumitra prosphora (Iredale, 1922).

1922. *Mitra solida* Peile (non Reeve), Proc. Malacol. Soc. Lond., XV., p. 93, fig. 1, (in text), radula.

1929. *Vicimitra prosphora* Iredale, Proc. roy. Zool. Soc. N.S.W., p. 343, pl. 38, fig. 17.

1951. *Mitra* (*Vicimitra*) *prosphora* Laseron, Rec. Aust. Mus., XXII., No. 4, p. 341, fig. 11 (protoconch).

Size: Length 27 mm., breadth 11 mm.

Locality. 20 fathoms off Lakes Entrance (W. S. Ayres).

Observations: A solid, brown shell, sometimes with occasional splashes of white. It is apparently smooth, but under lens the whole surface shows a distinct, concentric, punctate grooving. Type locality is Twofold Bay (10 fathoms). Previously known as *Mitra solida* Reeve, 1884, under which name the radula was figured as above. It is the type of the genus *Vicimitra* Iredale which is now placed in the synonymy of *Eumitra* Tate, 1889.

Eumitra perksi (Verco, 1908).

1908. *Mitra perksi* Verco, Cat. Mar. Moll. S. Aust., p. 13.

1932. Cotton and Godfrey, S. Aust. Nat., XIII., p. 77.

1957. *Vicimitra perksi* Cotton, Trans. roy. Soc. S. Aust. (Mal. Sect.) p. 3, fig. 4,

Size of Type: 21·5 mm., breadth 8 mm.

Localities. Portland (W. H. Dillon); Port Phillip, (G. B. Pritchard).

Observations: In beach-worn specimens the shell is shining white, but in living condition invested in a yellowish-brown periostracum. Surface with extremely fine radial striae and fairly regular, concentric incised lines of tiny punctations. Columella normally with four plaits, occasionally five.

Austromitra bucklandi Sp. Nov.

Pl. Fig. 6–7.

Shell small, fusiformly-turreted, spire acuminate, whorls eight including a two-whorl protoconch, the first whorl dome-shaped. Longitudinal sculpture predominates, consisting of shining, straight, rounded ribs which fade as they approach the anterior end. The shell is further ornamented with numerous, fine microscopic spiral lirae which appear in the interstices and even cross the radial costae, and are a little narrower than the interstices, about sixteen appearing on the penultimate whorl. The colour is creamy-white with bands of light brown, and a darker brown more or less disconnected band appearing near the periphery. Aperture narrow, colour bands discernible from within; outer lip acute and finely crenulate; columella quadriplicate, the folds being conspicuously very oblique, and much lighter in colour.

Size of Holotype: Length 15·4 mm., breadth 6·5 mm., aperture 7 mm.

Localities. Dredged in Twofold Bay, New South Wales 10 fathoms (type locality) (N. Buckland), one specimen 20 fathoms off Lakes Entrance, Victoria (W. S. Ayres).

Holotype Reg. No. F.20727. Two Paratypes Reg. No. F.20728.

Observations: An elegant shell by no means rare, it is astonishing to think so conspicuous a form has escaped notice for so long. It is readily distinguished by its peculiar brown colour pattern, its shouldered whorls and uniform, shining longitudinal costae, and four columella plaits.

Named after the discoverer, Mr. N. Buckland, Eden, New South Wales.

From fifteen fathoms, 18 miles East of Lakes Entrance, Victoria (W.S. Ayres) appeared another form of this genus, narrower and much lighter in colour, with similar facies to the above, but in the opinion of the writer, not sufficiently distinct to warrant a specific name, and it is here proposed to recognize it as *Austromitra bucklandi bassiana.*

Size of Holotype. Length 13·7 mm., breadth 5·9 mm., aperture 6·1 mm.

Holotype Reg. No. F.20729. Two Paratypes Reg. No. F.20730.

HARPIDAE.

Austroharpa exquisita (Iredale, 1931).

1931. *Palamharpa exquisita* Iredale, Rec. Aust. Mus., XVIII., No. 4, p. 230 pl. 22, fig. 8.

Size of Holotype: Length 24 mm., breadth 14 mm.

Locality: Off Lake Tyers (W. S. Ayres).

Observations: Recognized by its harpiform shape and characteristic latticed ornament.

It is the sole living representative of the genus.

VOLUTIDAE.

Microvoluta australis (Angas, 1877).

1877. *Microvoluta australis* Angas, Proc. zool Soc. Lond., p. 35, pl. 5, fig. 2.
1882. Brazier, Ann. Rept. Aust. Mus., for 1881, p. 20, 21.
1882. Tryon, Manual Conch., IV., p. 105, pl. 31, figs. 151, 152.
1887. *Voluta minima* Sowerby, Thes. Conch., p. 300, pl. 515, figs. 152, 152A.
1903. *Microvoluta australis* Hedley, Mem. Aust. Mus., IV., p. 371.
1922. Peile, Proc. Malacol. Soc. Lond., XV., Pt. 1, p. 18, fig. 8 (radula).

Size: Length 10 mm., breadth 3·5 mm.

Locality. 20 fathoms off Lakes Entrance (W. S. Ayres).

Observations: The species appears all along the New South Wales coast.

Microvoluta royana (Iredale, 1924).

1924. *Microvoluta royana* Iredale Proc. Linn. Soc. N.S.W., XLIX., Pt. 3, p. 269, pl. 35, fig. 13

Size of Type: Length 9·5 mm., breadth 4 mm., length of aperture 4·5 mm.

Locality. 15 miles South-East of Lakes Entrance. 25 fathoms (W. S. Ayres).

Observations: A deeper water relation of *M. australis,* differing in the longer spire and complex sculpture.

CANCELLARIIDAE.

Microsveltia recessa (Iredale, 1925).

1925. *Microsveltia recessa* Iredale, Rec. Aust. Mus., XIV., No. 4, p. 265, pl. 43, fig. 16.
1955. Laseron, Rec. Aust. Mus., XXIII, No. 5, p. 271, fig. 11.

Size: Length 6 mm., breadth 3·5 mm.

Locality. 65 fathoms off Cape Everard (N. Buckland).

Observations: The type locality is 70 fathoms off Bateman's Bay.

MARGINELLIDAE.

Austroginella vercoi (May, 1911).

1911. *Marginella vercoi* May, Proc. roy. Soc. Tas., p. 385, pl. 13, fig. 7.
1955. Kershaw, Proc. roy. Soc. Tas., LXXXIX., p. 318 Group A.
1957. *Austroginella vercoi* Laseron, Aust. Journ. Mar. and F. Water Research, VIII., No. 3, p. 285.
1958. Macpherson, May's Ill. Index Tas. Shells, Revision, pl. 35, fig. 21.

Size: Length 5·5 mm., breadth 5 mm.

Locality. 65 fathoms off Cape Everard (N. Buckland).

Observations: A shining, pyriform, broadly-shouldered species, with the labrum faintly denticled on the inner edge. Identified by comparison with paratypes from the author. Its range of distribution is Tasmania through Bass Strait to South Australia where it was obtained originally in deep water by Verco.

Mesoginella turbinata pusilla (Laseron, 1948).

1948. *Marginella turbinata* Sowerby *pusilla* Laseron, Rec. Aust. Mus., XXII., No. 1, p. 37, pl. 5, fig. 2.

Size: Length 6·5 mm.

Localities. Off Gabo Island (T. Iredale); 20 fathoms off Lakes Entrance (W. S. Ayres).

Observations: Smaller and broader than *M. turbinata* Sowerby, 1846 with the ribbing a little more pronounced. Type locality Twofold Bay, New South Wales.

Mesoginella pattisoni (Cotton, 1944).

1944. *Marginella pattisoni* Cotton, S. Aust. Nat., XXII., No. 4, p. 11, Group B. fig. 10.

1949. Rec. S. Aust. Mus. IX., p. 203, Group B.

Size of Type: Height 9 mm., Diam. 6 mm.

Locality. 20 fathoms off Lakes Entrance (W. S. Ayres).

Observations: Type from Encounter Bay, South Australia. The Lakes Entrance specimens obtained in living condition were compared with the type of *pattisoni* in the South Australian Museum by J. H. Macpherson. They certainly represent that species though differing by having a similar cream colour as typical *turbinata;* however they differ from the latter in the stronger, more pyriform shell, with fewer and more definite plications.

Cryptospira binivitta (Laseron, 1948).

1948. *Marginella binivitta* Laseron, Rec. Aust. Mus., XXII., No. 1, p. 39, pl. 5, fig. 11.

Size of Type: Length, 6·5 mm.

Localities. 20 miles off Lakes Entrance (W. S. Ayres). 65 miles off Cape Everard (N. Buckland).

Observations: The type locality is Jervis Bay, New South Wales, (15 fathoms), taken on a pure sandy sea-bed. The colour-bands serve as a useful recognition mark.

Sinuginella pipire (Laseron, 1948).

1948. *Marginella pipire,* Laseron, Rec. Aust. Mus., XXII., No. 1, p. 38, pl. 5, fig. 8.

Size of Type: Length 3·5 mm.

Locality. 25 miles South-East of Lakes Entrance, 30 fathoms (W. S. Ayres).

Observations: A pure white species somewhat resembling *M. schoutanica* May, the distinguishing feature being its longer spire.

Longinella kemblensis, (Hedley, 1903).

1903. *Marginella kemblensis* Hedley, Mem. Aust. Mus., IV., Part 6, p. 365, fig. 88 (in text).
1921. May, Check List Moll. Tas., p. 71.
1923. May, Ill. Index Tas. Shells, pl. 31, fig. 16.
1944. Cotton, S. Aust. Nat., XXII., No. 4, p. 204, Group B. fig. 14.
1948. Laseron, Rec. Aust. Mus., XXII., No. 1, pl. 6, fig. 27.
1949. Cotton, Rec. S. Aust. Mus., IX., p. 204, pl. 20, Group C.
1955. Kershaw, Proc. roy. Soc. Tas., LXXXIX., p. 319, Group C.
1958. *Longinella kemblensis* Macpherson, May's Ill. Index Tas. Shells, Revision, pl. 31, fig. 16.

Size of Type: Length, 5·2 mm., breadth, 2 mm.

Locality. Dredged off Wilson's Promontory.

Observations: This species is white, but Cotton (loc. cit.) refers to specimens which are faintly banded with pale-brown.

Longinella everardensis Sp. Nov.

Pl. , Fig. 5

Shell white, shining, biconical, with a prominent spire; apex blunt; whorls four; aperture more than twice the length of the shell, narrow but widening at the anterior end, outer lip thickened bearing numerous, faint irregular denticles; columella fairly straight with four oblique folds.

Size of Holotype: Length 6·2 mm., breadth 3 mm.

Locality. 65 fathoms off Cape Everard (N. Buckland).

Holotype Reg. No. F.20830. Paratype Reg. No. F.20831. (fractured).

Observations: This species may possibly be confused with the Tasmanian *Marginella dentiens* May, 1911, but its more biconic shape readily separates it from that species.

Triginella malinoides Sp. Nov.

Pl. Figs. 3-4.

Shell small, strong, white, shining, subtrigonal with the apex barely visible above the rather flat summit. Aperture slightly curved almost extending as long as the shell. Outer lip arched above the summit, well developed and faintly denticled at the inner margin. Columella bearing four weak, oblique plaits.

Size: Length 3 mm., breadth 2·2 mm.

Radula (fig. 4) has a small broad centre tooth with a fine serrated cutting edge; a single pair of large lateral cusps also with a serrated cutting edge and a series of simple marginals.

Locality. 65 fathoms off Cape Everard. (N. Buckland).

Holotype. Reg. No. F.20832. Paratype F.20833.

Observations: The genus *Triginella* was erected by Laseron in 1957, Aust. Journ. Mar. and F. Water Research VIII., No. 3, p. 280 with *Marginella malina* Hedley, 1915, as type. This second representative of the genus should be readily separated by its more triangular form.

Volvarinella mayii (Tate, 1900).

1900. *Marginella mayii* Tate, Trans. roy. Soc. S. Aust., XXIV., p. 93.
1901. Tate and May, Proc. Linn. Soc. N.S.W., XXVI., p. 362, pl. 27, fig. 84.
1921. May, Check List Moll. Tas., p. 71.
1923. May, Ill. Index Tas. Shells, pl. 31, fig. 13.
1948. Laseron, Rec. Aust. Mus., XXII., No. 1, p.43, pl. 6, fig. 28.
1949. Cotton, Rec. S. Aust. Mus., p. 204, pl. 20, Group C.
1955. Kershaw, Proc. roy. Soc. Tas., LXXXIX, p. 319, Group C.
1958. *Volvarinella mayii* Macpherson, May's Ill. Index Tas. Shells, Revision, pl. 31, fig. 13.

Size of Type: Length, 12 mm., length of aperture 9 mm., breadth 6 mm.

Locality. 15 fathoms off Lakes Entrance (W. S. Ayres).

Observations: When in living condition, it is recognized by its chestnut-brown colour, with two darker-coloured bands on the body whorl and a very much lighter and narrower one at the sutures. Its range of distribution is Tasmania, New South Wales through Bass Strait to South Australia.

Volvarinella difficilis Sp. Nov.

Plate , fig. 2

Shell small, strong, shining white, biconic; apex blunt. Spire about one third the length of shell. Aperture fairly wide, slightly longer than the spire; columella barely arched, with four, erect obliquely-ascending plications, the last about the centre of the mouth; outer lip with strong external varix, slightly denticulated at the inner edge.

Size: Length 5 mm., breadth 2·5 mm.

Locality: 65 fathoms off Cape Everard Nat. Mus. (N. Buckland).

Reg. No. Holotype F.20834.

Observations: A strong, shining-white species which appears to belong in Laseron's genus *Volvarinella* (*loc. cit.*). The type of *Volvarinella* is *makiyamai* Habe, 1951.

Pillarginella Gen. Nov.

Shell medium size, elongate, subcylindrical; whorls four with a slight elevation of the spire; aperture narrow, columella bearing three, strong, oblique plaits; outer-lip moderately strong but not denticulate within.

Type species *Marginella columnaria* Hedley & May, 1908.

Pillarginella columnaria (Hedley & May, 1908).

1908. *Marginella columnaria* Hedley & May, Rec. Aust. Mus., VII., p. 120, pl. 23, fig. 19.
1908. Verco. Trans. roy. Soc. S. Aust. XXXII., p. 345.
1917. Tomlin, Proc. Malacol. Soc. Lond., XII., Pt. V., p. 259.
1921. May, Check List Moll. Tas., p. 70.
1922. Gatliff and Gabriel, Proc. roy. Soc. Vict., XXXIV., (N.S.), p. 137.
1923. May Ill. Index Tas. Shells, pl. 32, fig. 7.
1951. Macpherson and Chapple, Mem. Nat. Mus. Vict., XVII., p. 134.
1955. Kershaw, Proc. roy. Soc. Tas., LXXXIX., p. 319, Group F.
1958. *Haloginella columnaria* Macpherson, May's Ill. Index Tas. Shells, Revision, pl. 32, fig. 7.

Size: Length 7·5 mm., breadth 3·5 mm.

Locality. 25 miles South-East of Lakes Entrance, 30 fathoms (W. S. Ayres).

Observations: Type locality 100 fathoms off Cape Pillar, Tasmania, occurring also in Bass Strait through to South Australia.

TURRIDAE.

Epidirella tasmanica (May, 1911).

1911. *Hemipleurotoma tasmanica* May, Proc. roy. Soc. Tas., for 1910, p. 391, pl. 14, fig. 16.
1918. *Epideira xanthophaes* Hedley (non Watson) J. roy. Soc. N.S.W., for 1917, p. M.82.
1922. Hedley (non Watson), Rec. Aust. Mus. XIII., No. 6, p. 231.
1931. *Epidirella tasmanica* Iredale, Rec. Aust. Mus., XVIII., No. 4, p. 226.
1954. *Austrogemmula tasmanica* Laseron, Proc. roy. zool. Soc. N.S.W. p. 7, pl. 1, figs. 8, 9.
1955. *Epidirella tasmanica* Kershaw, Proc. roy. Soc. Tas., 89, p. 319.
1958. *Epiderella tasmanica* Macpherson, May's Ill. Index Tas. Shells, Revision, pl. 34, fig. 18.

Size: Length 21 mm., breadth 8 mm., length of aperture 9 mm.

Locality: 20 fathoms off Lakes Entrance (W. S. Ayres).

Observations: This is the Type species of *Epidirella* Iredale 1931.

Epidirona molleri Laseron, 1954.

1954. *Epidirona molleri* Laseron, Proc. roy. Zool. Soc. N.S.W., p. 11, pl. 2, figs. 31, 32.

Size: Length 16 mm., breadth 6·2 mm., aperture 6 mm.

Locality. 20 fathoms off Lakes Entrance (W. S. Ayres).

Observations: A shell of medium size very close to *E. carinata* Laseron, 1954, and in the absence of a long series would have been taken as a variety of that species if it had not been for the different protoconch. First recorded from Crowdy Head, N.S.W. and since taken at 60 fathoms off Eden, N.S.W.

Vexitomina garrardi Laseron, 1954.

1954. *Vexitomina garrardi* Laseron, Proc. roy. Zool. Soc. N.S.W., p. 13, pl. 2, figs. 42, 43.

Size: Length 25 mm., breadth 7·5 mm., aperture 9 mm.

Locality: 20 fathoms off Lakes Entrance (W. S. Ayres).

Mitrithara axiscalpta (Verco, 1909).

1909. *Mitromorpha alba* Petterd *axiscalpta* Verco, Proc. roy. Soc. S. Aust., XXXIII., p. 329.

1922. *Mitrithara axiscalpta* Hedley, Rec. Aust. Mus., XIII., No. 6, p. 234.

Size: Length 6 mm., breadth 3 mm.

Locality. 6 miles South of Lakes Entrance on seaweed (W. S. Ayres).

Observations: It has the shape of *M. alba* (Petterd, 1879), but has crowded axial incisions granulating the spirals. It has also three spiral rows of small, square brown spots on the body-whorl. I concur with Hedley in regarding these features as of specific distinction. Type locality, off Cape Borda, South Australia dredged in 55 fathoms.

Mitrithara macphersonae Gabriel, 1956.

1956. *Mitrithara macphersonae* Gabriel, Mem. Nat. Mus. Vict., No. 22, Part 4, p. 3.

Size of Type: Length 5·02 mm., breadth 2·75 mm.

Locality: 25 miles South East of Lakes Entrance. 30 fathoms (W. S. Ayres).

Mitrithara bassiana Gabriel, 1956.

1956. *Mitrithara bassiana* Gabriel, Mem. Nat. Mus. Vict., No. 22, Part 4, p. 4, fig. 2 (in text).

Size of Type: Length 7·75 mm., breadth 3·48 mm.

Locality: 25 miles South East of Lakes Entrance 30 fathoms (W. S. Ayres).

Etrema levicosta Laseron, 1954.

1954. *Etrema levicosta* Laseron, Proc. roy. zool. Soc. N.S.W., p. 27, pl. 6, figs. 127, 128.

Size of Type: Length 14 mm., breadth 4 mm., aperture 4·5 mm.

Locality: 20 fathoms off Lakes Entrance (W. S. Ayres).

Observations: Its nearest ally in Victoria is the common *E. denseplicata* (Dunker, 1871), from which it may be distinguished by its weaker sculpture and more attenuate form. It is recorded from 30-35 fathoms off Port Stephens and 10 fathoms off Twofold Bay, New South Wales.

Filodrillia mucronata Hedley, 1922.

1922. *Filodrillia mucronata* Hedley, Rec. Aus. Mus., XIII., No. 6, p. 222, pl. 42, fig. 8.
1954. Hedley, Proc. roy. Zool. Soc. N.S.W., p. 23, pl. 5, figs. 97-99.

Size of Type: Length 9·5 mm., breadth 3·5 mm.

Locality: 20 fathoms off Lakes Entrance (W. S. Ayres).

Observations: Its nearest ally is perhaps *F. tricarinata* (T. Woods, 1878) but its narrower protoconch and finer, more numerous spirals immediately separate it.

Paracuneus spadix tumulus Laseron, 1954.

1954. *Paracuneus spadix tumulus* Laseron, Proc. roy. Zool. Soc., N.S.W., p. 14, pl. 3, figs. 54, 55.

Size: Length 15 mm., breadth 6 mm., aperture 6 mm.

Locality: 20 fathoms off Lakes Entrance (W. S. Ayres).

Observations: Variation exists in the size of the tubercles of Victorian specimens.

Paraguraleus emina (Hedley, 1905).

1905. *Mangelia emina* Hedley, Rec. Aust. Mus., VI., p. 53, fig. 20 (in text).
1918. *Guraleus kingensis* Petterd *emina* Hedley, J. roy. Soc. N.S.W., for 1917, p. M.80.
1921. May, Check List Moll. Tas., p. 75.
1922. Rec. Aust. Mus., XIII., No. 6, p. 317, fig. 8, (in text).
1954. *Paraguraleus emina* Laseron, Proc. roy. Zool. Soc. N.S.W., p. 38, pl. 8, figs. 161, 162.

Size: Length 11 mm., breadth 4·5 mm.

Locality: 20 fathoms off Lake Entrance (W. S. Ayres).

Observations: In 1918 (loc. cit.) Hedley relegated *emina* to a variety of *G. kingensis* (Petterd, 1879), and later (1922) in his monograph included it again as a variety under the genus *Guraleus,* remarking " In this variety the shell is more fusiform, the ribs more prominent and numerous and the spirals wider spaced ". Not subscribing to the conviction that these differences are merely varietal, Laseron raises the shell to specific rank under genus *Paraguraleus* a decision with which the present writer entirely concurs. The shell occurs throughout the whole Peronian Province.

TEREBRIDAE.

Pervicacia assecla Iredale, 1924.

1924. *Pervicacia assecla* Iredale, Proc. Linn. Soc. N.S.W., Part 3, p. 263, pl. 36, fig. 16.

Size: Length 28 mm., breadth 9 mm.

Locality: Off Lakes Entrance, 20 fathoms (W. S. Ayres).

ACTEONIDAE.

Acteon retusus Verco, 1907.

1907. *Actaeon retusus Verco*, Trans. roy. Soc. S. Aust., XXXI., p. 309, pl. 29, fig. 12.
1921. *Acteon retusus* Verco, May, Check List Moll. Tas., p. 97.
1923. May, Ill. Index Tas. Shells., pl. 44, fig. 1.
1955. *Actaeon retusus* Kershaw, Proc. roy. Soc. Tas., LXXXIX., p. 321.
1958. Macpherson, May's Ill. Index Tas. Shells, Revision, pl. 44, fig. 1.

Size: Length 9·4 mm., breadth 6·1 mm.

Localities: 20 fathoms off Lakes Entrance (W. S. Ayres). 65 fathoms off Cape Everard (N. Buckland).

Pupa nivea (Angas, 1871).

1871. *Buccinulus nivea* Angas, Proc. zool Soc. Lond., p. 19, pl. 1, fig. 27.
1886. *Actaeon (Buccinulus) niveus* Watson, "Chall. Zool," XV., p. 630, No. 10.
1893. *Solidula nivea* Tryon, Manual Conch., XV., p. 146, pl. 20A., fig. 62.
1918. *Pupa nivea* Hedley, J. roy. Soc. N.S.W., LI., for 1917. p. M.96.
1936. Iredale, Rec. Aust. Mus., XIX., No. 5, p. 329.

Size: Length 12·5 mm., breadth 4·7 mm.

Locality: 20 fathoms off Lakes Entrance (W. S. Ayres).

Observations: Not uncommon on the New South Wales coast.

Pupa tragulata Iredale, 1936.

1936. *Pupa tragulata* Iredale Rec. Aust. Mus., XIX., No. 5, p. 331, pl. 24, fig. 23.

Size: Length 10 mm., breadth 5·5 mm.

Locality: 65 fathoms off Cape Everard. (N. Buckland).

Observations: Its nearest ally is perhaps *P. nivea* Angas, but is easily separated by its more squat form and like that species appears all along the continental shelf.

SCAPHANDRIDAE.

Cylichnella thetidis (Hedley, 1903).

1903. *Cylichna thetidis* Hedley, Mem. Aust. Mus., IV., p. 395, fig. 111.
1938. Cotton and Godfrey, Mal. Soc. S. Aust., S. Aust. Nat. p. 33.

Size of Type: Length 11·5 mm., breadth 4·5 mm.

Locality: 18 miles east of Lakes Entrance 20 fathoms (W. S. Ayres); Western Port (Self).

UMBRACULIDAE.

Umbraculum sinicum (Gmelin, 1791).

1791. *Patella sinica* Gmelin, Syst. Nat., p. 3705.
1791. *Patella umbellata* Gmelin, Syst. Nat., p. 3705.
1801. *Acardo umbella* Lamarck, Syst. Anim. s. Vert., p. 130.
1811. *Acardo orbicularis* Muhlfeld, Der Gesellschaft Naturforsch, V., p. 63.
1817. *Umbraculum chinense* Schumacher, Essai d'un Nouv. Syst. Vers. Test., p. 178.
1819. *Umbrella indica* Lamarck, Anim. & Vert., VI., p. 343.
1819. *Umbrella mediterranea* Lamarck, ibid., p. 343.
1825. *Gastroplax tuberculosus* Blainville, Dict., Sci. Nat., XVIII., p. 177.
1843. *Umbrella lamarckiana* Recluz, Revue Zoologique, p. 109.
1854. *Operculum pictum* A. Adams, Proc. zool. Soc. Lond., p. 137.
1856. *Umbrella ovalis* Carpenter, Proc. zool. Soc. Lond., p. 161.
1863. *Umbrella cumingi,* Deshayes, Moll. de Illes Reunion, p. 52, pl. 8, figs. 4, 5.
1867. *Operculum aurantium* Pease, Amer. J. Conch., III., p. 287.
1875. *Operculum bermudense* Morch, Malak. Blatt., XXII., p. 179.
1880. *Umbrella plicatula* Martens, Conchologische Mittherlungen, I., p. 104, pl. 20, figs. 1-3.
1923. *Umbraculum botanicum* Hedley, Proc. Linn. Soc. N.S.W., XLVIII., (3), p. 315, pl. XXXII., fig. 20.
1959. *Umbraculum sinicum* Burn, Journ. Malacol. Soc. Aust., No. 3, p. 28, text fig. a.

Size: Length 47 mm., breadth 36 mm., height 8 mm.

Localities: Off Marlo (J. Austin), 40 miles east of Lakes Entrance (E. Paddon).

Observations: The specimen from the first named locality is in excellent condition and truly represents this well known species. It is a white coloured shell, interiorly yellowish, flattish, shield-shaped, and readily identified. Burn (1959) (loc. cit.) in his " Comments on the Australian Umbraculacean Molluses " discusses the genus with *Tylodina* and supplies a key to the families and genera, setting out the various features and I fully concur in his decision as to the above synonymy and in view of this have listed it in full above. The species has a world wide distribution, and is recorded in Australia also from New South Wales and Queensland.

PELECYPODA.

LEDIDAE.

Scaeoleda hanleyi (Angas, 1873).

1873. *Leda hanleyi* Angas, Proc. zool. Soc. Lond., p. 184, pl. 20, fig. 7.
1924. *Nuculana hanleyi* Iredale, Proc. Linn. Soc. N.S.W., XLIX., Pt. 3, p. 185.
1929. *Scaeoleda hanleyi* Iredale, Rec. Aust. Mus., XVII., No. 4, p. 158.

Size: Length 23 mm., height 13 mm., breadth 9 mm.

Locality: 20 fathoms off Lakes Entrance (W. S. Ayres).

1918. *Musculus subtortus* Hedley (non Dunker) J. roy. Soc. N.S.W., for 1917, p. M.12.
1956. *Fluviolanatus amarus* Laseron, Aust. Zool., XII., Part 3, p. 274, figs. 46-49.
Size of Type: (Fig. 46) Length 12·5 mm., depth of conjoined valves 5·5 mm.
Localities: Lake Bunga (Self); Lake Tyers (W. S. Ayres); near mouth of Betka River, Mallacoota (T. H. Sarovich and C.J.G.); near Ninety Mile Beach.

Observations: As far as the writer is aware, no record of this curious Estuarine Mussel exists in Victoria; this is hard to understand as, particularly at the last named locality, it appears in quantity on weed and so is easy of access. The shell is small, fragile, and of a yellowish colour, sometimes variegated; almost rectangular, inequivalve, the right valve slightly larger overlapping and clasping the left, this character alone providing a useful identification mark. The species occurs in New South Wales, appearing in many coastal lagoons.

MYOCHAMIDAE.

Myadora royana Iredale, 1924.

1924. *Myadora royana* Iredale Proc. Linn. Soc. N.S.W., XLIX., Pt. 3, p. 201, pl. 33, figs. 5, 6.
Size of Type: Length 17 mm., depth 9 mm.
Locality: 25 miles South East of Lakes Entrance (W. S. Ayres).

Observations: Type locality, from 50-70 fathoms off Green Cape, New South Wales.

Myadora elongata May, 1915.

1915. *Myodora elongata* May, Proc. roy Soc. Tas., p. 98, pl. 8, figs. 40, 40A.
1921. *Thraciopsis elongata* May, Check List Moll. Tas., p. 13.
1923. May, Ill. Index Tas. Shells, pl. 5, fig. 8.
1938. *Myadora elongata* Cotton and Godfrey, Fauna and Flora S. Aust., Handbook Pelecypoda, p. 141, fig. 137.
1955. *Myadora elongata* Kershaw, Proc. roy Soc. Tas., LXXXIX., p. 295.
1958. *Myadora elongata* Macpherson, May's Ill. Index Tas. Shells, Revision, pl. 5, fig. 8.
Size: Length 6 mm., depth 3·5 mm.
Locality: 25 miles South East of Lakes Entrance. 30 fathoms (W. S. Ayres).

Observations: Easily separated by its elongated form from any member of the genus in Victoria. The type locality is 40 fathoms off Thouin Bay, Tasmania and its distribution is through Bass Strait to South Australia.

CRASSATELLIDAE.

Salaputium fulvidum (Angas, 1871).

1871. *Crassatella fulvida* Angas, Proc. zool. Soc. Lond., p. 20, pl. 1, fig. 32.
1918. *Crassatellites fulvidus* Hedley, J. roy. Soc. N.S.W., LI., for 1917, p. M.16.
1921. May, Check List Moll. Tas. p. 16.

Observations: A species somewhat resembling *S. crassa* (Hinds, 1843), but smaller, less obese, and with finer sculpture. Recorded from Twofold Bay, New South Wales (10 fathoms) and Caloundra, Queensland.

GLYCYMERIDAE.

Tucetilla mayi Cotton, 1910.

1910. *Glycimeris tenuicostata* Gatliff and Gabriel, (non Reeve, 1843), Proc. roy. Soc. Vict., XXIII., (N.S.), Pt. 1, p. 97.
1921. *Glycymeris tenuicostata* May (non Reeve), Check List Moll. Tas., p. 9.
1923. May, Ill. Index Tas. Shells, pl. 2, fig. 9.
1947. *Tucetilla mayi* Cotton, Rec. S. Aust. Mus., VIII., p. 659, pl. 20, figs. 18, 19.
1951. *Glycymeris tenuicostatus* Macpherson and Chapple (non Reeve), Mem. Nat. Mus. Vict., 17, p. 144.
1958. *Glycymeris mayi* Macpherson, May's Ill. Index Tas. Shells, Revision, pl. 2, fig. 9.

Size: Height 18 mm., diameter 20 mm.

Localities: Off Wilson's Promontory (Endeavour), 50 fathoms East of Lakes Entrance (W. S. Ayres).

Observations: This, as the above synonymy indicates, appears to be a case of mistaken identification. *T. mayi* is smaller, more ovate, finer sculptured, and with the hinge teeth less well developed than the North Queensland *Glycymeris tenuicostatus* (Reeve, 1843). Type locality is off Beachport (100 fathoms), and its range of distribution is from South Australia through Bass Strait to Tasmania.

TRIGONIIDAE.

Neotrigonia gemma Iredale, 1924.

1924. *Neotrigonia gemma* Iredale Proc. Linn. Soc. N.S.W., XLIX., Part 3, p. 193, pl. 33, fig. 1, pl. 35, fig. 1.

Size: Length 14 mm., breadth 14 mm.

Locality: 40 miles East of Lakes Entrance.

Observations: This is a very small form and could easily be mistaken for the juvenile example of the common *N. margaritacea* Lamarck, 1804. Also recorded from off Green Cape 50-70 fathoms, and Twofold Bay, New South Wales.

MYTILIDAE.

Fluviolanatus amarus Laseron, 1956.

1858. *Modiola subtorta* Reeve (non Dunker) Proc. zool. Soc. Lond., 1856 (1857), p. 365; Conch. Icon., X., pl. 10, fig. 57.
1867. Angas (non Dunker), Proc. zool. Soc. Lond., p. 930.

1923. May, Ill. Index Tas. Shells, pl. 6, fig. 8.
1924. *Salaputium fulvidum* Iredale, Proc. Linn. Soc. N.S.W., XLIX Pt. 3, p. 204.
1955. Kershaw, Proc. roy. Soc. Tas., LXXXIX., p. 296.
1958. *Talabrica fulvida* Macpherson, May's Ill. Index Tas. Shells, Revision, pl. 6, fig. 8.

Size: Ant.-post. 7 mm., Umbo-Vent. 6 mm.

Locality: 18 miles East of Lakes Entrance, Victoria (W. S. Ayres).

Observations: A solid, triangularly-circular shell with strong concentric ribs. Iredale (loc. cit.), makes this the type of *Salaputium*.

CARDITIDAE.

Bathycardita raouli (Angas, 1872).

1872. *Cardita raouli* Angas, Proc. zool. Soc. Lond., p. 613, pl. 42, fig. 12.
1914. Hedley, Biol. Results "Endeavour" II., p. 73.
1918. Hedley, J. roy. Soc. N.S.W., LI., for 1917, p. M.17.
1921. *Venericardia raouli* May, Check List Moll. Tas. p. 17, No. 109.
1923. May, Ill. Index Tas. Shells, pl. 7, fig. 5.
1924. *Bathycardita raouli* Iredale, Proc. Linn. Soc. N.S.W., XLIX., pt. 3, p. 205, pl. 33, figs. 11, 12.
1955. Kershaw, Proc. roy. Soc. Tas., LXXXIX., p. 297.
1958. Macpherson, May's Ill. Index Tas. Shells, Revision, pl. 7, fig. 5.

Size: Length 23 mm., breadth 10 mm.

Locality: Off Lakes Entrance (W. S. Ayres).

Observations: This, the type of the genus is not uncommon in 50 fathoms off Eden and Green Cape, New South Wales.

TELLINIDAE.

Pseudarcopagia botanica (Hedley, 1918).

1877. *Tellina decussata* Angas (non Lamarck) Proc. zool. Soc. Lond., p. 191.
1918. *Pseudarcopagia botanica* Hedley, J. roy. Soc. N.S.W., LI., (1917), p. M.27, N.N.
1919. May, Proc. roy. Soc. Tas., p. 68.
1955. Kershaw, Proc. roy Soc. Tas., LXXXIX., p. 299.
1958. Macpherson, May's Ill. Index Tas. Shells., Revision, pl. 11, fig. 7.

Size: 35 mm.

Localities: Point Leo (Mrs. J. Kerslake); Port Albert (Self).

Observations: "Smaller but proportionately longer, more compressed and more delicately sculptured than *P. victoriae* (Gatliff and Gabriel, 1914).

TEREDIDAE.

Nausitora messeli Iredale, 1932.

1932. *Nausitora messeli* Iredale, Sydney Harbour Trust Publi. p. 37, pl. 4, figs 9-12.

Size: Shell; Height 15 mm., length 15 mm.; Pallets; Length 21 mm.; Stalk; Length 1·6 mm., breadth 1·2 mm.

Localities: Brackish water Mitchell River, Bairnsdale; Mallacoota.

Observations: In his original description the author remarks " This species is referable to the group *Nausitora* in the broad sense, but the obliquity off the pallets and the fusion of the elements deserve that it be separated sub-generically as *Inequarista.*"

Bankia gabrieli Cotton, 1934.

1934. *Bankia gabrieli* Cotton, Rec. S. Aust. Mus., V., No. 2, p. 178, figs. 5-7.

1938. Cotton and Godfrey, Fauna and Flora, S. Aust. Handbook Pelecypoda, p. 297, fig. 340, (in text).

Size of Holotype: Shell; Height 7 mm., length 8·8 mm. Pallet; Length 10·5 mm. Length of Stalk only 5 mm. Width of cone in cone section 1·9 mm. The pallets of the Holotype have a small fragment broken from each end, so that the measurements of a complete paratype pallet is given here. Paratype pallet (largest specimen); Length 20·5 mm., length of stalk only 11 mm., width of cone in cone section 2·1 mm.

Localities: Middle Brighton boat slip; Lakes Entrance.

Observations: The type locality of this species is Dennekin Slip, Port Adelaide.

PLATE.

Fig. 1. *Reticunassa compacta benthalis* sp. nov., Holotype Reg. No. F.20838, 65 fathoms off Cape Everard, Victoria.

Fig. 2. *Volvarinella difficilis* sp. nov., Holotype Reg. No. F.20834; 65 fathoms off Cape Everard, Victoria.

Fig. 3. *Triginella malinoides* sp. nov., Holotype Reg. No. F.20832; 65 fathoms off Cape Everard, Victoria.

Fig. 4. *Triginella malinoides* sp. nov. radula of Holotype.

Fig. 5. *Longinella everardensis* sp. nov., Holotype Reg. No. F.20830; 65 fathoms off Cape Everard, Victoria.

Fig. 6. *Austromitra bucklandi* sp. nov., Holotype Reg. No. F.20727; Twofold Bay, N.S.W.

Fig. 7. *Austromitra bucklandi bassiana* sp. nov., Holotype Reg. No. F.20729; 18 miles East of Lakes Entrance, Victoria.

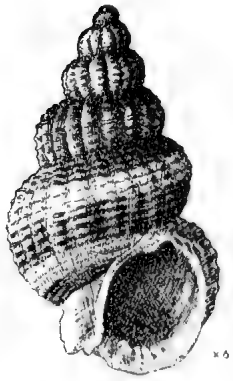
Fig. 8. *Polinices (Conuber) ayresi* sp. nov., Holotype Reg. No. F.20828; 18 miles East of Lakes Entrance, Victoria.

Fig. 9. *Polinices (Conuber) ayresi* sp. nov., radula of Holotype.

Fig. 10. *Notomella gabensis* sp. nov., Holotype Reg. No. F.20840; 50 fathoms off Gabo Island, Victoria.

Fig. 11. *Notomella gabensis* sp. nov., profile of Holotype.

Fig. 12. *Notomella gabensis* sp. nov., radula of Holotype.



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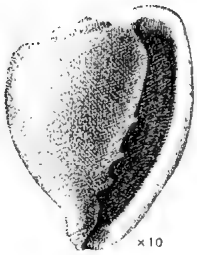

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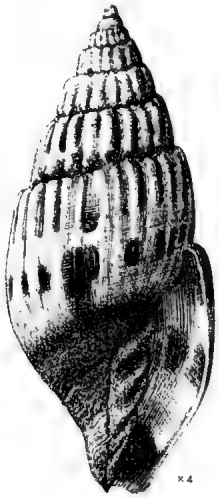

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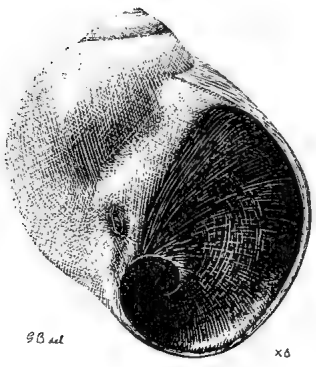

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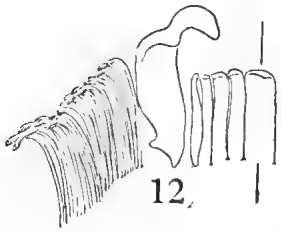

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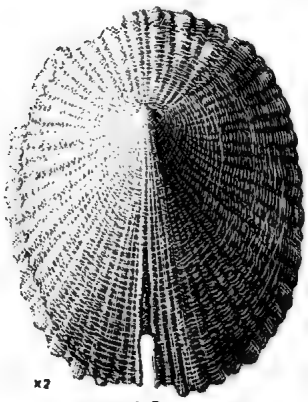

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A REVIEW OF THE *CYPRAEIDAE* GENUS *NOTOCYPRAEA*.

By R. J. Griffiths.

The genus *Notocypraea* Schilder 1927, which inhabits the seas round southern Australia, has been found an extremely difficult group to classify. The best review so far published is that of Schilder and Schilder (1938); but the amount of material available did not permit these authors to make as thorough a study as they would doubtless have wished.

The reasons for the difficulties of classification so far experienced are three-fold. Firstly, the species are conchologically separated from each other only by small differences. Secondly, there is great variation within species. Thirdly, the preference of the majority of animals for waters below the low tide line has made collection and study of living specimens difficult.

The present review began with a conchological study. The limitations of this method soon became apparent, and the approach was widened to include study of the radula. A considerable number of these was obtained both from fresh and from preserved specimens, and also from the dried remnants of animals salvaged from shells in collections. Evidence based on the appearance and behaviour of living animals and on the morphology of preserved ones has yielded important results, but, owing to scarcity of material, this line of investigation could not be followed very far.

The most useful diagnostic part of the radula was found to be its central tooth. While little subject to variation within each species, considerable differences were found between certain species. One result of the examination of radulae was proof that the three most common and best known forms, *N. angustata*, *N. comptonii* and *N. piperita,* are separate species. This had been doubted by several authors (Pritchard and Gatliff, 1900; Verco, 1918).

A further result was the discovery of several individuals with unique central radula teeth, but which, if judged solely on conchological grounds, would not have been considered to be distinct. These individuals may be freaks, or may later prove to be the first specimens so far found of new species. The specimens have been described and illustrated, but, in order to avoid a possible future swelling of the synonymy of this already over-named family, they have been referred to only by individual letters of the alphabet.

Until more is known about its morphology, classification within the genus is premature. The evidence of the radula, however, shows close relationship within two groups of species:—

(*a*) *N. cuclia, N. piperita, N. pulicaria* and *N. wilkinsi.*

(*b*) *N. comptonii* and *N. declivis.*

Variation within the species of *Notocypraea* differs considerably from that found in most other *Cypraeidae.* Most species of the latter are easy to determine conchologically, and much of their variation is attributable to the effect of different environmental conditions. Appreciable genetic differences are in some cases shown by the existence of subspecies; the areas inhabited by these subspecies are usually large.

In *Notocypraea* conchological differences within species are both more considerable and more local. Variation is neither clinal nor of conventional subspecific pattern; similar forms are often found in geographically distant areas, sometimes with different forms near-by. This variation was at first considered to be due to ecological factors, but it was later thought to be in excess of that likely to be caused by differing environments.

At this stage the author was informed of some observations made by Mr. C. F. Kurtze at Portland, Victoria. He has seen egg masses of *N. comptonii,* usually on Bryozoa, in all stages of development. The egg masses were roughly conical in shape, about 15 mm. wide at the base, and about 8 mm. high. In each case an adult was on them. In some capsules animals were seen with the oliviform shell already developed. As each young animal reached the appropriate stage of development, the case of its capsule split longitudinally, and the animal emerged and crawled away to the higher fronds of the Bryozoa. The young came out of their individual capsules over a period of several days. About sixteen were seen to come from one egg mass. These observations have been confirmed by Mr. Attorfer, Mr. Drogemuller, and Mr. Kerrison of Port MacDonnell, S.A.

Two egg masses were preserved for inspection. In several respects they differed from those of *C. caputserpentis* L. and *C. moneta L.* described by Vayssiere (1923), and from those of other *Cypraea* species seen by the author. The capsules of *Cypraea* are described by Vayssiere as about 150 to 300 in number, and each a maximum of 1½ by 1 mm. in size. The capsules of *N. comptonii* numbered not more than 50, and were ovoids about 2½ to 3 mm. long and about 1½ mm. wide. They were deep yellow in colour. Both egg masses were in their early stages of development, the capsules containing numerous minute eggs.

A likely hypothesis, supported by both Mr. Kurtze's observations and by the nature of the variation within species, is that *Notocypraea* differs from the rest of *Cypraeidae* in having no veliger larval stage. The intermixture of genes caused by the long distances travelled by free-swimming larvae plays a major part in keeping the species of *Cypraea* uniform. In *Notocypraea* this factor seems to be lacking. Differences in the genotypes of adjacent groups would accordingly be expected.

In the light of this hypothesis it would appear that most *Notocypraea* species are a synthesis of independent or semi-independent groups, many of them with dissimilar genetic constituents, and showing marked conchological differences. A great deal more collecting is needed before the geographical delineation of the species can be made clear; present knowledge is insufficient to permit the nomination of sub-species.

Notocypraea is found in one or more species of sponge in deep water, on the fronds and in holes in the stalks of Bryozoa, between the valves of dead *Pinna* shells, and under stones, rocks and rock ledges. It also lives on rock under seaweed in deep pools, and on piers and submerged wooden stumps. It is not normally found on sand. The preferred habitat is below the low tide line, and only in a few places are specimens found intertidally in considerable numbers.

The generic name *Notocypraea* was given by Schilder and Schilder in 1927, and has been accepted by later writers. Kay (1957) has, however, shown that, from the malacological point of view, *Cypraeidae* is not easily separable into genera. Conchologically, moreover, groups of species differ in an intergrading manner rather than in a clear-cut series of distinctions. The special geographic range of *Notocypraea,* as well as its likely difference in method of breeding, is enough to justify generic separation. The name *Notocypraea* is therefore retained.

Beddome (1896, 1898) named and described three varieties, *C. albata, C. mayi* and *C. subcarnea.* The first two appear to be forms of *N. angustata* and *N. comptonii* respectively. Owing to insufficient information, and to the absence of type specimens, *C. subcarnea* is less readily identifiable. In any case none of the three varieties is on present evidence worthy of specific or sub-specific rank. Beddome's names are in common use in South Australia; but the forms to which they are applied are variations of other species, and bear little resemblance to the shells described by Beddome.

The columellar teeth are large, and relatively few in number. The fossula is crossed by regular parallel teeth; often these are formed only at the top and bottom, resulting in a trough which runs along the fossula and joins the columellar sulcus.

Young Shell.—In the early oliviform stage the shell is white or very pale brown, and is crossed by four medium brown interrupted bands. When still below its maximum size the shell darkens into its adult colour, and the bands become concealed.

Animal.—Cephalic tentacles medium brown, rounded at tips. Siphon white, tinged with pale grey, unfringed at the front end, but having instead a series of serrations like the teeth of a saw. Mantle pale brown, appearing whitish-grey against the shell. No mantle papillae are apparent. Foot pale brown. There is some variation in colour, some animals being greyish-brown or even grey.

Radula.—The central tooth differs from other *Notocypraea* species by its large size and by its almost semicircular shape. There are no base cusps, their place being taken by a pair of sharp ridges which extend towards and sometimes across the bottom of the tooth. (Pl. IV., fig. 1).

Variation.—Beach shells from eastern Victoria are occasionally distinctly banded across the dorsum, the interrupted brown bands being of medium width.

Deep water specimens trawled alive off Eden, N.S.W., are of medium size. The shell has a reddish-brown dorsum crossed in the centre by two interrupted or continuous dark brown bands. In this it resembles some forms of *N. comptonii;* the shape of the fossula is here the best diagnostic point. (Pl. I., figs. 2-3).

Habitat: Under rocks and stones; in sponges and Bryozoa.

Distribution: N.S.W., south of Eden, to Gulf St. Vincent, S.A. Eastern and northern Tasmania from Cape Pillar to Cape Grim. A report of dead shells having been found in the Abrolhos Is., W. A., is probably incorrect, and is very likely based on worn specimens of *N. comptonii.*

Nomenclature: *N. angustata* was named by Gmelin in 1791, reference being made to a drawing by Gualtieri in Testarium Conchyliorum Index published in 1742. Iredale (1924) considers the description is not that of an Australian species, his grounds being that Australian shells did not reach Europe before the publication of Gualtieri's work. Since the Dutch were in Tasmania in 1642, an Australian shell could have been that illustrated by Gualtieri; his drawing and description, while not very illuminating, are as good as many referred to for other species by Linnaeus and Gmelin, and not hitherto questioned. There is thus good reason, apart from the need for continuity, for retaining Gmelin's name in place of the proposed alternative *N. verconis* Cotton and Godfrey, 1932.

Most of the specimens examined by the author came from the area between N.S.W. and Spencer Gulf. Little material from Western Australia was available. It is, however, evident that western *Notocypraea* differ in many respects from their eastern relations, and a thorough study of western specimens will very likely disclose the existence of new species and sub-species.

The geographical distributions given below for each species are based on records of shells in public and private collections, and on some localities quoted in literature. Owing to the confusion between species in most scientific papers, many of the latter references are not acceptable.

The list of species is in two parts. The first contains those which on present evidence must be considered valid species. The second describes some forms which further investigation may show to be good species, but on which our present knowledge is insufficient. Tables I.-III. contain details of shell dimensions and other measurable characters.

It only remains to emphasize that this paper is no more than a preliminary review of an extremely complex group. Study of the new material which modern methods of collecting are now providing will inevitably change the picture in many respects. This further research, will only be possible if every collector adopts a new point of view. He will have to realize that information on the animal—its habitat, appearance, structure, radula, behaviour and method of breeding—is even more important than collection of the shell. Until further knowledge of the animal is gained, little progress is likely.

This review would have been impossible without the support and advice of the authorities of the National Museum, Melbourne; to them I am most grateful. My thanks are also due to the Directors and Staffs of the Australian Museum, the South Australian Museum, the Tasmanian Museum and the Western Australian Museum. Much assistance has also been given by private collectors.

LIST OF SPECIES.

Notocypraea angustata (Gmelin, 1791).

(Plate I., figs. 1-8. Plate IV., fig. 1).

Shell.—This is longer than those of most other species of the genus, and broader and taller in proportion to length. Shell size is variable, some shells being longer and considerably more swollen than the average. The dorsum is dark brown or greyish-brown, and rarely shows any trace of dorsal bands.

Notocypraea comptonii (Gray, 1847).
(Plate I., figs. 9-21. Plate IV., fig. 2).

Shell: Usually with two continuous brown bands crossing the centre of the brown or reddish-brown dorsum; less frequently there are two additional bands, one towards the front of the shell and a less distinct one near the rear. The bands are narrow, and usually remain separate from each other over the whole width of the shell. In very dark shells these bands are sometimes hard to see. Occasional shells are piperate on the lateral part or even on the top of the dorsum. The fossular teeth are smaller than those of *N. angustata,* and are interrupted or shallowed to form a depression halfway down; the depression is deep in front and shallow where it meets the columellar sulcus. The lateral spots are smaller than those of *N. angustata.* The base of the shell is white, cream, brown or even tinged with purple.

Young Shell: Pale brown in colour, with the dorsum and sides crossed by four narrow medium brown bands composed of discontinuous small patches. (I., 9).

Animal: Pale orange or bright yellow in colour. The cephalic tentacles are rounded at the tips, and darker in colour in front. The siphon bears no fringe of papillae. The mantle has a dozen or so unbranched whitish mamilliform papillae on each side. The mantle edges sometimes meet on top and sometimes on the labial side of the dorsum.

Radula: The central is shaped like a truncated triangle. In the lower corners are two cusps, positioned obliquely with the tips pointing outwards. (Pl. IV., fig. 2).

Variation: The dorsal colour is very variable. In Western Port Bay, Victoria, and Tumby Bay, S.A., shells are very dark brown (I., 10-13), but in other places they are medium or even light brown.

Shells from below the tide level at Portland and Lakes Entrance, Victoria, and intertidally at Port MacDonnell, S.A., are often pale yellow or pale brown in colour, with the dorsal bands sometimes only faintly visible. Some Port MacDonnell shells are completely white. (Pl. I., 18 and 21).

Specimens trawled from southern N.S.W. and eastern Victoria at about 40 fathoms have straw coloured dorsums, and are narrower than shallow water specimens. They have been identified as *N. comptonii* mainly on the evidence of the radula. Later research may show them to be specifically distinct. (Pl. I., figs. 14-16).

Habitat: Intertidally, under stones. In deeper waters on and in Bryozoa and in sponges.

Distribution: Southern N.S.W., about Eden, to Abrolhos Is., W.A. Tasmania.

Notocypraea declivis (Sowerby, 1870).
(Plate II., figs. 22-27. Plate IV., fig. 3).

Shell: Fully adult specimens are recognizable by the dorsal pattern. which consists of a pale milky layer densely covered by many small brown specks. *N. declivis* differs from *N. comptonii* by its general colour being sepia rather than reddish-brown, by the more prominent pairs of terminal patches, and by its greater width and height. The close relationship between the two species is shown by some similarity in the fossular arrangement; but the teeth of *N. declivis* tend to be larger, and are more formed in the centre of the

fossula. The fossular depression is consequently less noticeable. Shells of *N. declivis* from Tasmania are darker and more heavily spotted on the dorsum than shells from western Victoria.

Young Shell: Immature shells from Tasmania (believed to be *N. declivis*) have dorsal bands recalling those of *N. comptonii.*

Radula: Resembles that of *N. comptonii* (Pl. IV., fig. 3).

Distribution: Tasmania, St. Helen's to Stanley; Carnarvon, W.A.; Flinders I., Bass Strait; Lorne, Victoria; Port MacDonnell, S.A.

Nomenclature: Iredale (1935) named a subspecies *N. d.occidentalis* from Western Australia. Of the shells in the Australian Museum labelled with this name, one is *N. pulicaria* and the others, which are piperate on the backs and have no dorsal bands visible, more nearly resemble *N. piperita* than *N. declivis.* Any further specimens put forward as *N. d.occidentalis* can easily be verified by the radula. At present evidence for a western sub-species is insufficient, and the name *occidentalis* must be considered invalid.

Remarks: The only sinistral specimen of *Cypraeidae* known to the author is in the South Australian Museum.

Notocypraea dissecta (Iredale, 1931).

(Plate II., figs. 28-23. Plate IV., fig. 4).

Shell: Subovate or somewhat cylindrical in shape, thin and light in weight, with the right side little calloused. The white or reddish-brown dorsum is crossed by up to four narrow, interrupted, evenly spaced brown bands, the centre two being the most prominent. There is no other dorsal decoration. There are usually two light brown blotches on the front end of the shell, and a stain in the deep and wide spire pit. The spots on the labial side of the shell are small, and average 20 to 30 in number; mature shells have about ten slightly larger spots on the columellar side. The base of fully-grown shells is white. The aperture is broad throughout, slightly constricted in front on the labial side, and sharply bent at the rear. The small teeth extend about halfway across the base on the labial side, but are confined to the aperture on the columellar side. The fossula is wide, deep and long, often with a very prominent lower edge which extends a considerable way out into the aperture in a manner reminiscent of *N. pulicaria.* The columellar sulcus is slight.

Young shell: Similar in colour to the adult. The bands are usually more distinct.

Radula: The central has some points in common with that of *N. piperita.* The base cusps, however, are different in form. (Pl. IV., fig. 4).

Habitat: In sponges. Usually dredged at about 40 fathoms.

Distribution: Sydney to Green Cape, N.S.W.

Remarks: The holotype is in the Australian Museum. It is 19·5 mm. long, 10·9 mm. wide and 9 mm. high, with 28 labial and 21 columellar teeth. The twenty spots on the labial side are

small; the ten on the columellar side are slightly larger. The lower edge of the fossula protudes less far out into the aperture than in most specimens examined. There are traces of the two central dorsal bands.

Notocypraea emblema Iredale, 1931.
(Plate IV., fig. 12).

Shell: The holotype in the Autralian Museum is 27·3 mm. long, 18·1 mm. wide and 15·3 mm. tall. It has 26 teeth on the labial side and 21 on the columellar side. On the labial side there are about 30 medium or large brown spots, with about ten of the same size on the opposite side. The shell is white, with no trace of dorsal bands. The labial side of the aperture is considerably constricted forward. The spire lies in a pit.

Radula: The central of the holotype is very large, and almost square in shape. It has two large base cusps which extend below the bottom edge of the tooth. (Pl. IV., fig. 12).

Remarks: Only one specimen of this species is available. It has many points in common with the holotype of *N. molleri* and with a series of specimens dredged between Green Cape and Gabo Island, and included under the latter name. It was at first proposed to lump the three groups together, but the radula of the holotype of *N. emblema* was later found to differ in shape, size and in form of basal cusps from those of the Green Cape specimens. *N. emblema* is therefore retained as a separate species.

Notocypraea euclia Steadman and Cotton, 1946.
(Plate II., figs. 34-36. Plate IV., fig. 5).

Shell: *N. euclia* differs from *N. pulicaria* by the pale cream dorsum, by the total absence of transverse dorsal bands, by the lower edge of the fossula not protruding to any great extent into the aperture, and by the lesser number of spots on the labial side. While the dorsum is usually plain, occasional specimens are decorated with faint and small light brown spots.

Radula: Resembles that of *N. piperita*. (Pl. IV., fig. 5).

Habitat: All known specimens were dredged by Sir J. Verco at depths of 100 to 116 fathoms.

Distribution: 40 to 90 miles west of Eucla, W. A.

Notocypraea molleri (Iredale, 1931).
(Plate II., figs. 37-44. Plate IV., fig. 8).

Shell: Ovate, with a tall and wide dorsum. The dorsal colour is usually pale flesh, but occasionally white. There are four fairly wide interrupted light brown dorsal bands; the central ones sometimes extend completely across the dorsum, while the end ones reach only to the top. On some shells the bands are only present well down on the left side, or are even absent altogether. There are usually two pale brown anterior terminal blotches, and often an

uneven patch of colour in the spire pit. The labial spots, usually large in size, are generally few in number; the infrequent shells with the columellar sides spotted have still fewer but equally large spots. In mature shells the base is white. The aperture is wide throughout, considerably bent at the rear, and almost unconstricted in front. The teeth are fairly big; on the labial side they extend halfway across the base, though on the columellar side they reach only just beyond the aperture. The fossula is deep, wide and long; it is formed of ridges of teeth on top and bottom, somewhat similar to many specimens of *N. angustata,* but the lower edge goes down more deeply into the shell than the lower edge of the columellar sulcus. The lower adge of the fossula extends slightly out into the aperture.

Radula: The central is almost square in shape; it sometimes has a slight protrusion on the sides. The base cusps are replaced by a pair of ridges similar to those of *N. angustata.* (Pl. IV., fig. 8).

Habitat: In sponges at about 60 fathoms.

Distribution: Off Green Cape, N.S.W., to Lakes Entrance, Victoria. Also off Stanley, North-west Tasmania.

Nomenclature: There are a number of points of similarity in the holotype of *N. molleri* and in the series of shells dredged off Green Cape and Gabo I., by Mr. Buckland. A good case could be made for separating the latter specimens under a new specific name. It is better, however, to consider them for the present as different forms of the one species, and to withhold new nomenclature until more evidence is available.

Iredale proposed the new generic name *Thelxinovum* for the species *molleri* on the grounds that the spire protrudes. While this protrusion is not common, it occurs occasionally in several other species of the genus *Notocypraea,* and is not generically significant. The name *Thelxinovum* must therefore be considered invalid.

Description of the Holotype: The holotype of *N. molleri* (Iredale), which is in the Australian Museum, is 25·5 mm. long, 15·7 mm. wide and 13·3 mm. high. It has 28 labial and 23 columellar teeth. There are about 60 small to medium spots on the labial side, and about 80 on the columellar side. The constriction on the forward end of the labial side of the aperture is slight. The spire protrudes slightly above its pit; its tip is concealed in the callus material deposited on the rear end of the shell. There are no dorsal bands visible. The side and end markings are darker than those of the shells dredged by Buckland, and the lateral spots are more numerous.

Notocypraea piperita (Gray, 1825).

(Plate III., figs. 47-59. Plate IV., fig. 7).

Shell: The dorsum is cream to light brown in colour. On it are four wide interrupted medium-brown bands; on most shells the central two join into one very wide band on top of the shell. The front and rear bands are often less prominent than the central pair. Occasional shells have bands so wide that they coalesce, obscuring most of the cream dorsum. The top and

sides of the shell are sometimes spotted ("piperate") and even occasionally reticulate, the marks being medium or dark brown. The teeth in the region of the fossula are smaller than those of *N. angustata* and more regular than those of *N. comptonii.* They are longitudinally channelled in the centre, the depression extending to form a marked columellar sulcus running the whole length of the shell. The lower part of the fossular teeth sometimes bends out to form a distinct protrusion into the aperture.

Young Shell: Not readily distinguishable from that of *N. comptonii.*

Animal: Orange. Mantle papillae elevated above mantle, and sparsely scattered over it.

Radula: The central is somewhat square in shape, and slightly narrower on top. The base cusps are situated near the centre line of the tooth, and point downwards parallel to it. (Pl. IV., fig. 7.)

Variation: Some beach shells from Mallacoota, Victoria, are broader and heavier than shells from other places.

Dorsal reticulation is more frequent in Western Australian shells. There, too, the bands are sometimes hidden.

The identification of the specimens illustrated in pl. III., figs. 57-59 is tentative. Greater knowledge of the Western Australian *Notocypraea* may show this form to be a distinct species.

Habitat: Intertidally, under stones and rocks. In sponges at 40 fathoms off Eden, N.S.W.

Distribution: From Eden, N.S.W., to Freemantle, W.A. Northern shores of Tasmania.

Nomenclature: *Cypraea bicolor* Gaskoin, 1848, is not specifically separable.

Notocypraea pulicaria (Reeve, 1846).

(Plate II., figs. 45-46. Plate IV., fig. 6).

Shell: Somewhat cylindrical in shape, shorter in length than most other *Notocypraea* species, and relatively light in weight. The pale yellow or cream-coloured dorsum is crossed by four narrow transverse bands, medium-brown in colour, consisting of distinct squarish blotches. The lower edge of the fossula usually protrudes a considerable way into the aperture of the shell. The teeth are small and numerous. The base is covered by a thin layer of white callus, occasionally thick enough to hide the coloured bands which cross the columellar side.

Young Shell: Similar in colour and banding to the adult.

Radula: Resembles that of *N. piperita.* (Pl. IV., fig. 6.)

Variation: Occasional shells have slightly wider dorsal bands, while some, perhaps not quite mature, have the lower edge of the fossula less projecting.

Habitat: Intertidally, under stones.

Distribution: Western Australia: Esperance to Freemantle.

Notocypraea wilkinsi (Griffiths, 1959).
(Plate III., figs. 60-63. Plate IV., fig. 9).

Shell: This is easily distinguished from other shallow water species by its dorsal colour, which is pale gold or pale yellow. In this it is similar to some deep-water *Notocypraea,* but it differs by the total absence of dorsal bands, even in the one oliviform shell so far found. Most shells are without lateral spots; when present, as in the holotype, they are very small. The fossular arrangement is somewhat reminiscent of *N. piperita,* to which *N. wilkinsi* is obviously closely related. In proportion to length, shells of *N. wilkinsi* are lighter in weight than the shallow water specimens of the other eastern species.

Animal: Tentacles pale orange, darker at the ends; tapering in shape, with rounded tips. Siphon pale cream, almost translucent, with no papillae at the front edge. Mantle translucent, colourless or very pale orange, almost invisible when extended over the shell; marked on the left with about twenty patches composed of dark dots. Mantle papillae unbranched, mamilliform, with tips rounded; about twenty such papillae occur on each side. Foot very pale cream, also almost translucent, with some raised tubercles on the sides; it extends behind and on both sides of the shell when the animal crawls. The animal of the holotype is the only one so far observed.

Radula: The central has points of similarity with that of *N. piperita.* (Pl. IV., fig. 9).

Habitat: Intertidally, under stones; in deeper water, on Bryozoa.

Distribution: Western Port Bay, Victoria; from Flinders to San Remo. North-west Tasmania (?).

POSSIBLE NEW SPECIES.

Species W.: (Plate III., figs. 64-66; Plate IV., fig. 13). The three specimens which form this group are part of lot 367.57 in the Western Australian Museum. They were collected alive at Bunker Bay, Cape Naturaliste, W.A. The shell dorsum is pale brown, crossed by traces of four interrupted medium-brown bands. The distinctive feature of the group is the radula (Pl. IV., fig. 13); the single one found differs from those of any other species.

Species X.: (Plate III., fig. 67-68.) The specimen illustrated was found in deep water off Portland, Victoria, and is now in the collection of Mr. Kurtze. Two other specimens are known, one number D.985 in the South Australian Museum, and one, from Tasmania, in the author's collection. No radula has been examined. The shells of this group are distinguished by their narrow width (56 per cent. of length) and height (44 per cent. of length), and by their large number of teeth (26 labial and 26 columellar, reduced according to Schilder and Schilder, 1938.) Its dorsum is yellowish.

TABLE II.
SHELL MEASUREMENTS.

Serial.	*angustata.*		*comptonii.*		*declivis.*		*dissecta.*		*euclia.*		*molleri.*		*piperita.*		*pulicaria.*		*wilkinsi.*	
1 L ..	26·3	2·7	23·2	2·1	23·8	2·5	19·6	0·9	19	1·7	24	2·2	21	2·6	17·3	1·9	22·7	4·7
2 W ..	67	2·6	61	3·6	66	2·3	55	2·1	54	1·1	60	2·6	60	4	56	2·2	57	3·7
3 H ..	53	1·9	49	2·7	52	2·4	46	1·5	44	1·4	49	3·2	48	2·8	44	1·6	46	2·5
4 LT ..	25	1·9	24·7	2·2	24·9	1·7	27·5	2·3	28	2·1	26·1	2	25·7	1·5	28·2	1·8	27·2	1·5
5 CT ..	19·9	1·7	21·1	1·7	19·6	1·4	22·7	1·8	25·1	1·2	21·7	1·8	22·1	1·6	27·3	2·5	23·9	1·4
6 PLE ..	2·3	0·6	3·2	0·8	2·5	0·9	5	0·6	3·5	0·7	3·4	0·9	3·8	0·6	6·2	1·4	3·6	0·7
7 Wt ..	1·5	0·3	1·3	0·3	1·7	0·2	0·9	0·1	0·9	0·1	0·8	0·2	1·2	0·3	1	0·1	1	0·3
8 LSN ..	60	(40–80)	50	(40–80)	55	(30–90)	15	(10–20)	25	(0–40)	15	(0–30)	35	(0–100)	35	(10–50)	5	(0–40)
9 CSN ..	45	(30–60)	20	(0–40)	15	(10–20)	10	(0–10)	5	(0–20)	0	(0–10)	15	(0–30)	5	(0–30)	0	(0–10)
10 Ap ..	37	6·3	32	5·3	32	3·1	27	3·6	26	3·3	33	6·5	36	5·4	25	4·5	44	5·8
11 AW ..	9·5	0·9	10·3	1	9·5	0·7	8·4	0·6	7·8	0·4	8·2	1·1	9·1	1·1	9·9	1·2	9·6	0·8

NOTES.—1. Serials 1–7, 10 and 11 give the mean reading followed by the standard deviation.
2. Serials 8 and 9 give the mean reading to the nearest 5 followed by the extremes measured.
3. The number of shells measured varied between 8 (*euclia*) and 62 (*comptonii*).

Species Y.: (Plate III., figs. 69-70; Plate IV., fig. 11). The one immature specimen examined was found to have a distinct radula (Pl. IV., fig. 11). The shell dorsum is deep straw in colour, with faint traces of light-brown bands low down on the columellar side. There are pairs of small light-brown terminal patches in front and to the rear. The spire tip is in a deep pit. The specimen is F20,864 in the National Museum, Melbourne; no locality is given other than Tasmania.

Species Z.: (Plate III., figs. 71-72; Plate IV., fig. 10). Two specimens have been found. One, taken alive off Portland, is pale gold all over; it is in Mr. Kurtze's collection. The second specimen, also taken alive, but from an unknown locality, is in the South Australian Museum; the shell is faded almost to white. The shells are scarcely distinguishable from those of *N. wilkinsi,* but the radula, extracted from the second specimen, is very different in form. (Pl. IV., fig. 10.)

TABLE I.

LIST OF CHARACTERS MEASURED.

Serial.	Abbreviation.	Measurement.
1	L	Length of shell in mm.
2	W	Width of shell as percentage of length.
3	H	Height of shell as percentage of length.
4	LT	Number of labial teeth, reduced to those of a shell 25 mm. long (Schilder and Schilder, 1938). All teeth and ridges were counted.
5	CT	Number of columellar teeth, reduced as in Serial 4. The anterior terminal ridge was the only projection not included in the count.
6	PLE	Protrusion of lower edge of fossula out into aperture. As percentage of length.
7	Wt	Weight of shell in gms. divided by L cubed; Multiplied by 10,000 to facilitate handling of results.
8	LSN	Number of spots on labial side of shell.
9	CSN	Number of spots on columellar side.
10	Ap	Angle between tangents to aperture at front and rear.
11	AW	Width of aperture at rear. As percentage of length.

Table III.

SIGNIFICANCE TESTS.

The statistical significance of differences between certain pairs of species was determined. In the table given below a blank indicates a difference of 0·001 or more, and an entry a difference of less than 0·001. This means that on the average more than a thousand samples would have to be selected from two like populations before a difference of the size actually found could be expected to occur once. Entries in the table thus show that important differences exist between the species. The species named is the one with the larger measurement.

Serial.	*comptonii-declivis.*	*dissecta-molleri.*	*piperita-pulicaria.*	*piperita-wilkinsi.*	*euclia-pulicaria.*
1 L	..	*molleri*	*piperita*	..	..
2 W	*declivis*	*molleri*	*piperita*	..	..
3 H	*declivis*	..	*piperita*	..	..
4 LT	..	..	*pulicaria*	..	..
5 CT	..	..	*pulicaria*	..	..
6 PLE	..	*dissecta*	*pulicaria*	..	***pulicaria***
7 Wt	..	..	..	..	..
10 Ap	..	..	*piperita*	*wilkinsi*	..
11 AW	..	..	..	..	*pulicaria*

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CONTENTS OF PLATES.

PLATE I.

N. angustata:

1 - 2 Mallacoota, Vict. Beach shell. G.80, 26.
3 - 5 Queenscliff, Vict. G.80, 24.
6 - 7 San Remo, Vict. Beach shell. G.80, 22.
8 Between Eden and Cape Howe, N.S.W. Deep water. Coll. Buckland.

N. comptonii:

9 Flinders, Vict. G.77, 12.
10-12 Flinders, Vict. G.77, 14.
13 Tumby Bay, S.A. G.77, 59.
14-16 Between Eden and Green Cape, N.S.W. Deep water. G.77, 40.
17 Portland, Vict. Coll. Kurtze.
18 Port MacDonnell, S.A. S.A. Museum.
19-20 San Remo, Vict. Beach shell. G.77, 27.
21 Port MacDonnell, S.A. S.A. Museum.

PLATE II.

N. declivis:

22-24 Seven Mile Beach, Stanley, N.W. Tasmania. Beach shell. G.78, 4.
25-27 Portland, Vict. G.78, 7.

N. dissecta:

28-29 G.D.1
30 Coll. Buckland
31 Coll. Buckland
32-33 G.D.2

All between Eden and Green Cape, N.S.W. Deep water.

N. euclia:

34-36 80 miles west of Eucla, W.A. Deep water. G.F.1.

N. molleri:

37-39 Off Gabo I., Vict. Deep water. G.E.8, 1.
40-41 Off Gabo I. Deep water. G.E.8, 2.
42-44 Between Eden and Green Cape, N.S.W. Deep water. G.E.3.

N. pulicaria:

45-46 W. Aust. G.75, 2.

PLATE III.

N. piperita:

47 San Remo, Vict. Beach shell. G.76, 14.
48-50 Glenelg, S.A. G.76, 2
51 Western Port Bay, Vict. G.76, 16.
52-54 Tumby Bay, S.A. G.76, 17.
55-56 Eden, N.S.W. Deep water. Coll. Buckland.
57-59 Bunker Bay, Cape Naturaliste, W.A. W.A. Mus., 367-57.

N. wilkinsi:

60-61 Western Port Bay, Vict. Paratype No. 3. G.C.6.
62-63 Flinders, Vict. Beach shell. Paratype No. 2. G.C.3.

Species W.:

64-66 Bunker Bay, Cape Naturaliste, W.A. W.A. Mus., 367-57.

Species X.:

67-68 S.A. Museum D.985.

Species Y.:

69-70 National Museum, Melbourne F.

Species Z.:

71-72 Portland, Vict. Coll. Kurtze.

PLATE IV.

Central Teeth of Radulae.

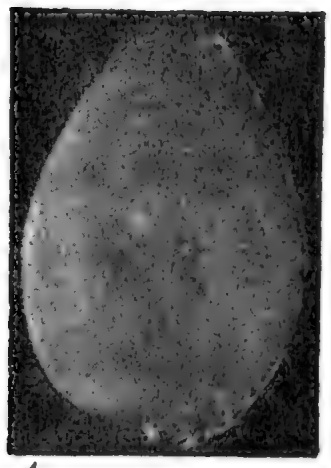
1. *N. angustata* (Gmelin).
2. *N. comptonii* (Gray).
3. *N. declivis* (Sowerby).
4. *N. dissecta* Iredale.
5. *N. euclia* Steadman and Cotton.
6. *N. pulicaria* (Reeve).
7. *N. piperita* (Gray).
8. *N. molleri* (Iredale).
9. *N. wilkinsi* (Griffiths).
10. Species Z.
11. Species Y.
12. *N. emblema* Iredale.
13. Species W.

Notes.—1. The teeth shown in 1, 2, 4, 5, 6, 7 and 8 are the average forms taken from a number of radulae. 3 is based on a sketch by Vayssiere. 9 and 12 are drawn from the holotypes; no other radulae of these species has so far been found. The radulae on which 10, 11 and 13 are based are also unique.

2. 2 and 8 show alternative forms of centrals.

3. The chain dotted lines in 13 show the position of cusps which appear to be on the back of the tooth.

4. Magnification is x 150.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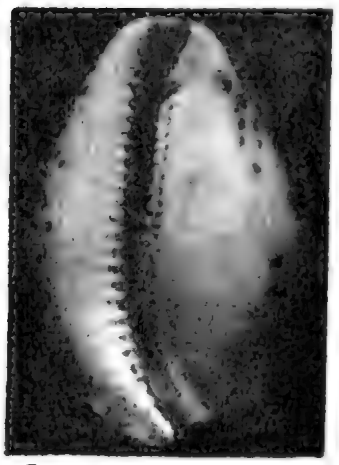
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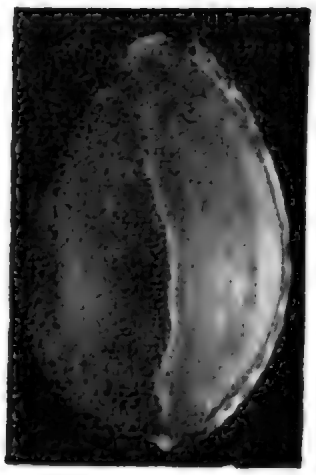
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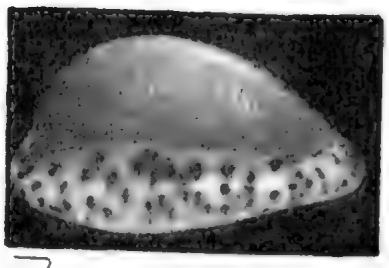
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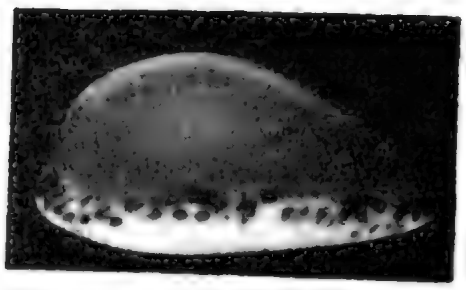
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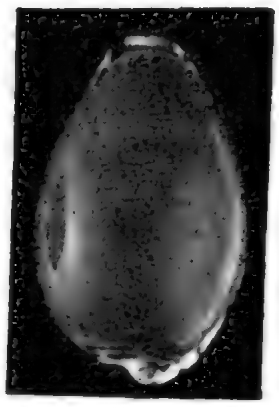
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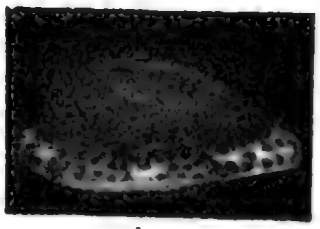
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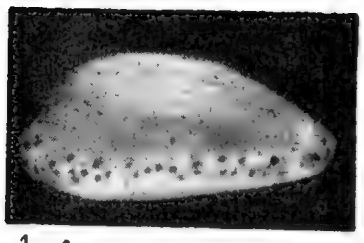
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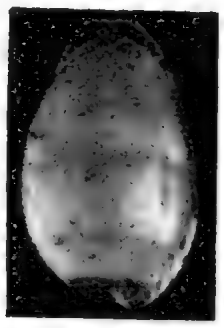
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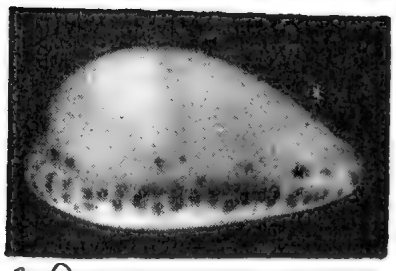
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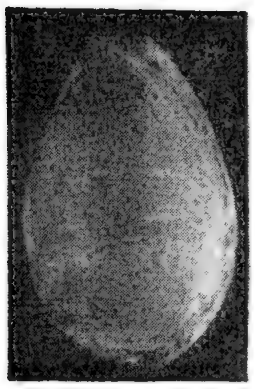
PLATE I.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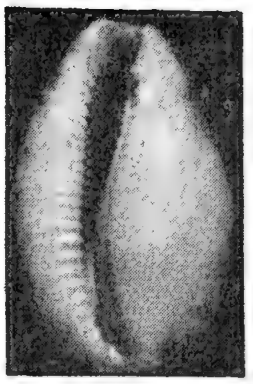
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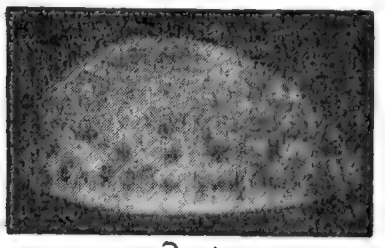
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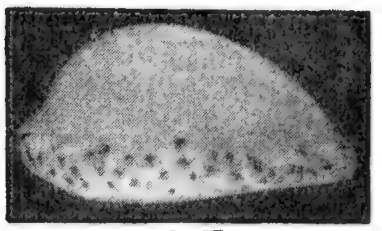
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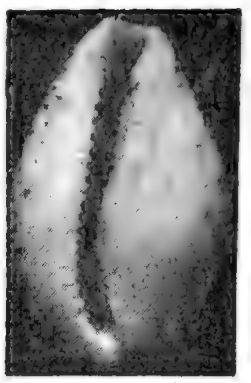
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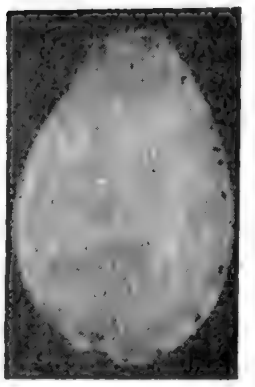
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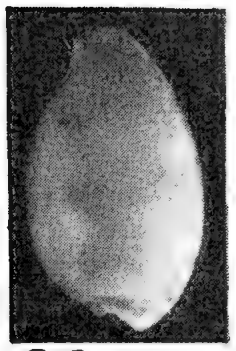
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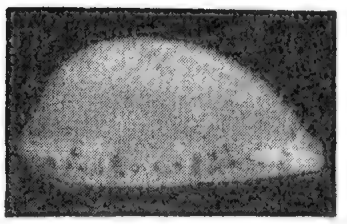
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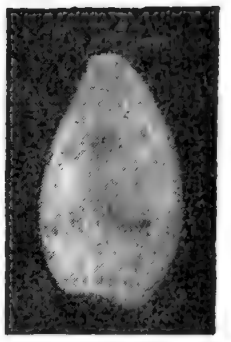
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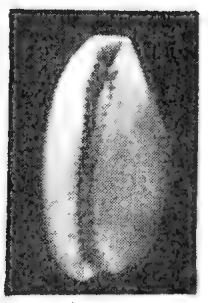
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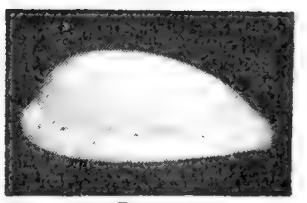
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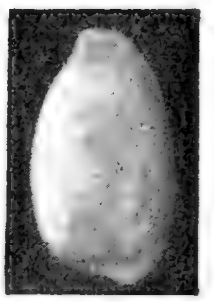
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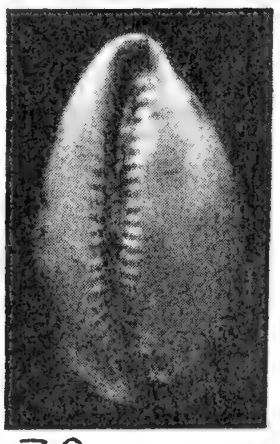
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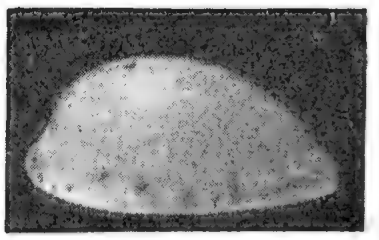
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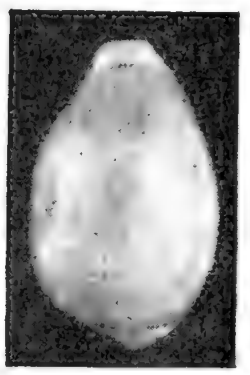
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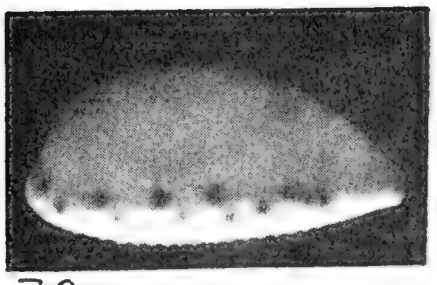
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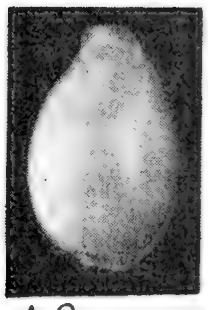
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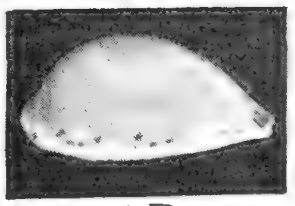
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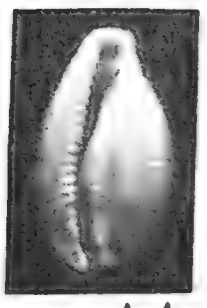
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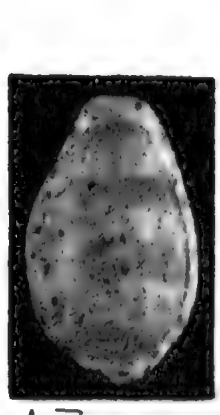
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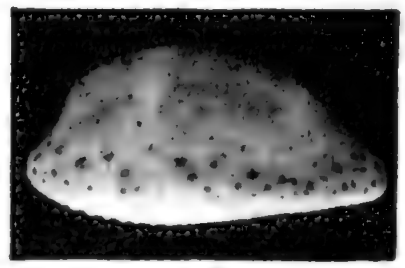
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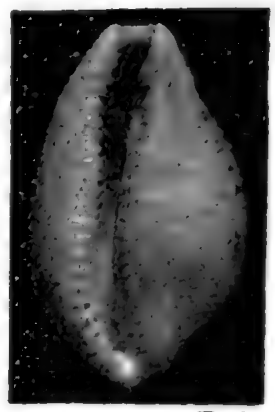
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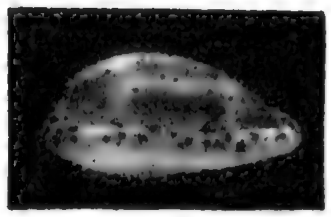
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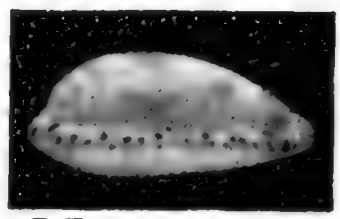
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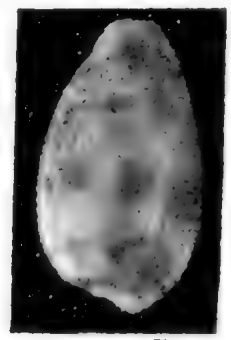
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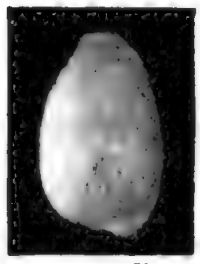
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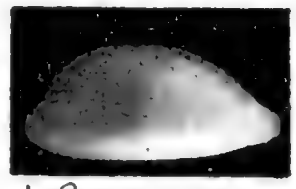
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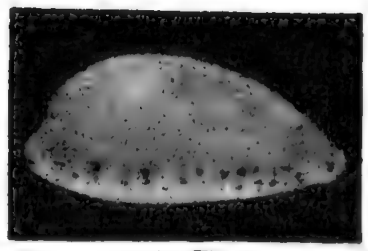
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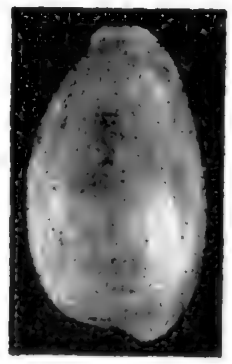
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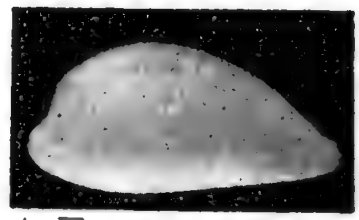
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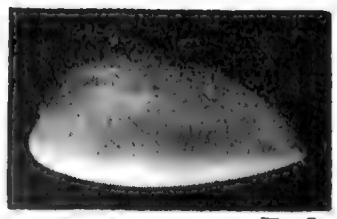
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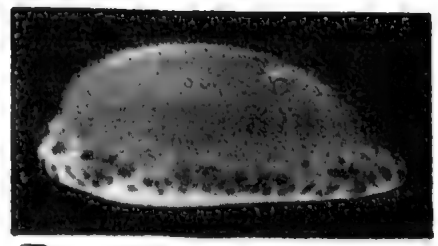
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PLATE III.

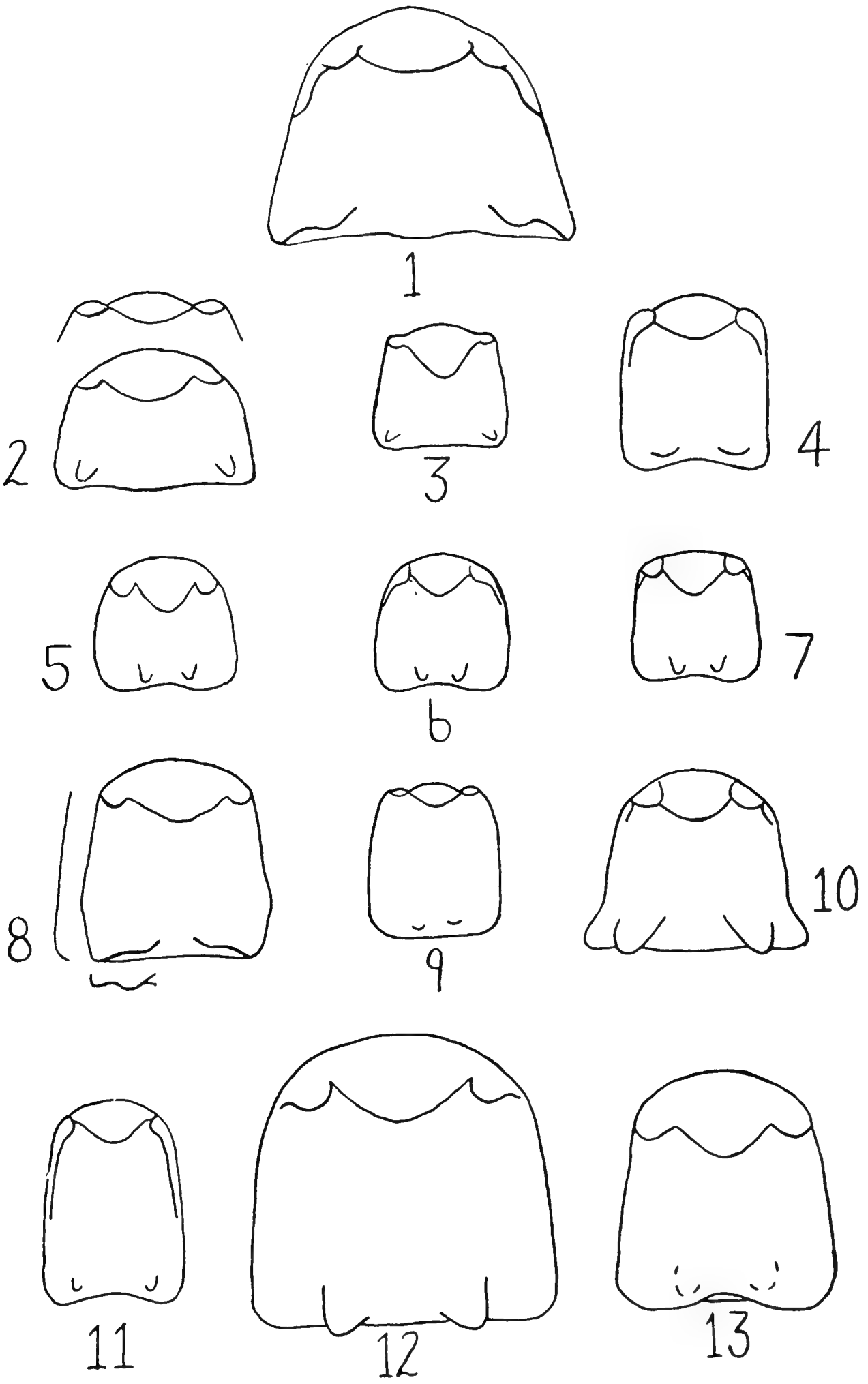

PLATE IV.

CENTRAL TEETH OF RADULAE.

THE LINNAEAN *HALIOTIS VARIA* IN AUSTRALIA.

By Robert R. Talmadge.

Text Figures 1-3.

Haliotis varia Linnè, 1758 is a very common shell along the north-eastern, northern and north-western coast of Australia. Iredale, 1928 briefly discussed the species as a whole, designated the Philippines as the type locality of *H. varia* s.s. and separated the Australian shells sub-specifically as *H. varia aliena.*

Recent examination of specimens from Australia and adjacent localities indicated strongly that there were definite clinal variations within the population of the sub-species and the species as a whole.

Before discussing populations it was first necessary to establish whether more than one species was involved. This was accomplished by a comparison of the soft parts of animals from all localities. This species has a rather narrow epipodium, which is strongly papilose and expanded. The tentacles are long and narrow as are the eye stalks. The snout is well developed. The epipendular processes are long and fine. Due to preservatives, the full colouration of the animal could not be determined, but all appeared to be a tan or light brown, with maculations of dark brown on the epipodium.

Thus it was found that regardless of the shape, form, colouration, or sculpturing of the shell, all animals were anatomically similar, and therefore only a single species referable to *H. varia* Linnè was present.

As Reeve, 1846, described a number of species which are obviously closely related to *H. varia* Linnè it was necessary to establish the identity of these names. The range of variation shown by the large number of specimens examined made it seem likely that selected specimens from the various localities could be matched with the Reeve species.

Such a selected series was sent to the British Museum (Natural History). Mr. S. P. Dance kindly compared these with the type specimens in the Hugh Cuming Collection upon which Reeve based his descriptions in Proc. Zool. Soc. and Conchologica Iconica. This established the fact that the Reeve species *viridis,*

Here the shell becomes more rounded and wider than those in the Capricorns. Tiny nodes are found on a number of specimens, but the majority of shells lack this nodulation. The cording has now become nearly obsolete and the lamellae are much stronger. The number of specimens with the colour pattern of *semistriata,* is much reduced. Strong maculations and the concoloured phase, *pustulifera* are the common patterns. The basic colouration is now a rich, reddish brown, with cream or white markings.

The measurement formula 1·52 x 1 x ·20 x ·18.

Bowen, Queensland and adjacent coast: Like the closely related Keppel Island population, the material from this series was relatively smooth with strong lamellae. Here shells reach the broadest width-to-length ratio, and nearly all specimens exhibit small pustules or nodes. The colour form *semistriata* is absent while *pustulifera* is the dominant phase.

The measurement formula 1·50 x 1 x ·22 x ·20.

Townsville and Magnetic Island: There is so little separation between the mainland and island series, that they are placed together. With northward progression there is a definite trend for the shell to lengthen. Nodes are on almost all specimens and the lamellae are strong. The colouration of the shell is almost pure *pustulifera,* the rich red brown concoloured type. A few examples with maculations are found.

The measurement formula 1·55 x 1 x ·20 x ·18.

Cairns: Here the northern elongate type of shell is more evident. The small pustules present in the more southern populations are now starting to decrease, as well as the lamellae. The colouration is also changing to the maculated pattern; the rich red brown colouration being replaced with a dark brown.

The measurement formula 1·60 x 1 x ·18 x ·16.

Darwin: Here appears to be found the most elongate, arched specimens of the population. This is to be expected, as across the shallow Arafura Sea one finds nearly pure populations of an adjacent geographical race showing these characters. The rounded lamellae are nearly gone, with the cording now increasing in strength. The colour pattern is now either rayed or maculated. Tints of green make their appearance, with dark brown and white.

The measurement formula 1·75 x 1 x ·25 x ·24.

semistriata, concinna, papulata and also *pustulifera* Pilsbry, 1890, were all referable to colour phases of *varia* s.l. and *astricta* and *rubiginosa* of Reeve represented distinctive cording and sculpturing. Thus all these names sink into the synonomy of the Linnaean species *H. varia.*

To correlate the variation, some way of expressing the mean characters of the basic population must be found. The simple length, width, height of spire, and height of shell is here reduced to a formula, with the width of the shell represented by " 1." Graphs are used to show the clinal nature of the types of colouration, sculpturing and proportions of shell. No attempt is made to make any evaluation, other than that listed above. Small series, pathological specimens, and those with vague localities were discarded because of the possibility of their abberant nature. However, they were considered in the broadest sense in summing up the variations. Juvenile shells were found to have little value beyond specific identification.

Ino (1951), proved in his study of *Haliotis discus* Reeve, that diet is a very strong factor in the colouration of the shell. The colour variations in the present study indicate that there is a more or less geographical correlation. It would be interesting to learn whether there is also a distinct correlation of species of the marine algae on which the animals feed to geography, or whether chemical variations in the sea waters is the altering factor.

Discussion on Populations.

Capricorn Group: Series from individual islands of the group were so uniform that they were treated as a single population. Typical Capricorn example are rather broad, coarsely corded shells, with low rounded lamellae that are semi-obsolete. The sculpture-form, *astricta,* appears to be quite common, with only a few of the examples exhibiting small rounded nodes. The basic colouration is a dark reddish brown, with white or cream markings. The banded form, *semistriata* is the predominant pattern. The form *rubiginosa* occurred here, and, beyond question, is only a pathological shell.

The measurement formula 1·58 x 1 x ·20 x ·18.

Keppel Islands: Again, as with Capricorn shells populations from the various islands do not differ.

Broome: This form has a broader shell, with lamellae again present. A few specimens exhibit tiny nodes. In contrast the colouration is either maculated or rayed with green-brown and white. Very few banded or concoloured examples are found, and these are all of green tints.

The measurement formula 1·70 x 1 x ·24 x ·22.

Discussion

The significant factors are:—First, as one moves from south to north along the Queensland coast, the number of the pustules increase; the cording loses its strength and becomes almost obsolete. The shells become wider and more rounded. At Cairns the pustules decrease again and the shell becomes more elongate; the cording increases in strength. The peak of the elongate unsculptured shell is reached at Darwin; then the shell again changes to become wider and more heavily sculptured on the North-western coast.

Examples of *H. varia* s.s. from the Philippines, especially the eastern coasts, show a rather broad, heavily tuberculated shell. The tubercles are large and plentiful. The dominant colour pattern is either heavily maculated or rayed. This basic type of shell is found to range south along the coast of New Guinea and into the Solomons. Specimens available from Papua and New Caledonia show this similarity, but were too few in numbers to be considered for a comparison of populations. However, these few specimens appear to furnish the key to the problem.

Some selected localities within the range of the *varia* s.s. produce the following formulae:—

Okinawa, Ryukyu Islands, 1·39 x 1 x ·29 x ·30.

Batan, Luzon Island, Philippines, 1·35 x 1 x ·30 x ·32.

Biak, Northern New Guinea, 1·35 x 1 x ·28 x ·25.

Zamboanga, Mindanao Island, Philippines, 1·48 x 1 x ·30 x ·30.

Unlike all the other localities, the coarse, irregular tubercles were not present in the majority of the specimens from Zamboanga. A number of the shells were of the more elongate type, associated with the warm inner seas of Indonesia. However, in all of these localities there was no trace of the lamellae present in so many of the Australian specimens.

The Haliotids inhabit a rather specific ecological biome, shallow water with rock or coral formations, and it is quite possible that any expansive area without this habitat would be a

physical barrier. Distributional evidence suggests that the intermingling of populations by the free swimming trochoforme is also restricted. This is probably due to the lack of strength of the trochoforme, which would prevent it from traversing great distances prior to final settlement. Thus adjacent populations are in contact only if conditions, such as shallow narrow seas, are favourable.

Thus it would seem that the clinal variation exhibited by the Australian shells is a logical and natural trend. Particularly as it seems likely that there is a genetic interchange between populations in New Caledonia and the Queensland coast, across the Coral Sea. This interchange is further suggested by the finding of typical New Caledonian species of this and other genera on the Queensland coast, and it is in such areas that *aliena* shows similar shell characters to *varia* s.s. Such a contact is still further indicated by the decrease in the pustules as one moves away from this probable area of contact.

The shallow warm waters of the inner Indonesian Seas produce a deep, very elongate, finely corded race; the *H. varia stomataeformis* Reeve* specimens from the north coast of Java were the most elongate and smooth of the entire species. The measurement formula 1·78 x 1 x ·25 x ·24. Contact with *aliena* would be made across the shallow waters of the Arafura Sea. Again, as one moves both south and west from this area of contact, the shells become broader and less elevated, with the decrease in the cording.

Thus it appears that the Australian sub-species of *aliena* Iredale, has an animal that is the same as the Indonesian and more northern races, but may be separated by shell features. These being chiefly the more elongate shell and the presence of lamellae, with the tubercles reduced in most cases to fine nodules.

Taxonomy

The above study has established the probable occurence of an Australian sub-species which Iredale arbitrarily called *aliena*. He did not consider whether an earlier name was available, which in fact it is. Reeve described *papulata* from Northern Australia and this name must take priority over Iredale's much more recent innovation. Thus the Australian sub-species becomes *H. varia papulata* Reeve, 1846 and *aliena* falls into its synonomy.

* Reeve gave the locality of *H. stomataeformis* as New Zealand but it has not been recognized from there but shells from Indonesia exactly match Reeve's figure and description. Talmadge (1956).

Summary

A study based upon a series of shells indicated that *H. varia aliena* Iredale is a sub-species showing clinal variation within its populations. These populations are in what may be considered physical contact, and certain features are carried from one to adjacent groups. There is also strong indication of interchange of genetic factors with adjacent sub-species particularly at the geographical areas of contact; i.e., shallow, relatively narrow seas. This latter factor is probably the reason for the major variations within the range causing confusion in the taxonomy. The correct name of the Australian sub-species is *H. varia papulata* Reeve, 1846.

Acknowledgements

Appreciation is expressed to Mr. S. P. Dance of the British Museum (Natural History) for making the comparisons of certain specimens with the original material used by Reeve. To the many Australian collectors, who obtained both shell and animal, with accurate locality data, my heartfelt thanks. Without such material the study could not have been made.

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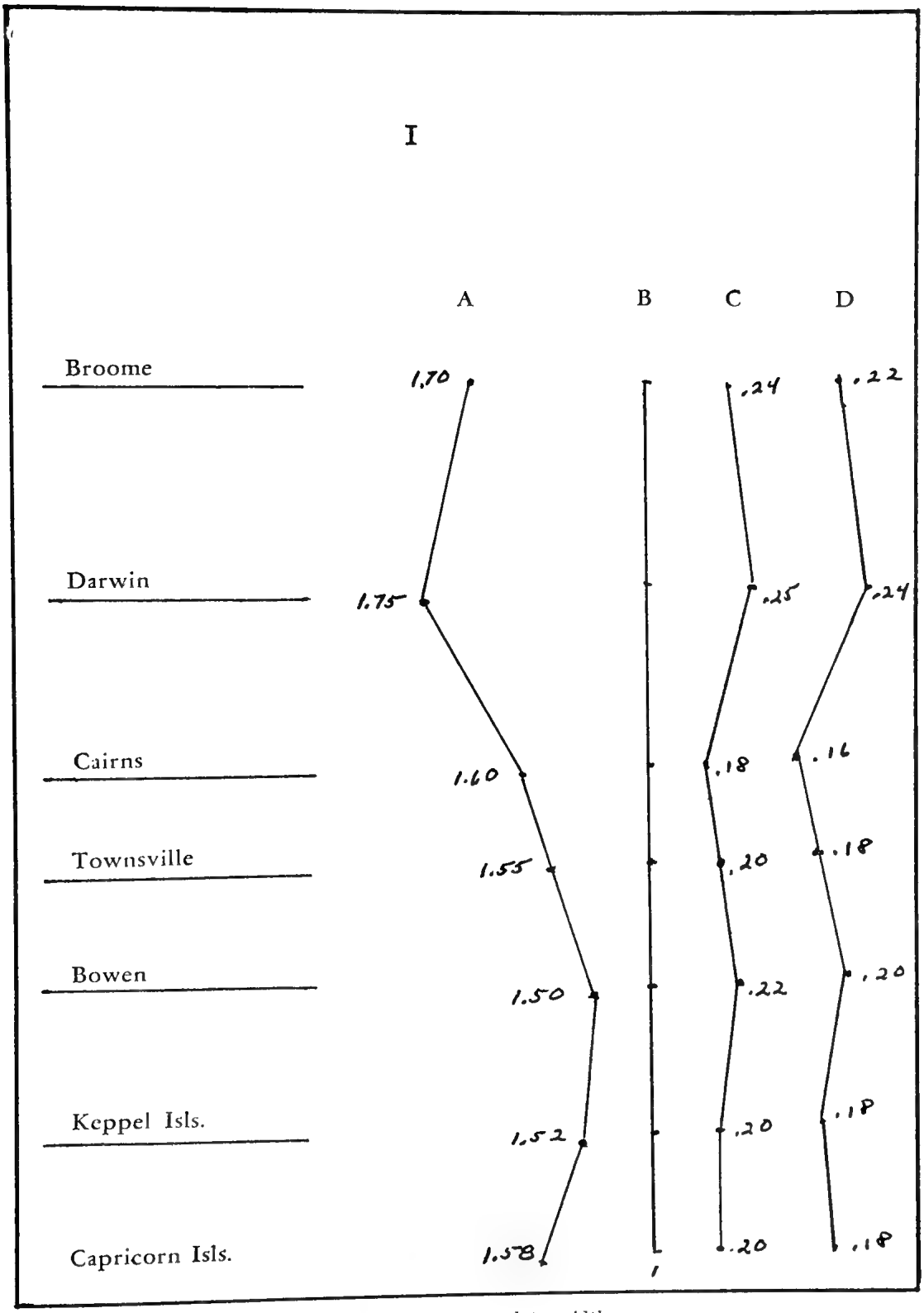
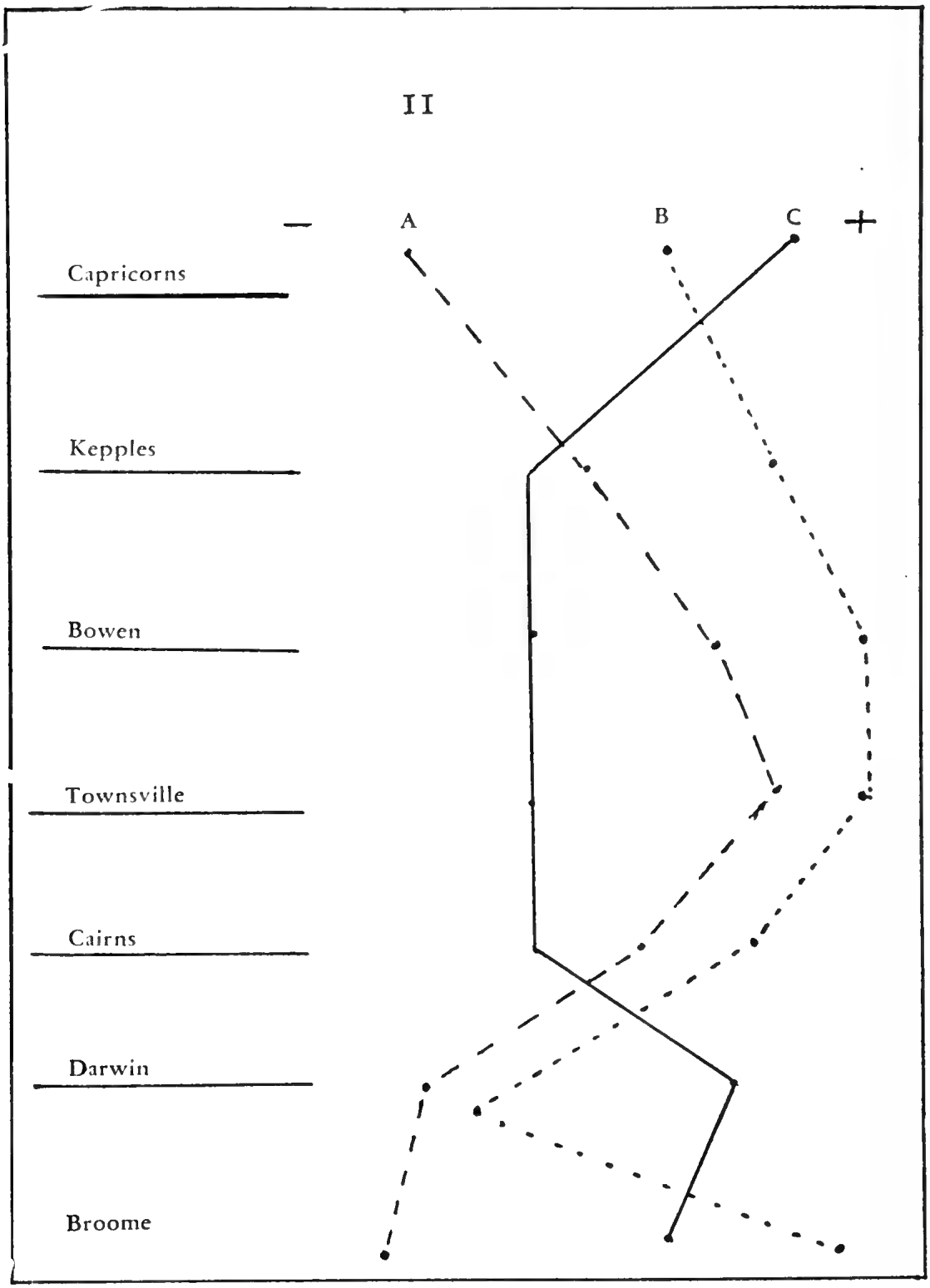
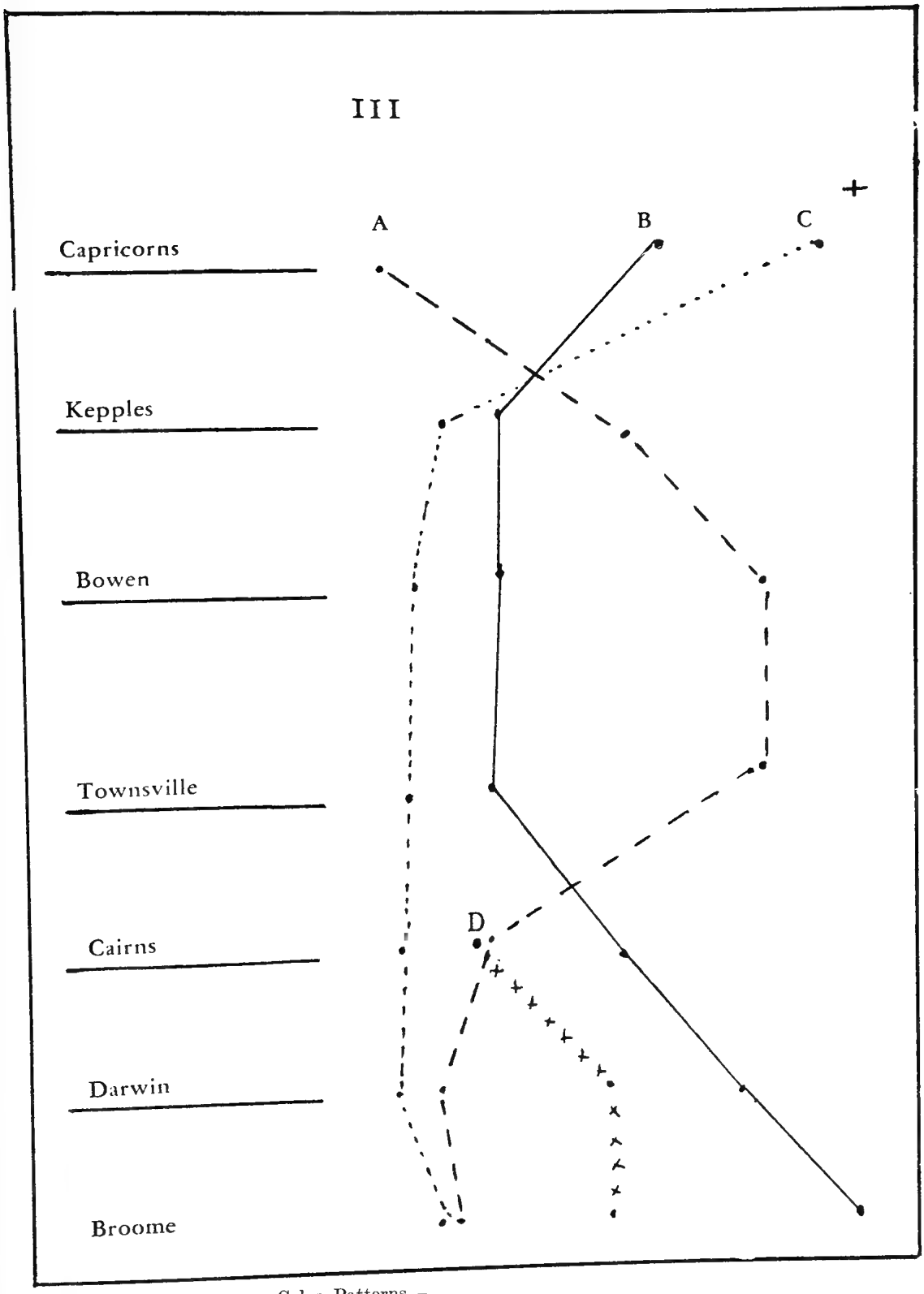


A = Length of shell compared to width.
B = Width of shell, compared to length.
C = Height of spire compared to width.
D = Height of dorsal surface compared to width.



Sculpturing—
A (– – – – – – – – –) pustules.
B (. . . . . .) lamellae.
C (————————) cording.
\+ = majority of lot.
— = minority of lot.



Color Patterns—

A (– – – – – – – – –) Concolored (pustulifera).
B (———————) Maculated.
C (. . . . . .) Banded (Semistriata).
D (x x x x x x x x x) Rayed.
\+ = majority of lot.
— = minority of lot.

NOTES ON DISTRIBUTION AND DESCRIPTIONS OF NEW SPECIES.

(Orders: Odonata, Plecoptera, Orthoptera, Trichoptera and Coleoptera).

By A. Neboiss, M.Sc., F.R.E.S., Assistant Curator of Insects, National Museum of Victoria.

Contents.

Summary.

The range of distribution is greatly increased in two dragonfly species, one of them, *Austropetalia patricia* being recorded for the first time from Victoria. Larva of *Thaumatoperla alpina* is described, figured and compared with larva of *Th. flaveola,* described previously. A new species of *Cylindracheta* is described from Queensland, thus extending the range of the genus to that State. *Archaeophylax canarus* is but the second species of the family Limnephilidae to be recorded from Australia. Two new species of Tenebrionid beetles are described; one of which, *Tribolium apiculum* was discovered in a nest of a native bee, and is but the fourth indigenous species of that well known cosmopolitan genus. Larva of a common click-beetle *Hapatesus hirtus,* which has caused considerable damage to potato crops in Victoria, is described.

Order ODONATA.

(Fig. 1).

Interesting data on distribution of two dragonfly species have been accumulated during the past few years, and extends the known range considerably. One of them, *Austropetalia patricia (Till)*, is recorded in Victoria for the first time.

Family HEMIPHLEBIIDAE.

Hemiphebia mirabilis Selys (1877).

Specimens of this rare and interesting species have been collected and recorded in literature only occasionally. The distribution was believed to be restricted to one known locality —the Goulburn River near Alexandra, Victoria. Though the locality for the type specimen was given as Port Denison, Queensland, it is certain that the type has been mislabelled. In the Victorian locality specimens are found flying between reeds in calm backwater pools which occasionally, in flood time, are connected with the nearby river; the type locality has dry tropical conditions with coastal mangrove swamps and with no fresh water in the area for long periods. Frazer (1957, p. 51) in his " Reclassification of the order Odonata " refers to the Victorian locality only: " *H. mirabilis* Selys, confined, so far as is at present known, to a single habitat on the Goulburn River, near Alexandra, Victoria, Australia." Tillyard visited this locality on 22nd and 23rd December, 1906, and again on 6th and 7th November, 1927. During this second visit Tillyard and his colleagues collected larvae of *H. mirabilis*.

Since Tillyard's last visit no more captures have been recorded in literature. In November, 1954 Mr. R. Dobson, a well-known dragonfly collector from New South Wales (now of Jersey Isl.) asked the entomological staff of the National Museum of Victoria to join in the search for the exact locality described by Tillyard (1928). With three or four of Tillyard's photographs of the locality in hand, Mr. Dobson, accompanied by Mr. Burns and the author, searched the country along the Goulburn River near Alexandra on 6th December, 1954. It was expected that the backwater pools would have changed considerably during the 27 years since Tillyard's visit, but it was a great surprise that after a day's search, in the late afternoon the locality was located almost unchanged; even an old dead gumtree in the distance was still standing, and with only one of its dry limbs lost! It took only five more minutes to capture the first specimen.

Some time later, while arranging specimens collected by the author earlier that year, the species was recognized from another locality—Tarrawarra, near Healesville, Victoria (2♀ 5th January, 1954). To ascertain the presence of *H. mirabilis* in this locality, another visit was made on 15th December, 1958 when again more specimens were collected and others seen resting on reeds. Further specimens were collected at this locality by

Dr. B. P. Moore on 2nd February, 1959. This new locality is situated on Yarra River flats which are subject to flooding each year and which retain their swampy nature for some months. Towards the end of summer the area dries out, the only water remaining being in the nearby river.

Another two specimens of *H. mirabilis* were found amongst the late Mr. Renton's material, now in the National Museum. Both specimens are labelled " Seville, Victoria, 26th December, 1917." This locality is situated some miles upstream from Tarrawarra, but has similar characteristics.

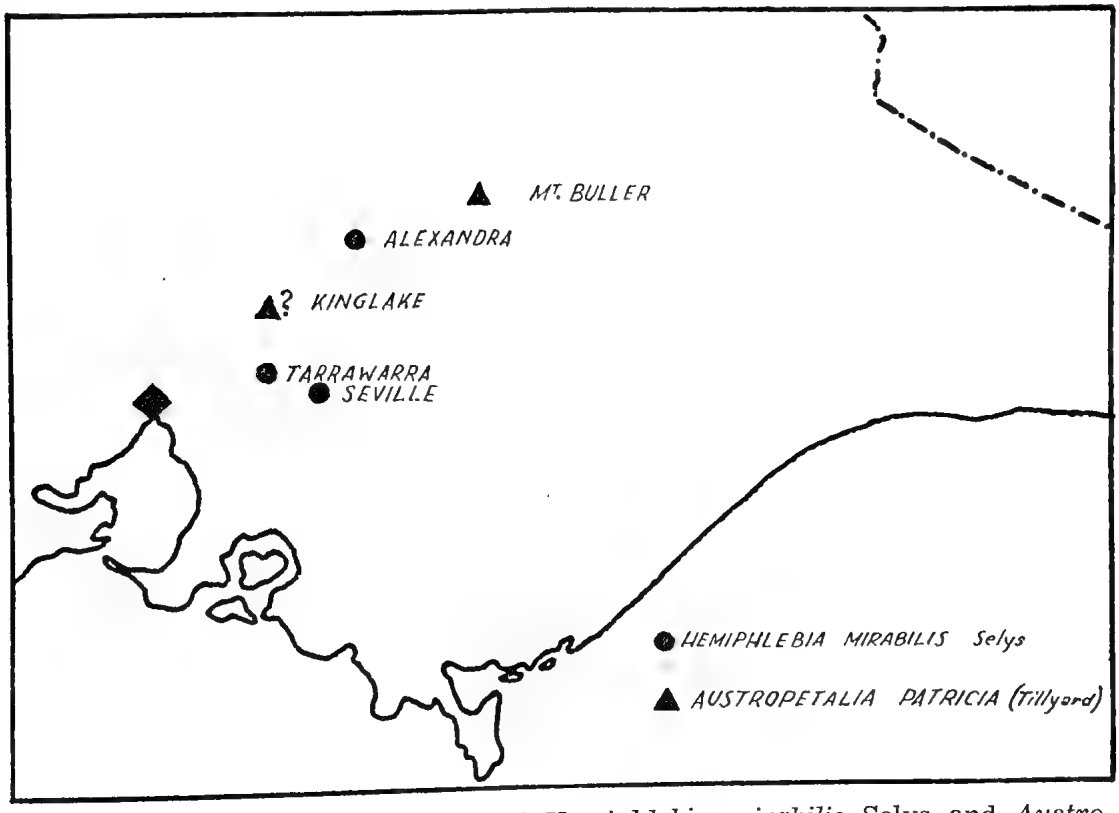


Fig. 1. Map showing distribution of *Hemiphlebia mirabilis* Selys and *Austropetalia patricia* (Tillyard) in Victoria.

Summarizing the above discussion, we can be quite certain that the type specimen has been mislabelled, and that it has never been collected at Bowen, Queensland. The species is not as rare as believed, but it does require certain conditions for its domain. All three Victorian localities, where *H. mirabilis* has been collected, although separated by the Great Dividing Range, are located on wide river flats, subject to periodic flooding and possessing, at least for part of the year, large or small backwater pools with a rich and varied vegetation.

Family AESHNIDAE.

Austropetalia patricia (Tillyard), (1909).

This species was previously known from several localities in New South Wales but had not been recorded further south. The first but rather uncertain indication of its occurrence in Victoria was a specimen found by the author caught in a car radiator grille. Prior to the discovery, the car had been used solely around suburban Melbourne with an exception of a single day's outing in the Kinglake–Toolangi district about 45 miles N.E. of Melbourne. It seems likely therefore, that the species would occur somewhere in that area, and the time was limited to a period of about 3 weeks in late October or early November, 1954. That particular specimen, a female, was in reasonably good condition and is now in the National Museum collection.

Some years later two specimens were brought to the National Museum for identification from the Mt. Buller area in Central Victoria. These two specimens, ♀, 6th November, 1957, and ♂, 20th November, 1957, were collected by Mr. I. F. Edwards along a rapid flowing stream near Timbertop School property at the foot of Mt. Buller; they are now in the National Museum collection. Other specimens in the Geelong Grammar School Timbertop collection, were collected at the early part of November of the two successive years 1957 and 1958.

The species is obviously breeding in the area and thus extends the known area of distribution for several hundred miles south. It is also the first record of the species from Victoria.

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Order PLECOPTERA.

Family EUSTHENIDAE.

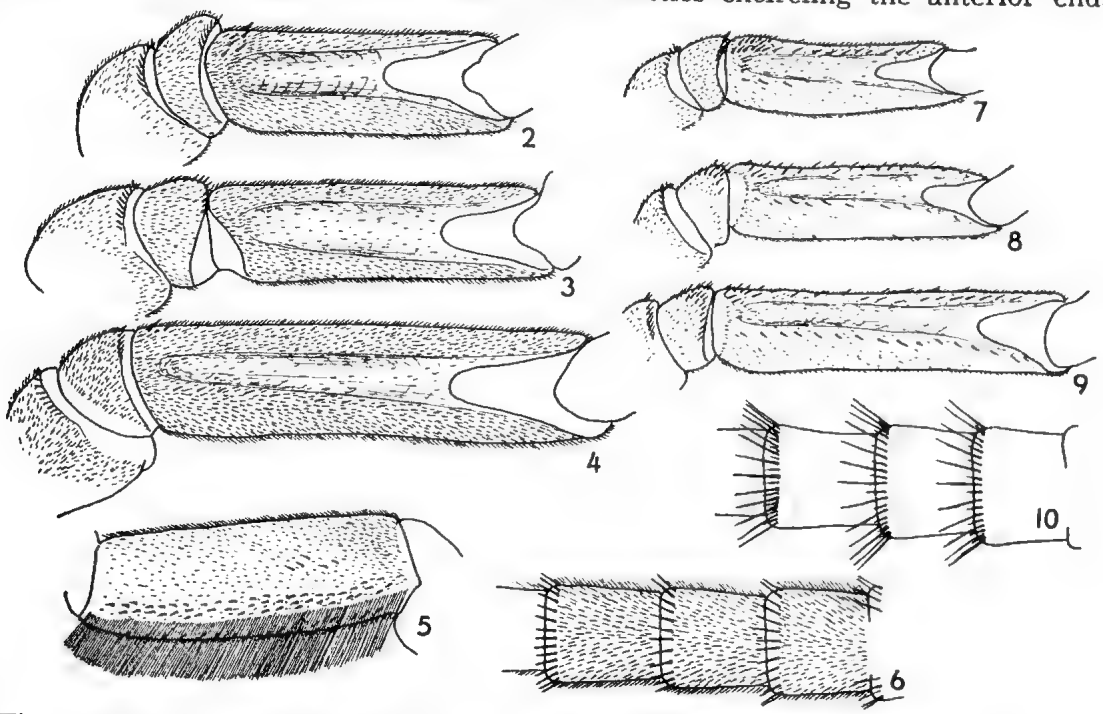
Thaumatoperla alpina Burns and Neboiss (1957).

Description of the nymph.

(Figures 2-10).

Colour dorsally: head olive, pronotum reddish brown with darker central patch, meso-and metathorax brown to olive brown; ventrally: head olive, thoracic segments light ochraceous buff with tinge of olive around the base of legs, abdomen deep olive buff, last segments olive brown to blackish; antennae yellow brown, cerci brownish.

Head slightly narrower than prothorax, widest at posterior third. A row of short stiff bristles just behind the eyes. Antennae up to 15 mm. long, consisting of approximately 100 segments, first segment large, second segment smaller, the following three or four segments very short, succeeding ones gradually increasing in length and becoming narrower towards the apex; each segment with a single row of small stiff bristles encircling the anterior end.



Figs. 2 - 6. *Thaumatoperla alpina* B. and N. nymph: 2, anterior femur ventrally; 3, median femur ventrally; 4, posterior femur ventrally; 5, anterior femur dorsally showing row of long hairs; 6, portion of cercus showing dense pubescence and the encircling row of spines around the distal margin.

Figs. 7-10. *Thaumatoperla flaveola* B. and N. nymph: 7, anterior femur ventrally; 8, median femur ventrally; 9, posterior femur ventrally; 10, portion of cercus.

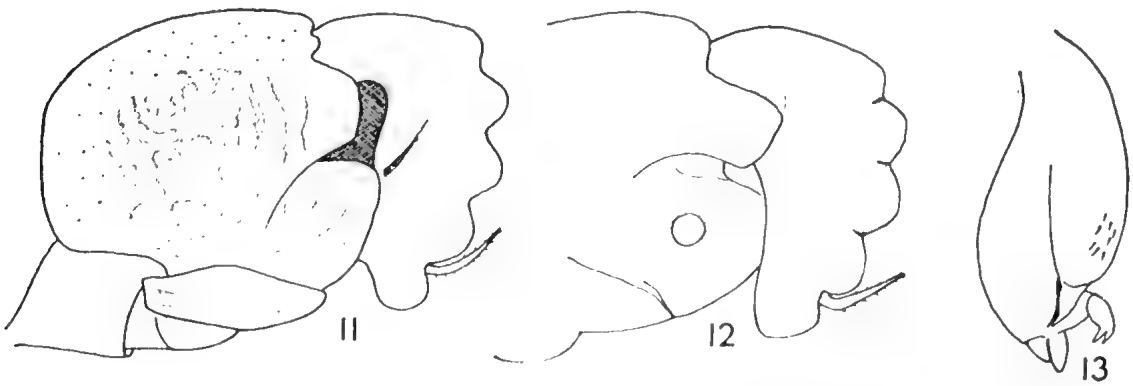
Labrum, labium, maxilla, maxillary palpae and mandibles are not sufficiently distinct from *Thaumatoperla flaveola* to warrant their use as distinguishing characters for separating the two species.

Pronotum show the typical colour pattern found in adults, but colours are not so bright. Short stiff bristles along lateral margins, but median section of anterior margin and the entire posterior margin without such bristles.

Legs densely covered with short pubescence, femorae ventrally without distinct spines (Figs. 2-4); femorae and tibiae dorsally with a row of fine, long whitish hairs.

Abdomen somewhat cylindrical, depressed dorso-ventrally, dorsally covered with variable size stout spines, ventrally with very sparse decumbent hairs and an occasional spine on all except the last three segments. First six segments each with a pair of pinkish to bluish lateral gills. Ninth segment the longest. Cerci up to 23 mm. long, with variable number of segments, reaching over 50, densely covered with short pubescence (absent in *Th. flaveola*); proximal segments very short becoming longer and narrower distally. Each segment bears an encircling row of short spines around the distal margin (Fig. 6), much shorter than in *Thaumatoperla flaveola* (Fig. 10.)

short and rounded; tarsus single segmented, long, pointed at apex. Median legs with femora and tibial short, short and broad, the latter with a pair of strong spines at the apex, and a distinct ridge on the outer surface which forms



Figs. 11-13. *Cylindracheta ustulata*, sp. nov.: 11, outer view of anterior leg; 12, inner view of anterior leg; 13, median tibia.

two blunt points near the apex; tarsi stout, two segmented, terminating in a pair of short claws. Posterior legs more slenderly built than the median pair, tibia with four strong spines at the apex, ridge on the outer surface short and ending in a blunt point apically; tarsi single segmented, short and pointed, without claws.

Length 36 mm.; prothorax — length 6·5 mm., width 5·8 mm.; cerci 1·6 mm.

Holotype ♀: Ayr. Nth. Qld. May, 1957, R. Gotts. (National Museum of Victoria collection). ♂ unknown.

This species is very close to the New Guinea species *C. longera* Tind., but is separated by the smaller overall size, distinctly rounded lobes of the anterior tibia, and less angular inner apical projection of the anterior femur.

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Order TRICHOPTERA.

Family LIMNEPHILIDAE.

There has been only one species, *Archaeophylax ochreus* Mosely, of the family Limnephilidae known from Australia, with a distribution reaching from Tasmania in the south to Mt.

The description has been prepared from mature nymphs, which had reached the length up to 38 mm. At the same time also a number of smaller nymphs were collected (length 15-20 mm.), these were more uniformly coloured. Nymphs are usually found under stones in rapid parts of the stream and are very active.

Material was collected in a small stream on Mt. Mackay, Vic., 26th January, 1960, and are deposited in the National Museum collection.

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Order ORTHOPTERA.

Family CYLINDRACHETIDAE.

The discovery of a new species of Cylindracheta in North Queensland extends the known distribution of the genus to the north-eastern part of Australia. According to Tindale (1928) the genus is distributed over the whole of the arid parts of Australia (*C. psammophila* Tind.—W.A.; *C. arenivaga* Tind.—S.A., N.T.; *C. kochi* Sauss.—Nth. Austr.), in New Guinea (*C. longeva* Tind.) and Melville Island (*C. campbelli* Gray).

CYLINDRACHETA USTULATA, sp. nov.

(Figures 11-13).

The species is known from a unique female specimen.

Stout, cylindrical, chestnut-brown, abdomen slightly lighter in colour than the head and thoracic segments; medium and posterior tibiae yellowish brown. Head large, depressed anteriorly; antennae short, seven-segmented; third segment the smallest, apical segment concave; eyes oval, fenestrae conspicuous. Prothorax almost cylindrical, anterior margin moderately and evenly concave; antero-lateral spine well developed, mesothorax short, compressed posteriorly; metathorax compressed laterally to form a short and narrow dorsal ridge. Abdominal segments wider than long, anterior two compressed laterally, third segment somewhat conical, terminal segment with distinct transverse suture. Eight sternite only slightly longer than wide; cerci bluntly pointed, widest at base, about twice as long as the basal width. Anterior legs with femora stout, inner apical projection somewhat angular; the chitinous ridges of external surface broad, indistinct, not elevated; tibia stout with the five projecting lobes

Kosciusko area of New South Wales (Mosely and Kimmins, 1953; Neboiss, 1958). It has been limited always to mountainous districts of these states. The new species described hereunder, is also associated with a mountain region.

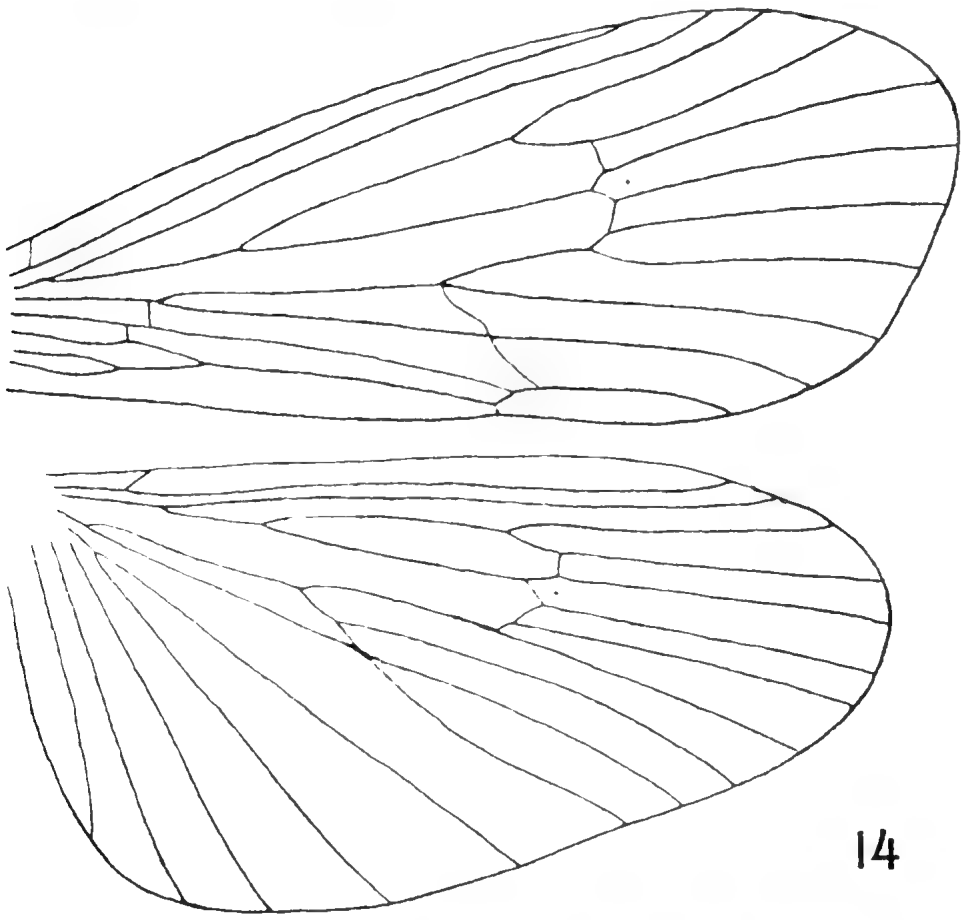


Fig. 14. *Archaeophylax canarus,* sp. nov.: wing venation.

Archaeophylax canarus, sp. nov.

(Figures 14-18).

Head, thorax and abdomen dark ochraceus, legs, antennae and anterior wings paler; the latter with very pale yellowish spots along costal margin; posterior wings very pale, slightly darker at apex. Spurs 1:2:2. Ocelli very prominent; the median one located anteriorly of the base of antennae; the two posterior ones just behind the base of antennae and close to the dorsal margin of eyes. No distinct warts on dorsal surface of head.

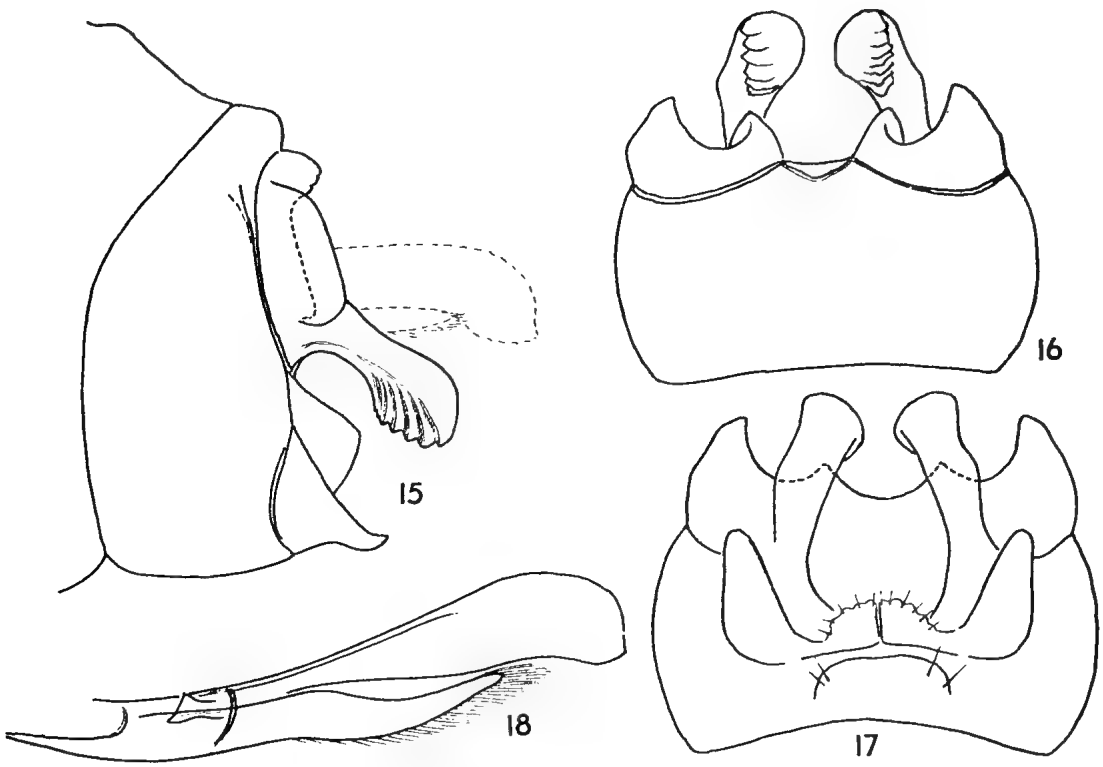
Genitalia, ♂—Dorsal plate very short, broad, with margin crenulate, covered with short hairs. Superior appendages short, flattened laterally, almost rectangular when viewed from side, long hairs along external margin. Upper penis cover formed by two separate processes, directed downward and inward; apex bulbous, ventrally with acute serrate ridge. Penis long, gradually

widening towards apex; sheats slightly curved, pointed at apex, ventrally with row of stout hairs. Inferior appendages short, triangular, curving inwards, covered with short hairs.

♀ unknown.

Length of the anterior wing: 12 mm.

Type material: Holotype ♂, Victorian Alps (prob. Mt. Buller area) (National Museum collection).



Figs. 15-18. *Archaeophylax canarus,* sp. nov.: 15, ♂ genitalia lateral; 16, ventral; 17, dorsal; 18, penis lateral.

Differs from the other Australian species by its smaller size, spotted costal area of the anterior wing, and very distinct genitalia.

The name is derived from an aboriginal name " canara " meaning " small ".

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Order COLEOPTERA.

Family TENEBRIONIDAE.

Blepegenes cicatricosa, sp. nov.

(Plate 1).

Elongate, black species with slightly bronze tinge, head and prothorax with waxy lustre, elytra with odd intervals seminitid; antennae, palpi and tarsi black.

Head distinctly protruding forward, narrowed at the base, frontal margin concave; antennae orbits raised; labrum rectangular, anterior margin concave; eyes narrow, oblique; antennae filiform, reaching just beyond posterior angles of the prothorax, slightly longer in males.

Prothorax wider than long, somewhat flattened, lateral margins rounded, only indistinctly subangulate; occasionally with slight depressions on either side of median line; anterior and posterior angles rounded.

Scutellum smooth, triangular. Elytra elongate, oval, only slightly flattened dorsally, evenly rounded at apex; odd intervals slightly convex, lateral ones even more than the median ones; even intervals planate, less nitid. Ventral surface smooth.

Tarsi and posterior section of tibiae reddish golden pilose beneath; anterior tarsi in male dilated.

Length 19-24 mm; width 7-8·5 mm.

Type material: Holotype ♂ and allotype ♀ (National Museum of Victoria collection); 3 ♂ 3 ♀ paratypes (E. T. Smith collection) all collected at Lowther, Blue Mountains, N.S.W., November, 1958, E. T. Smith.

Key to species of the genus *Blepegenes*

1. Sides of pronotum not spinose 2
   Sides of pronotum spinose 4
2. Elytra rounded at apex .. .. *cicatricosa*, sp. nov.
   Elytra terminates in a single spine at apex 3
3. All elytral intervals costate*) .. .. *nitidus* Blackburn.
   Elytral intervals costate only at sides .. .. *equestris* Pascoe.
4. Head with spines between base of antennae and eyes .. .. *aruspex* Pascoe
   Head without spines .. .. *lachrymosa* Carter.

Genus TRIBOLIUM Macleay.

A total of five species of the genus *Tribolium* have been recorded from Australia. Two of these are introductions (*confusum* and *castaneum*), but the remaining three (*myrmecophilum, antennatum* and *waterhousei*) are of Australian origin. To this latter group a new species (*apiculum*) is now added.

*) It should be noted that *nitidus* Blackburn is very difficult to separate from *equestris Pascoe*. The only distinguishing character given by Blackburn (1891) is that "*B. equestris* Pascoe, is a larger insect with the elytrae interstices costate only at sides". The unique type of *nitidus* is in the National Museum of Victoria collection, but as the abdomen has been damaged, the genitalia is not available for study. More material of *nitidus* is needed before satisfactory conclusions can be reached for separating the two species (*nitidus* and *equestris*).

Hinton (1948) produced an excellent key for separating *Tribolium* species of the world, and therefore only an abbreviated summary of characteristics is given here to facilitate identification of Australian species and to indicate the position of the new species described hereunder.

(*Numbers of couplets as in Hinton's Key*).

1. Pronotum with apex unmargined 6
6. Pronotum with base completely and distinctly margined .. 8
—. Pronotum with middle two thirds of base not margined .. .. (*myrmecophilum* Lea, *antennatum* Hinton).
8. Head with margins above eyes not elevated. Antennae club of three or five segments.. 17
—. Head with margins above eyes elevated to form a distinct ridge .. .. (includes *confusum* Jack Du Val).
17. Antenna with a sharply differentiated 3–segmented club 20
20. Head, pronotum, and elytra with numerous punctures not less than half as coarse as facets of eyes 21
21. Eyes separated beneath head by once or very little more than once the transverse diameter of the ventral part of an eye.. .. 23
23. Surface between punctures of head and pronotum dull or seminitid, with reticulate microsculpture. Elytra with one or more of intervals four to eight strongly carinate from base to apex .. 23A
—. Surface between punctures of head and pronotum smooth and strongly shining, without a visible microsculpture (at x 75). Elytra not or at most only indistinctly carinate .. .. (includes *waterhousei* Hinton.)
23A. (New section) Pronotum without large depressions on either side of median line .. .. *castaneum* Herbst.
—. Pronotum with large irregular depressions on either side of median line .. .. *apiculum*, sp. nov.

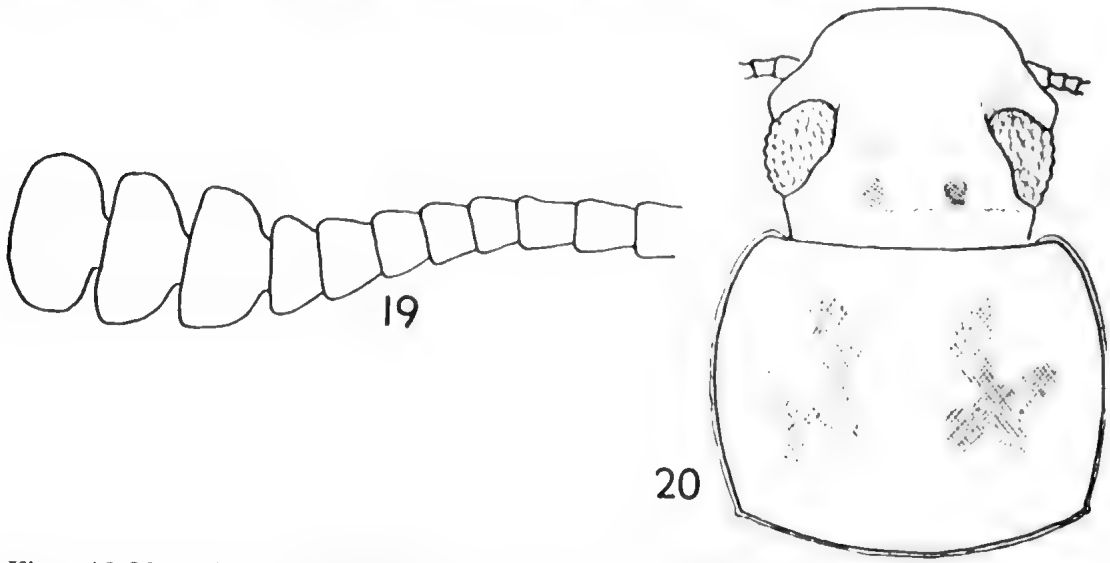
Tribolium apiculum, sp. nov.
(Figures 19-20).

Uniformly reddish brown species, body sub-parallel-sided, moderately convex with elytra somewhat depressed. Surface between punctures on the head and pronotum seminitid with fine but distinct microsculpture.

Head dorsally with moderately deep, round to elongate punctures, which are usually separated by about one or slightly less than one of their own diameters; a pair of depressions on the level with posterior margin of eyes; ventral surface smooth, very shiny. The narrowest part of eye as broad as six facets; eyes ventrally separated by less than the transverse (greatest) diameter of ventral part of an eye. Antenna with abruptly formed 3-segmented club; segments three to eight gradually widening (Fig. 19.)

Pronotum broader than long, posterior margin completely and distinctly carinate; lateral margin rather evenly rounded, anterior angles not produced forward beyond middle of anterior margin, latter not carinate; punctures mostly round, usually separated by approximately one to two of their own diameters; irregular shaped depdessions on either side of median line.

Elytra with first two or three intervals indistinctly, following ones distinctly carinate, striae with irregular row of dense punctures.



Figs. 19-20. *Tribolium apiculum*, sp. nov.: 19, antenna; 20, head and pronotum, shaded areas indicating depressions.

Females are separable from males by absence of the pit and associated brush of hairs on ventral side of anterior femur.

The carinate posterior margin of pronotum, distinctly 3-segmented antennal club, and presence of sub-basal ventral pit and associated brush of hairs on anterior femur in the male, indicates that this species belong to *castaneum* species-group, whereas general facia with its denser punctuation and somewhat rough surface greatly resembles *T. myrmecophilum* Lea.

This species was discovered by Dr. C. D. Michener in a nest of native bee *Trigona carbonaria* Smith. Length 4·9—5·0 mm.; width 1·7 mm.

Type material: Holotype ♂ and allotype ♀, Yarraman, Queensland. 16th February, 1959. C. D. Michener (National Museum of Victoria collection.)

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Family *ELATERIDAE*.

Hapatesus hirtus Candèze, (1863).

Description of larva.

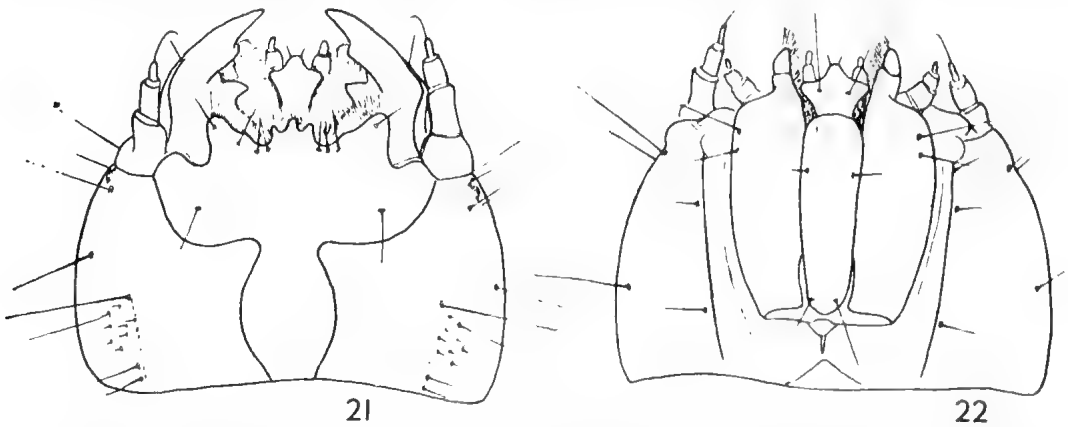
(Figures 21-26).

Larvae of this and some other not yet identified species are causing damage to potato crops in Gembrook area, Victoria. They were collected and bred by Mr. R. A. Van Baer of the Victorian Department of Agriculture and forwarded to the author for identification.

First reference to the larvae of *H. hirtus* was made by Baron von Müller (1891) in connection with damage done to the blue gum (*Eucalyptus globulus*). He refers to two wood boring beetles attacking these trees, but Froggatt (1923) queried the correctness of one being an elaterid. It is now certain that the larva of *H. hirtus* is not wood boring, as its presence in potatoes is typical of ground living larvae that feed upon various roots. Lea (1908) expressed the opinion that the larvae feed upon roots of beach plants on King Island, but since then it has been established (Neboiss, 1957) that his note refers to another species of the genus.

This is the first time that this species has been bred from larvae to adult stage, and it is therefore possible to describe larval characters. The natural food is still unknown, but it can be assumed that they would normally feed on roots of various plant species.

A number of specimens was available for examination, but their relative maturity is unknown. Body sub-cylindrical slightly depressed dorso-ventrally, the head and thoracic segments more so than the abdominal segments. Dorsal surface yellowish with pale narrow median line, thoracic segments and head gradually darkening, 9th segment yellowish brown; mandibles, nasale and apices of prongs almost black; ventral surface slightly paler than dorsum.



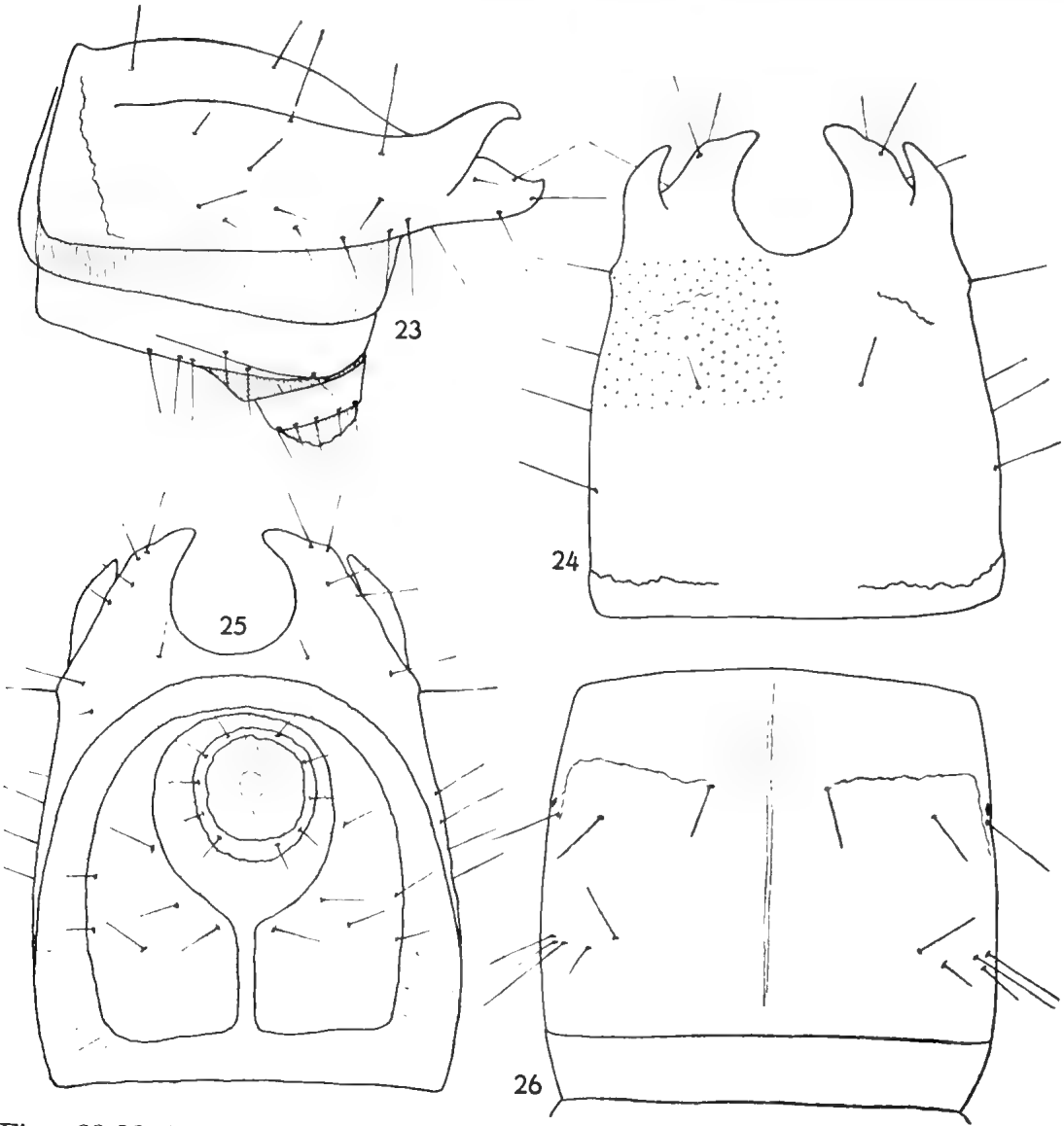
21 22

Figs. 21-22. *Hapatesus hirtus* Cand. larval head: 21, dorsal; 22, ventral.

Frontoclypeal region with posterior part extending back as far as foramen magnum. Nasale broad, terminating apically in three forward projecting denticles, two nasosulcal setae on each side of nasale. Paranasal lobes rounded apically, produced beyond nasale, each with a small single seta.

Epicranial plates very sparsely and finely punctate. Dorsal sulci rather indistinct, with one long anterior seta followed by a group of small setae. Ventral sulci with three setae. Eye spot indistinct. Mandibles slender, broad at base, suddenly narrowing at apical third, retinaculum well developed. Ventral mouth parts sub-parallel, stipes large sub-rectangular with two setae near antero-lateral angles. Maxillary palpae with segments sub-cylindrical narrowing towards apex. Postmentum with one pair of setae caudally and another pair approximately one-third from anterior end. Prementum somewhat cruciform with a pair of short setae at apex and another pair of longer ones just caudad of base of labial palpae.

Prothorax about three-quarter length of meso- and metathorax together; gradually narrowing anteriorly, wider than long. Two groups of setae one on either side of tergite; about five setae in anterior group but only three setae in posterior group.



Figs. 23-26. *Hapatesus hirtus* Cand. larva: 23, terminal segments lateral; 24, terminal segment dorsal, showing density of pits; 25, terminal segments ventral; 26, 7th segment dorsal.

Meso- and metathorax with only one seta near longitudinal branch of impression but with three setae near posterior margin. Abdominal tergites usually with three anterior and three to five posterior setae.

Legs short, sub-equal in length, covered with rows of short spines.

Ninth abdominal segment longer than wide. Dorsal surface somewhat flattened, covered with small round pits; caudal notch round; urogomphi separate, robust, bifid, with inner prongs directed inwardly, longer and stouter than outer prongs; the latter projecting upward and inward. Tenth abdominal segment surrounded by ten short rather prominent setae.

Length up to 23 mm. (fully distended 27·5 mm); width 2·5 mm.

Terminology is that used by Glen (1950).

Material examined: Fourty specimens Gembrook, Vic. June, 1959 and April, 1960. R. A. van Baer. (Specimens in Plant Research Laboratories and National Museum of Victoria collections.)

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REVISION OF THE GENUS *ARUNTA* DISTANT CICADIDAE, CICADINAE, DIVISION THOPHARIA HOMOPTERA—HEMIPTERA.

By A. N. Burns, M.Sc., F.R.E.S., Curator of Insects, National Museum of Victoria.

Plate M1, Figure M2.

Abstract.

The Australian genus *Arunta* Distant (1904) contains three species, two of which, prior to 1904, were included in the genus *Thopha,* the third species being added by Distant in 1921. Until 1904 the genus *Thopha* contained six species, but in his "Rhyncotal Notes" (Homoptera), Distant erected the genus *Arunta* to include two species which he considered showed characters diverse enough to be included in a new genus. The writer has studied carefully the characters shown by Distant, and to them has added further structural differences in support. It should be pointed out that species of both *Thopha* and *Arunta* are large insects bearing a strong superficial resemblance to one another; both genera are included in the Division *Thopharia* which is characterized by the immensity of the tympanal sacs, small operculae, and truncate lateral margins of the pronotum.

Introduction.

The cicadas belonging to this genus are confined to the eastern coastal region of Australia, two species (*A. perulata* and *A. interclusa*) occur in New South Wales and Queensland, the third species (*A. intermedia*) is confined to far northern Queensland. The writer has no experience of the latter species in the field, but *A. perulata* which ranges from a little over a hundred miles south of Sydney to 250 miles north of the Tropic of Capricorn at least, inhabits different species of trees on which it occurs at heights usually more than six feet from the ground. *A. interclusa* ranges from the northern rivers of New South Wales to northern Queensland as far as Kuranda at least, and in the writer's experience almost invariably occurs on mangrove trees fringing estuaries, and at an average height of six feet from the ground. Its song is not loud but is audible at a considerable distance. *A. intermedia* appears to be found only in far northern Queensland on Cape York Peninsula. Ashton (1921) in his description of this cicada states, "One male and two females in Coll. H. Ashton, collected by H. Elgner, 1906."

PLATE 1.
Blepegenes cicatricosa, sp. nov. ♀ paratype.

As already indicated, species of *Arunta* are very similar in appearance to species of *Thopha*; the principal differences between the two genera may be summarized as follows:—

Thopha: Head, including eyes, wider than the pronotum the width of which equals length of pro. and mesonotum (incl. cruciform elevation). Tympanal sacs extending to half the length of the abdomen; frons weakly grooved medianally and longitudionally in upper half, transverse ridges 14 in number.

Arunta: Head only slightly wider than the pronotum, the width of which is less than length of pro. and mesonotum (incl. cruciform elevation). Tympanal sacs extending to two thirds of the length of the abdomen; frons widely and strongly grooved medianally and longitudionally from vertex almost to clypeus, transverse ridges 10 in number.

Summary of External Morphology.

General: Large insects with stout bodies of which the length is two and a half times the width; anterior wings approximately one and a third times body length. Body brownish or yellowish brown marked with green; tympanal sacs in *A. perulata* and *A. interclusa* densely covered with white tomentum, not so in in *A. intermedia*. Wings clear vitreous. Head sculptured, lightly and finely pubescent, its width (including eyes) slightly more than three times its length, weakly trilobed, almost truncate; ocelli close together and almost equidistant; frons obtusely convex, grooved in front, rostrum extending to middle coxae. Thorax with width of pronotum slightly more than twice its length, sculptured, two sulci on either side of median, posterior margin well developed; mesonotum almost smooth, cruciform elevation only moderately developed, almost flat apically, metanotum visible dorsally as a narrow band. Anterior femora fairly strongly developed, bearing two moderately large spines. Posterior tibiae normally with six or seven spines. Length of anterior wings slightly more than three times their width; of posterior wings, twice their width. Abdomen smooth, pubescent along intersegmental margins; operculae very small, exterior margins curved outwards; tympanal sacs extending laterally to the fifth abdominal segment. Measurements of each species are given with its description. Individual label data is omitted in *A. perulata* and *A. interclusa* which normally are common species.

Key to the species of *Arunta*.

1. Wings clear vitreous, ocelli almost equidistant; head greenish yellow with dark markings, tympanal sacs extending laterally to the fifth abdominal segment 2

2. (I) Anterior wings with brownish infuscation bordering cross veins between R3 and R4 + 5, and R4 + 5 and MI; legs creamy yellow with brownish black markings, most extensive on anterior pair .. .. *perulata*

   Anterior wings without infuscation bordering cross veins as in *perulata*, legs creamy yellow with obscure pale brown markings.. 3

3. (I) Head and thorax greenish yellow with brown markings, ocelli pale lemon vitreous, cruciform elevation pale yellowish green .. .. .. *interclusa*

Tympanal sacs and ventral area of thorax and abdomen not invested with white tomentum 4

4. (I) Anterior wings with pale infuscation bordering cross veins between R3 and R4 + 5, and R4 + 5 and MI, pronotum reddish .. .. *intermedia*

Arunta perulata (Guèrin).

Cicada perulata Guèrin, 1830.—*Voy. Coquille,* Zool., 2: 180, pl. 10, figs. 5, 5A.

Thopha perulata Amyot and Serville, 1843.—*Hist. Hemip.*: 471.

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Arunta perulata Distant, 1904.—*Ann. Mag. Nat. Hist.,* (7) 14: 302.

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Cicada perulata Froggatt, 1907.—*" Australian Insects "*: 349.

Arunta perulata Distant, 1912.—*Gen. Ins.* 142: 21, pl. 2, figs. 18A, 18B, 18C.

Arunta perulata Ashton, 1914.—*Trans. roy. Soc. S. Aust.,* 38: 346.

Arunta perulata Ashton, 1921.—*Proc. roy. Soc. Vict.,* (N.S.), 33: 90.

A common species in some years in coastal New South Wales and southern Queensland. In the former State it is recorded from as far south as Conjola, 105 miles south of Sydney, and in Queensland as far north as Bowen, North Queensland. It is apparently much rarer in the north of that State inasmuch as the writer lived and collected for several years at Cairns, Mackay, and near Rockhampton but did not encounter this species. *A. perulata* is essentially a mid-summer insect, being found during December and January. Males appear to be considerably more numerous than females, and the species frequents various kinds of trees and at a height usually greater than eight feet from the ground.

Average body length, male, 37·5 mm., + 2·5 mm. — 4·0 mm.; female, 37·2 mm., + 2·5 mm. — 4·2 mm.

Head: Greenish yellow marked with dark reddish brown and invested with pale golden pubescence which is densest in depressed areas; very slightly wider than pronotum and with a sulcus on either side of median just exterior to each

lateral ocellus. Vertex of frons dark reddish brown with a yellowish green median groove which extends down the front as far as the clypeus. Ocelli greenish yellow vitreous, almost equidistant; anterior in line with fore margin of eyes. Antennae dark brownish black. Frons (excepting vertex) yellowish green, the interstitial grooves fairly densely invested with pale golden pubescence. Transverse ridges ten in number, well and evenly defined; clypeus black with lateral margins sometimes narrowly greenish, thickly covered with pale golden pubescence, two thirds length of frons; labrum pale yellowish green, smooth, planate laterally; labium pale yellowish green with a dark median longitudional very narrow groove anteriorly; genae pale yellowish green with a large dark brown central marking varying in size in individuals, and covered with long pale golden pubescence. Eyes opalescent dark reddish brown, orbits fringed with pale golden pubescence.

Thorax: Width (average) 15·5 mm., dark reddish brown; pronotum with three deep sulci on each side of median; a median greenish yellow longitudional marking extends from anterior margin for three quarters of length; posterior marginal band reddish brown, transverse, striate; exterior margins finely carinate. Mesonotum dark reddish brown, a small triangular darker brown marking on either side of median anteriorly; lateral margins fringed with pale golden pubescence; cruciform elevation slightly paler reddish brown tinged yellowish green, its anterior depression with golden pubescence posterior with pale golden. Anterior portion of metasternum with a shining black area on each side of median. Metanotum pale yellowish green, transverse, almost linear, densely clothed with pale golden pubescence.

Wings: Anterior, average length, male, 49·7 mm., width, 15·9 mm., female, 48·4 mm., 15 mm. Clear vitreous, veins reddish brown, area between C and R, R and R2, yellowish green; cross veins between R3 and R4 + 5, R4+5 and MI and in their angles, bordered infuscate brown; cell at base between R and Cu2 yellowish green in basal half. Posterior, average length, male, 28·5 mm., width, 15·2 mm., female, 28·7 mm., 15·2 mm. Clear vitreous, veins pale yellowish brown, anal cell opalescent white excepting apical portion; veins 1A, 2A, also margined opalescent white, widest basally. Legs yellowish green with dark brown and dull black markings, most extensive on anterior pair; moderately clothed with very fine pale golden (almost silvery) pubescence. Anterior pair with tibiae and tarsi, middle pair with distal of tibiae and tarsi, dark brown; posterior tibiae and tarsi (excepting terminal claws), pale yellowish green. Anterior femora with two brownish sharp pointed spines of which the anterior is the larger; posterior tibiae normally with six brown spines, three along inner and three along outer sides; on the latter the first just anterior to half way, the other two close together near distal, on the former the first at one third, others equidistantly spaced between it and distal. This is a variable character, but most constant in males; some however exhibit four spines on the inner row. Females frequently have three spines on the outer row and four on the inner, very rarely five. Occasionally specimens are found in which the total number of spines differs on each posterior tibia.

Abdomen: Dark brownish red with greenish suffusion across posterior margins of segments, lightly pubescent, last two or sometimes three, segments with white tomentum. Tympanal sacs white, extending laterally to fifth abdominal segment; opercula small, white, interior margins widely separated, interior angles rounded, exterior openly so. Underside of abdomen greenish yellow with median areas of segments black; lateral expansions covered with

white tomentum. In the female the dorso-lateral and lateral areas of the first two abdominal segments are covered with white tomentum, and the black areas on the ventral surface are more restricted. Specimens from Rockhampton and Bowen are slightly smaller than those from southern Queensland and New South Wales and are lighter in colour, and show less infuscation bordering the cross veins in the anterior wings.

Type?

Arunta interclusa (Walker).

Thopha n. sp. Walker, 1851.—*List Hom. Br. Mus.*, Pl. 1, fig. 6.

Thopha interclusa Walker, 1858.—Ibid. Suppl.: 5.

Henicopsaltria interclusa Stäl, 1866.—*Berl. Ent. Zeitschr.*, 10: 171.

Henicopsaltria interclusa Goding and Froggatt, 1904.—*Proc. Linn. Soc. N.S.W.*, 29: 576.

Arunta interclusa Distant, 1906.—*Syn. Cat. Hom.*, I.: 27.

Arunta flava Ashton, 1912.—*Rec. Aust. Mus.*, 9; 76, Pl. 7, figs. 1-2.

Arunta interclusa Distant, 1912.—*Proc. Linn. Soc. N.S.W.*, 37: 600.

Arunta interclusa Ashton, 1914.—*Trans. Roy. Soc. S. Aust.*, 38: 346.

Arunta interclusa Ashton, 1921.—*Proc. Roy. Soc. Vict.*, (N.S.), 33: 90.

This pretty species is more local than *perulata,* and much more abundant in some seasons than others. From information supplied, and in the writer's experience, it is found nearly always on Mangrove trees, rarely on other trees growing amongst Mangroves along the fringes of estuaries where tidal influence is felt. At Mackay, North Queensland, the writer captured specimens from Mangrove trees which at full tide had at least two feet of water covering their roots. It is an easy insect to capture, and usually rests at from six to eight feet from the ground. Females are very much scarcer than males, the ratio being about 40 males for every female captured. *A. interclusa* is confined to the tropical and sub-tropical estuarine areas of northern New South Wales and Queensland, the range (in the writer's experience) being from the Richmond River in the former State to Mackay, Queensland. A single specimen (female) from Kuranda N.Q., in the collection of the S.A. Museum, was examined by the writer. It would not be collected from Mangroves as they do not occur there, the nearest being about four miles distant in a straight line.

Average Body Length: Male, 30·5 mm. + 2·0 mm., — 3·2 mm., female 29·5 mm. + 1·5 mm. — 3·0 mm.

Head: Greenish yellow with dull black markings and silvery pubescence in depressions; slightly wider than pronotum; a median groove from anterior ocellus to posterior margin, and another shallow groove exterior to each lateral ocellus. Vertex of frons black with a shallow median groove which opens out into a wide groove extending down the front of the frons to the clypeus. Ocelli greenish-orange vitreous, almost equidistant, anterior in line with fore margin of eyes. Antennae black. Frons, (excepting vertex) greenish yellow suffused brownish; median groove and furrows between transverse ridges invested with silvery pubescence; ridges ten in number, clearly defined. Clypeus yellowish green with basal portion dark brown, clothed with silvery pubescence. Labrum yellowish green; labium yellowish green, very finely grooved longitudionally, brown, apex brownish. Genae black with exterior margins yellowish green; carinate, thickly invested with long silvery pubescence. Eyes opalescent reddish brown, orbits fringed with silvery pubescence.

Thorax: Width, (average) 14 mm., yellowish green, sculptured; pronotum with two blackish sulci on either side of median, a slightly lighter coloured median patch bordered black extending from anterior margin for three quarters of length; posterior marginal band wide, greenish yellow, transverse, very finely striate; exterior margins slightly paler in colour. Mesonotum yellowish green, a small triangular blackish patch, edged light brown, on each side of median anteriorly, exterior to these a much larger similarly coloured patch extending to two thirds; a median black marking arising between the two small dorsal patches and extending to anterior face of cruciform elevation; this, and lateral margins clothed with silvery pubescence. Cruciform elevation pale yellowish green; smooth apically and with a minute longitudional groove along its apex. Anterior portion of mesonotum with a brownish area on each side of median. Metanotum pale yellowish green, almost linear, finely silvery pubescent.

Wings: Anterior, average length, male, 40·4 mm., width, 13·6 mm., female, 38 mm., 14·25 mm. Clear vitreous, veins greenish yellow, area between C and R, R and R2, greenish; cell at base between R and Cu2 greenish in basal half. Posterior, average length, male, 23·8 mm., width, 12·5 mm., female, 22 mm., 11·7 mm. Clear vitreous, veins greenish yellow, 3A, 2A, and basal portion of Cu1 edged opalescent greenish white, 3A broadly so basally, others less so. Legs, pale yellowish green, clothed with very fine silvery pubescence; anterior tibiae and tarsi brownish, middle and posterior femora suffused brownish, terminal claws black. Anterior femora with two small sharp teeth, the distal longest and tipped black. Posterior tibiae normally with six spines; three on the outer side, the first at half way, others equidistant to distal; three on the inner side, the first at one quarter, others almost equidistant to distal. As in the preceding species this character is variable and specimens of both sexes may exhibit three spines on the outer row and four on the inner. Rarely individuals are met with in which the total number of spines differs on each posterior tibia.

Abdomen: Black with posterior margins of segments greenish yellow and silvery pubescent; terminal segments suffused greenish, pre-apical segment thickly tomentose white. Tympanal sacs pure white, extending laterally to fifth abdominal segment; operculae small, recurved outwards; interior margins widely separated, interior angles rounded; exterior openly so. Underside of

abdomen greenish yellow with median areas of segments black; lateral expansions and segmental margins silvery pubescent. In the female the abdomen is greenish brown densely overlaid with silvery pubescence; underside as in the male but lighter in colour.

Type, Brit. Mus.

Type of *A. flava Ashton,* Aust. Mus.

ARUNTA INTERMEDIA Ashton.

Arunta intermedia Ashton, 1921, Proc. Roy. Soc. Vict., 33: 91.

Apparently three specimens only (one male and two females) of this species have been collected, taken on Cape York Peninsula by the late H. G. Elgner. These specimens were included in the Howard Ashton collection which is now in the Australian Museum, Sydney. Unfortunately much of the material in this valuable collection was destroyed before it was received by the Australian Museum, and the single male and one female of this species were lost. Through the courtesy of Dr. Evans and the late Mr. Musgrave of the above Museum, I have been privileged to study the single remaining female.

Body length: 34·5 mm.

Head: Greenish yellow with black frontal markings and fine pale golden pubescence densest in depressions; slightly wider than pronotum, vertex with a median " V " shaped groove from anterior ocellus to posterior margin; exterior to each lateral ocellus another groove extending almost from posterior margin to the frons. Vertex of frons black with pale golden pubescence, deeply cleft medianally from posterior margin to clypeus. Ocelli yellowish orange vitreous, almost equidistant, anterior behind anterior margin of eyes. First antennal segment brownish black, remaining segments missing from specimen. Frons (excepting vertex) yellowish brown suffused greenish darkening to brown in front; with ten well defined transverse ridges invested with pale golden pubescence. Clypeus brownish shading to brownish yellow near labium, pale golden pubescent; slightly keeled medianally and longitudionally, devoid of pubescence on keel. Labrum yellowish, grooved longitudionally; labium yellowish, shading to brownish yellow at apex, grooved longitudionally. Genae densely covered with pale golden pubescence completely excluding basal colouration. Eyes opalescent reddish brown; orbits pale golden, pubescent posteriorly.

Thorax: Width 13·5 mm., brownish yellow with black markings, not strongly sculptured; pronotum with two black sulci on either side of midline, a lighter median patch bordered black from anterior margin to three quarters, posterior marginal band finely striate transversely, paler in colour. Mesonotum yellowish brown, tinged greenish, pale golden pubescent along anterior and lateral margins; a small triangular black marking on each side of midline anteriorly, another interrupted black patch broadest anteriorly on each side and extending as far as cruciform elevation; a median narrow black marking from near anterior margin to cruciform elevation; the latter yellowish green, smooth, pale golden pubescent in anterior and lateral depressions. Metanotum yellowish green with pale golden pubescence.

Wings: Anterior, length, 45 mm., width, 14 mm., clear vitreous with all veins brownish yellow; cross veins between R3, R4 + 5, and MI edged pale brown infuscation; basal cell partly infuscate yellowish. Posterior, length 23 mm., width, 12·5 mm., clear vitreous, all veins yellowish brown excepting 3A which is dark brown; this and 2A basally bordered white. Legs yellowish green with brownish markings on distal portion of femora; tarsi brownish yellow, terminal claws (where present) tipped black. Posterior tibiae with eight spines; three on outer side, of which two are near distal and the other very small at one third; five on inner side, first opposite anterior small spine of outer side, second just before half way, third just beyond, fourth and fifth close together near distal. Anterior femora with two small sharp teeth; anterior the larger, directed forwards, posterior darker, directed outwards.
Abdomen: Yellowish brown with pale golden pubescence, a black marking on each side of terminal segment. Underside paler, segment 5—8 each with a central black marking.

Syntype: Australian Museum, Sydney.

ACKNOWLEDGEMENTS.

The writer wishes to thank the following for loan of specimens and generous assistance in obtaining material for study. Dr. J. A. Evans and the late Mr. A. Musgrave of the Australian Museum, Sydney; Mr. H. Hale and Mr. G. Gross of the South Australian Museum; Mr. G. Mack of the Queensland Museum; Dr. T. E. Woodward of Department of Entomology, University of Queensland; the late Mr. F. E. Wilson, honorary worker in entomology National Museum of Victoria; Dr. John Kerr of Brisbane; and Mr. F. Dodd of Coramba, New South Wales.

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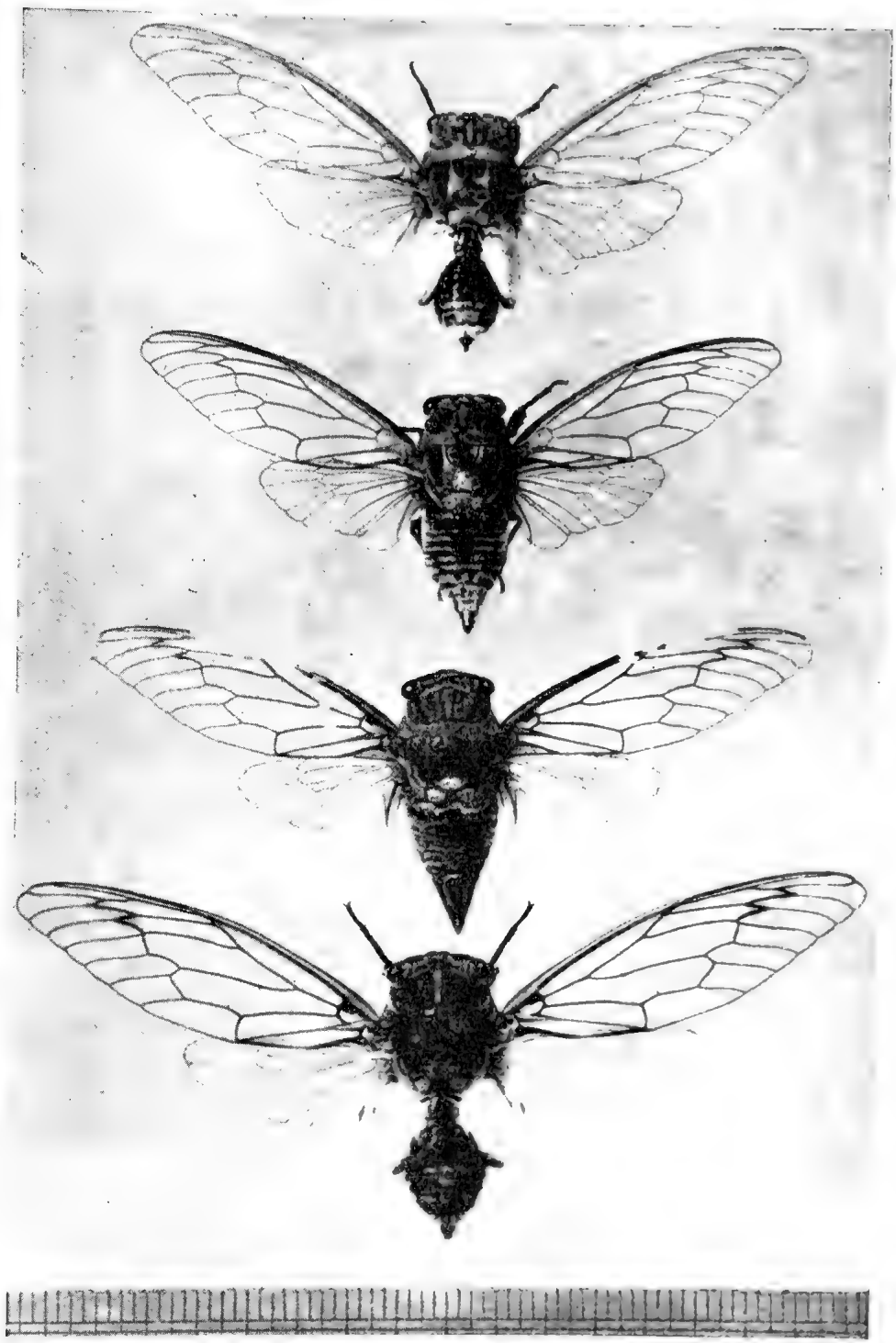

PLATE I.

FIG. 1.—*Arunta interclusa*, male.
2.—*Arunta interclusa*, female.
3.—*Arunta intermedia*, female.
4.—*Arunta perulata*, male.

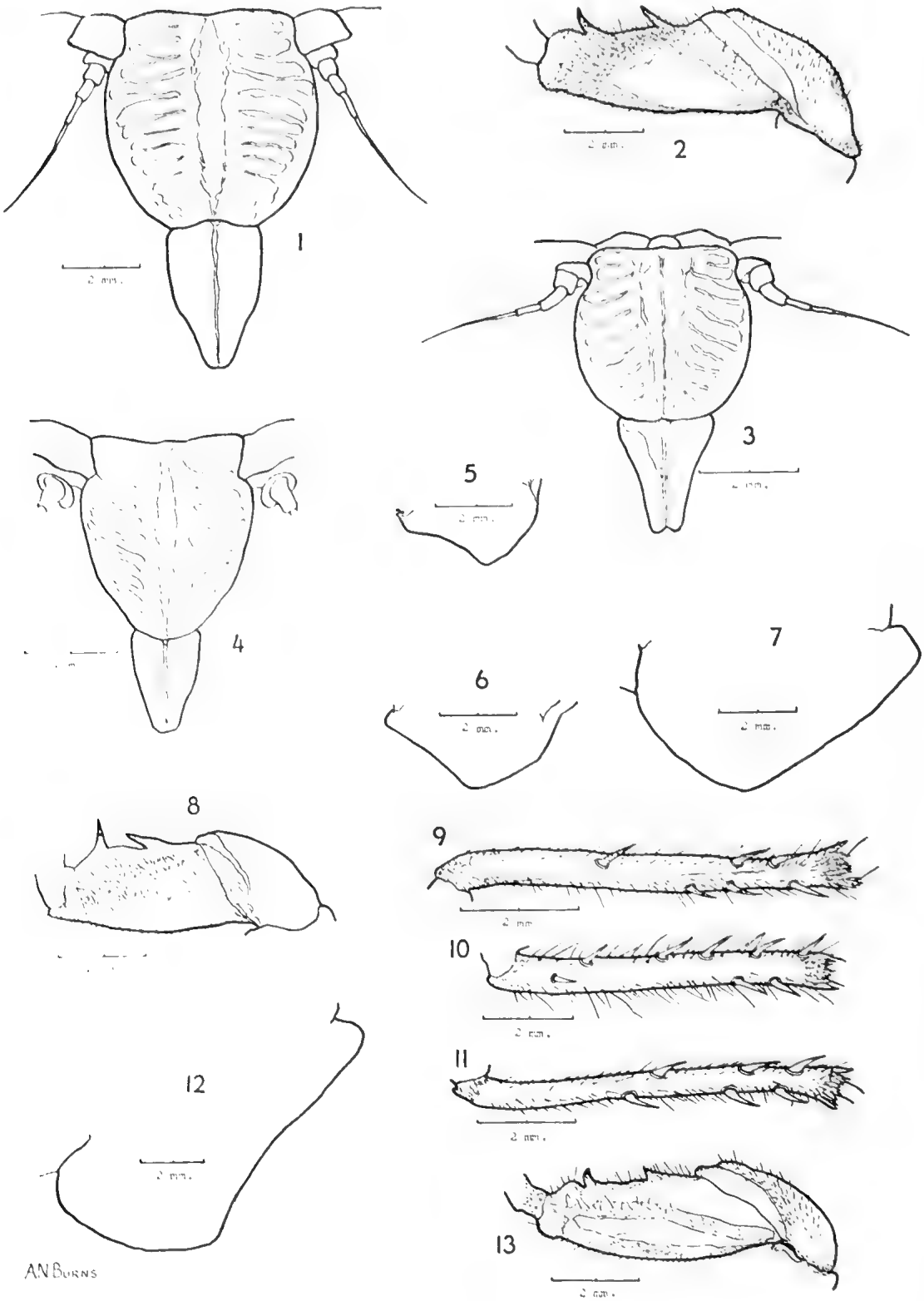

PLATE 2.

FIG. 1.—*Arunta perulata* (male), frons.
2.—*Arunta perulata* (male), anterior femur.
3.—*Arunta interclusa* (male), frons.
4.—*Arunta intermedia* (female), frons.
5.—*Arunta interclusa* (female), operculum.
6.—*Arunta intermedia* (female), operculum.
7.—*Arunta interclusa* (male), operculum.
8.—*Arunat intermedia* (female), anterior femur.
9.—*Arunta perulata* (male), posterior tibia.
10.—*Arunta intermedia* (female), posterior tibia.
11.—*Arunta interclusa* (male), posterior tibia.
12.—*Arunta perulata* (male), operculum.
13.—*Arunta interclusa* (male), anterior femur.

REVISION OF THE GENUS *THOPHA* AMYOT AND SERVILLE CICADIDAE, DIVISION THOPHARIA HOMOPTERA–HEMIPTERA

By A. N. Burns M.Sc., F.R.E.S., Curator of Insects, National Museum of Victoria

Abstract

This genus erected by Amyot and Serville (1843) contains four species one of which (*saccata*) has been known for over 150 years. Prior to 1904 the genus contained four species, but in that year Distant erected the genus *Arunta* to which he transferred two species. In 1907 and 1910 respectively Distant added two more species to *Thopha* bringing the total back to four species. The main differences between *Arunta* and *Thopha* have already been set out under *Arunta,* it should be added however that in *Thopha* the eyes are strongly pedunculate. Two of the species rank probably as the two largest cicadas in Australia, and they are similar in size and pattern of markings.

Introduction

The geographical distribution of the genus is interesting, two species (*saccata* and *sessiliba*) occur near the coast where the rainfall exceeds thirty inches a year, it is possible also that *nigricans* occurs in a region of similar rainfall, but *colorata* is definitely a dry country species; *saccata* is found in eucalyptus forest in a wide coastal strip from a little south of Sydney to some distance north of Brisbane, and at Mareeba on the Atherton Tableland. *Sessiliba* has a coastal as well as inland range of distribution being found in savannah forest; it ranges from southern Queensland (Gatton, Brisbane) along the coast of northern Australia to Wyndham, and in inland districts ranging from the Northern Territory (coastal) to Batchelor and Tennants Creek to Mundiwindi in Western Australia. Both species are at times very abundant, and are referred to as " Double Drummers " on account of the loudness and penetrating qualities of their song. They seem to prefer eucalyptus and angophora trees, and often climb to the uppermost branches of high trees especially if the weather is sunny. In warm dull weather however specimens may often be taken from the trunks of both large and small trees at heights only a few feet from the ground. *T. colorata* has an interesting range of distribution which appears mainly to follow a strip running across the continent from near Alice Springs to Carnarvon on the coast of Western Australia. I have been informed that it frequents fairly large trees, mainly eucalyptus. For information about *T. nigricans* I am indebted to Mr. Izzard of the British Museum (Natural History) for figure and structural details.

THOPHA COLORATA Distant.

Thopha colorata Distant, 1907.—*Ann. Mag. Nat. Hist.* (7), 20: 411.

Thopha colorata Ashton, 1914.—*Trans. Roy. Soc. S. Aust.*, 38: 346.

Thopha colorata Ashton, 1921.—*Proc. Roy. Soc. Vict.* (N.S.), 33: 89.

This species is apparently not rare but rather local and is a dry country cicada. All specimens examined by the writer came from Alice Springs, Hermannsburg, and Carnarvon W.A., and label data indicates that it is an early summer species, November and December.

Average body length, male, 38·6 mm., female, 38·2 mm.; maximum of specimens examined, males, (I2) 42· mm., females, (3) 39· mm.; minimum, males, 37· mm., females, 37·5 mm. Head yellowish brown with a black transverse bar between eyes enclosing ocelli, sculptured with numerous longitudional grooves, a median sulcus from anterior ocellus to posterior margin. Frons black with yellowish brown vertex, front with a wide median, longitudional groove, normally ten transverse ridges visible, interstitial depressions with very short greyish pubescence. Ocelli garnet vitreous, not equidistant, anterior in midline of eyes. Genae black, lightly invested with fine greyish pubescence. Antennae black; clypeus black, keeled longitudionally, half length of frons; labrum brown, sides planate; labium brownish black, grooved medianally and longitudionally. Eyes opalescent reddish brown, orbits not pubescent.

Thorax, average width 17 mm., yellowish brown; pronotum faintly sculptured, unicolorous with exterior margins edged black; three sulci on either side of median, posterior marginal band wide, transversely striate; mesonotum yellowish brown with black markings, anterior margins finely golden pubescent; close to median on each side a small triangular black marking anteriorly, dorso laterally another " 7 " shaped marking from anterior margin to external angle of cruciform elevation, and a black dorsal marking in its interior angle narrowing to a point at anterior margin. Cruciform elevation yellowish brown with a black median longitudional line, angles lightly silvery pubescent. Metanotum reddish brown. Wings, anterior, average length, male, 48·1 mm., width, 16·8 mm.; female, 48·2 mm., 16·8 mm. Clear vitreous, veins yellowish brown excepting costal which is brownish black. Posterior, male, 28·0 mm., 13·0 mm.; female, 27·5 mm., 12·5 mm. Clear vitreous with veins yellowish brown; 2A and 3A bordered brownish orange. Legs brown, unicolorous, lightly clothed with fine short silvery pubescence. Anterior femora with two sharply pointed spines of about equal size; posterior tibiae with five spines; three on inner side, the proximal at middle, third near distal, second just beyond half way between; two on outer side and approximately opposite one and three of inner row. Underside of thorax yellowish brown mid-ventrally, yellowish laterally, dusted with white tomentum.

Summary of External Morphology.

General: Very large insects with robust bodies of which the length is a little over twice the width; the anterior wings approximately one and a quarter times body length. Body reddish brown or yellowish brown marked mainly with black, tympanal sacs very large but not covered with white tomentum. Wings clear vitreous, head sculptured, almost devoid of pubescence, slightly wider than pronotum, eyes pedunculate, ocelli small and grouped closely together, distance between two posterior almost twice that between anterior and each posterior, frons rather weakly and obtusely convex, grooved in front, rostrum extending to posterior coxae. Thorax with width of pronotum twice its length, sculptured, three sulci on either side of median, posterior margin well developed, very slightly concave, mesonotum almost smooth, cruciform elevation clearly but not strongly developed, rounded apically, metanotum only partly visible dorsally. Anterior femora not strongly developed, bearing two sharply pointed spines. Posterior tibiae normally with five or six spines; length of anterior wings just exceeding three times their width; of posterior, twice. Abdomen smooth, slightly pubescent dorsally on first three segments, sparingly on medians, fairly dense 7-9. Operculae small, (slightly larger than in Arunta) interior margins separated, exterior recurved; tympanal sacs very large and extending laterally almost to segment four. Remaining abdominal segments compressed. Measurements of each species are given with description.

Genotype: *Tettigonia saccata* Fabr. 1803, "Syst. Rhyng.": 34-9.

Key to the species of Thopha.

1. Wings clear vitreous, eyes pedunculate, head wider than pronotum, tympanal sacs (males) extending laterally almost to fourth abdominal segment 2

2. (I) Head with a black transverse band between eyes enclosing ocelli; anterior to this a yellowish brown transverse band of similar width; frons (excepting vertex), genae, and ventral surface of head, black .. .. *colorata*

   Head and frons not banded transversely, ocelli almost equidistant and same colour as head, vitreous 3

3. (I) Head, including frons, uniform deep purplish brown, posterior tibiae with six spines (male) .. .. *nigricans*

   Head not of uniform colour, ocelli not same colour as head .. 4

4. (I) Head black, a narrow interrupted yellowish brown band across front, a similar band across back of head, ocelli small, dark red vitreous .. .. *saccata*

   Head not black or unicolorous, ocelli not equidistant and of same colour as vertex of head 5

5. (I) Head reddish brown with light plum coloured suffusion, a pale yellowish transverse band across front, legs unicolorous with tympanal sacs .. .. *sessiliba*

Abdomen black with pre-anal segment thickly invested with white tomentum; tympanal sacs brown, extending laterally almost to fourth segment; opercula pale yellowish brown, interior margins fairly widely separated, interior angles acutely rounded, exterior openly so. Underside of abdomen brownish black with some white tomentum along base of tympanal sacs and on ventral angles of sternites.

Type: British Museum.

THOPHA NIGRICANS Distant.

Thopha nigricans Distant, 1910.—*Ann. Soc. ent. Belg.*, 54: 415.

An apparently rare or local species recorded by Distant (1910) as being allied to *T. sessiliba*, but recorded as differing from that species by the shorter and broader abdomen, strongly pedunculate eyes, and black head and thorax. I am indebted to Mr. R. J. Izzard of the British Museum (Natural History) for structural details and figure of this cicada. He expresses the opinion with which I agree, that this species is a colour variety of *T. sessiliba*. It is recorded only from North Queensland, the precise locality not being given.

Body length, male, 43 mm., female, 41 mm.; two specimens only examined. Head uniformly deep purplish brown, slightly darker in the male; wider than pronotum. Ocelli purplish brown vitreous, almost equidistant; antennae deep purplish brown. Frons unicolorous with head and showing nine visible transverse ridges (both sexes); genae purplish brown, invested with greyish pubescence. Labrum brown, slightly over half length of frons; labium brown; eyes opalescent brown.

Thorax, width, male, 18 mm., female 18 mm.; pronotum deep purplish brown, three sulci on either side of median, grooves and depressions pubescent, greyish. Mesonotum deep purplish brown, slightly pubescent in female, not so in male, excepting in grooves and sulci. Cruciform elevation purplish brown with greyish pubescence in depressed areas. Wings, anterior, length, male, 56 mm., width, 19 mm.; female, 56 mm., 17 mm.; clear vitreous with veins brownish yellow. Posterior, length, male, 31 mm., width, 14 mm.; female, 30 mm., 15 mm.; clear vitreous with veins light brown. Legs purplish brown of same shade as body in both sexes. Anterior femora with two rather sharp spines about equal in size, the first at proximal third, other at distal third; posterior tibiae (male) with six spines, three on inner margin, three on outer; female with five spines, three on inner margin, two on outer.

Abdomen deep purplish brown, sparsely pubescent excepting for penultimate tergite which is thickly invested with white tomentum. Tympanal sacs unicolorous with body, extending laterally almost as far as fourth segment; operculae purplish brown, interior margins fairly widely separated, interior angles rather sharply rounded, exterior obtusely so. Underside of abdomen coloured similarly to above, slightly pubescent at junctions of tergites and sternites.

It is probable that this species closely resembles *T. sessiliba,* to which it is allied, in habits. The writer has collected the latter many times in the Cairns area; in some seasons it is very common in eucalyptus forest, but over a number of years residence there, he did not encounter *T. nigricans.*

THOPHA SACCATA (Fabricius).

Tettigonia saccata Fabricius, 1803.—*" Syst. Rhyng."*: 349.

Cicada saccata Germar, 1830.—*In Thon. " Ent. Arch."* (2) : 5, 57.

Cicada saccata Guérin, 1838.—*Mag. Zool.,* 9: 80, pl. 238.

Thopha saccata Amyot and Serville, 1843.—*" Hist. Hem."*: 471.

Thopha saccata Stäl, 1869, *" Hem. Fabr."* 2: 6, 1.

Thopha saccata Froggatt, 1903.—*Agric. Gaz. N.S.W.,* 14: 340, 419 fig. 3.

Thopha saccata Goding and Froggatt, 1904.—*Proc. Linn. Soc. N.S.W.,* 29: 571.

Thopha saccata Distant, 1906.—*" Syn. Cat. Hom.",* 1: 26.

Thopha saccata Froggatt, 1907.—*" Australian Insects "*: 348, fig. 154.

Thopha saccata Jarvis, 1912.—*Qld. Nat.* : 229-232.

Thopha saccata Ashton, 1914.—*Trans. Roy. Soc. S. Aust.,* 38: 346.

Thopha saccata Ashton, 1921.—*Proc. Roy. Soc. Vict.* (N.S.), 33: 89.

Thopha saccata Musgrave, 1926.—*Aust. Mus. Mag.,* 2: 405, figs.

Thopha saccata Tillyard, 1926.—*" Insects of Australia and New Zealand "*: 162.

Thopha saccata McKeown, 1942.—*" Australian Insects "*: 98.

A very pretty cicada and one of, if not the largest species in Australia. It is a very well known insect which ranges along the coastal strip from a little south of Sydney to some distance north of Brisbane, also at Mareeba, North Queensland. On account of the loudness and penetrating qualities of its song, it has for many years been commonly known as " The Double Drummer ". It is very abundant in certain seasons, especially

in localized areas between Sydney and Brisbane where it favours fairly open eucalyptus forest with angophoras and tristanias intermixed. In hot weather it seeks the higher branches of tall trees, but in warm dull weather or showery weather it is not uncommon to find many specimens on tree trunks a few feet from the ground.

Average body length, male, 47·5 mm.; female, 51·2 mm.; maximum of specimens examined, males, (8) 50·0 mm., females, (7) 52·5 mm.; minimum, males, 42·0 mm., females, 47·5. Head wider than pronotum, deep black, sculptured, an interrupted transverse narrow pale brownish band across vertex just posterior to ocelli; another narrower similar interrupted band across front and vertex of frons; a short median sulcus from anterior ocellus to posterior margin. Frons deep black with a few fine long greyish hairs on lateral margins, widely and openly depressed in front, a short groove at anterior angle of vertex; normally ten transverse ridges visible. Ocelli garnet vitreous, not quite equidistant, anterior slightly in front of eyes. Genae black with very light investment of fine grey pubescence, lateral margins carinate, pale brown. Antennae black. Clypeus black, with a median longitudional keel, slightly more than half length of frons; labrum dark brown, planate laterally, with a median longitudional groove; labium brownish black, grooved as labrum. Eyes opalescent dark brown slightly tinged reddish.

Thorax, average width, 20 mm.; light to dark fuscous with black markings. Pronotum with three sulci on each side of median, the raised areas between with vermiculate sculpturing; anterior margins of these areas, black; posterior marginal band wide, faintly transversely striate. Mesonotum slightly paler than pronotum, finely silvery pubescent on lateral margins; two black spots anteriorly on each side of median, the inner pair to one third, outer "7" shaped and almost reaching anterior arms of cruciform elevation; a small elongate central median black spot, and a black dot near base of anterior angles of cruciform elevation. Cruciform elevation fuscous, its posterior lateral areas with four transverse grooves. Metanotum dark brown. Wings, anterior, average length, male, 60·2 mm., width, 20·9 mm.; female, 62·2 mm., 21·4 mm.; clear vitreous with veins pale fuscous, sub-costal darker basally, 1A brownish black. Posterior, average length, male, 34·1 mm., width, 19·1 mm.; female, 34·9 mm., 19·6 mm.; clear vitreous with veins slightly paler, area 3A faintly translucent whitish. Legs dark brown, finely pubescent grey, anterior coxae and proximal portion of femora with black opaque markings; anterior femora with two small spines of about equal size; posterior tibiae normally with five spines, three on inner margin, the proximal half way, median half way between to distal, third near distal; two on outer margin being almost opposite proximal and distal of inner margin. Underside of thorax dark reddish brown, with very fine silvery pubescence. Abdomen, dark reddish brown, segments one and two black dorsally, three partly so, and remainder with a median black spot; some scattered short silvery pubescence dorso-laterally. Tympanal sacs dark reddish brown, extending laterally almost to fourth segment. Operculae brownish black, interior margins widely separated, interior angles sharply rounded, exterior broadly so. Underside of abdomen as above, intersegmental margins narrowly darker, junction first and second segment and base of opercula, and immediate junctions of tergites and sclerites segments three to eight dusted with white pubescence.

This cicada is larger and more stoutly built and the markings darker than *T. sessiliba* to which it bears a superficial resemblance. It is fairly constant in colour and pattern of markings; sometimes however females are met with which are darker in colour with the markings obscure or some even absent; such specimens are always more densely pubescent than normal ones, especially on the underside. Amongst the many specimens examined are two females and one male from Mareeba, North Queensland; the male is smaller than southern examples and has the ground colour dark brownish-black with the markings obscure and the sub-costal vein of the anterior wings brownish-black from base to apex; the females are almost normal in size, brownish-black; sub-costal veins as in the male, and generally more pubescent than normal southern specimens. *T. saccata* does not appear to extend its range northwards on the coast much further than Brisbane; Mareeba is over 1,000 miles north of Brisbane and about 2,000 feet above sea level with eucalyptus forest; the altitude gives it a climate similar to that of Brisbane including that of rainfall (49-50 inches average) though Kuranda, only 22 miles distant on the edge of the tableland, has about 90 inches.

Type: ?

THOPHA SESSILIBA Distant.

Thopha sessiliba Distant, 1892.—*Ann. Mag. Nat. Hist.* (6), 9: 314.

Thopha stentor Buckton, 1898.—*The Home Univ. Mag.* &c. (Haslemere), 1: 37.

Thopha sessiliba Goding and Froggatt, 1904.—*Proc. Linn. Soc. N.S.W.*, 29: 572.

Thopha sessiliba Distant, 1906.—" *Syn. Cat. Hom.*", 1: 26.

Thopha sessiliba Froggatt, 1907.—" *Australian Insects* ": 349.

Thopha sessiliba Distant, 1912.—" *Gen. Ins.*" 142: 21, pl. 3, figs. 17A, 17B, 17C.

Thopha sessiliba Ashton, 1914.—*Trans. Roy. Soc. S. Aust.*, 36: 346.

Thopha sessiliba Ashton, 1921.—*Proc. Roy. Soc. Vict.* (N.S.), 33: 89.

Thopha sessiliba Tillyard, 1926.—" *Insects of Australia and New Zealand* ": 162.

This species, as mentioned previously, ranges from near Brisbane through coastal northern Queensland and the Northern Territory to Wyndham, and some inland districts as far as Mundiwindi in Western Australia. It is very doubtful if the habitat, Sydney given by Distant (Ann. Mag. Nat. Hist. (6) : 315, 1892) is correct. The song of this cicada is loud and penetrating but not as much so as that of *T. saccata*. In some seasons it is very abundant in eucalyptus forest near Cairns, and on parts of the Atherton Tableland.

Average body length, male, 45·6 mm.; female, 45·6 mm.; maximum of specimens examined, males (7), 46·5 mm., females (6), 50·0 mm.; minimum, males, 44·0 mm., females, 43·5 mm. Head wider than pronotum, brown with a light purplish tinge; grooved longitudionally, the median groove being deepest, depressions dusted fine golden pubescence; a creamy yellow transverse band across front including vertex of frons, another obscure similar interrupted band across vertex of head extending almost to each eye. Frons coloured as head, a faint median groove at anterior vertical angle, lateral margins fringed with long golden fine hairs; normally ten transverse ridges visible. Ocelli purplish brown vitreous, not equidistant, anterior well in front of eyes. Genae concolorous with frons, finely golden pubescent, lateral margins carinate, narrowly edged creamy yellow. Antennae dark brownish. Clypeus concolorous with frons, palely golden pubescent; about half length of frons, with median longitudional keel. Labrum pale brown, sides planate, grooved as labrum; labium pale brown, darker laterally, grooved as labium. Eyes opalescent brown tinged purplish.

Thorax, average width 18·5 mm.; brown with purplish tinge and yellowish brown markings. Pronotum paler than mesonotum and with three sulci on each side of median, slightly sculptured, depressions finely silvery pubescent; a central darker marking from anterior margin to posterior marginal band which is pale yellowish brown and finely striate transversely. Lateral margins narrowly dark brown. Mesonotum dark brown suffused purplish, a pale brown narrow triangular marking on each side of median from anterior margin to cruciform elevation; exterior margin thickly pubescent, pale golden. Cruciform elevation pale yellowish brown; pubescent in anterior and lateral depressions, the latter with (normally) four transverse grooves. Metanotum dark purplish brown. Wings, anterior, average length, male, 58·6 mm., width, 20·6 mm.; female, 57·2 mm., 20·3 mm. Clear vitreous with veins brownish; posterior, average length, male, 34·3 mm., width, 17·8 mm.; female 32·1 mm., 17·5 mm.; clear vitreous with veins paler yellowish brown, area 3A very faintly translucent whitish. Legs concolorous with mesonotum and tympanal sacs, very finely silvery pubescent. Anterior femora paler along ventral and with two small spines of nearly equal size; posterior tibiae normally with five spines, three on inner margin, the proximal at half way, second half way from proximal to distal, third almost at distal; two on outer margin, the first just beyond half way between median and distal of inner margin, second just anterior to distal of inner margin.

Underside of thorax reddish brown almost obscured with white tomentum. Abdomen, dark brown with purplish suffusion, segments one and two silvery pubescent dorsally, others with scattered pubescence dorsally on

segments seven and eight. Tympanal sacs coloured as abdomen, extending laterally almost to fourth segment. Opercula greyish brown, interior margins widely separated, interior angles almost equally rounded, exterior obtusely so. Underside of abdomen paler than upperside, junctions of tergites and sternites silvery pubescent and a faint dusting on intersegmental margins of segments three to seven inclusive.

Type: British Museum.

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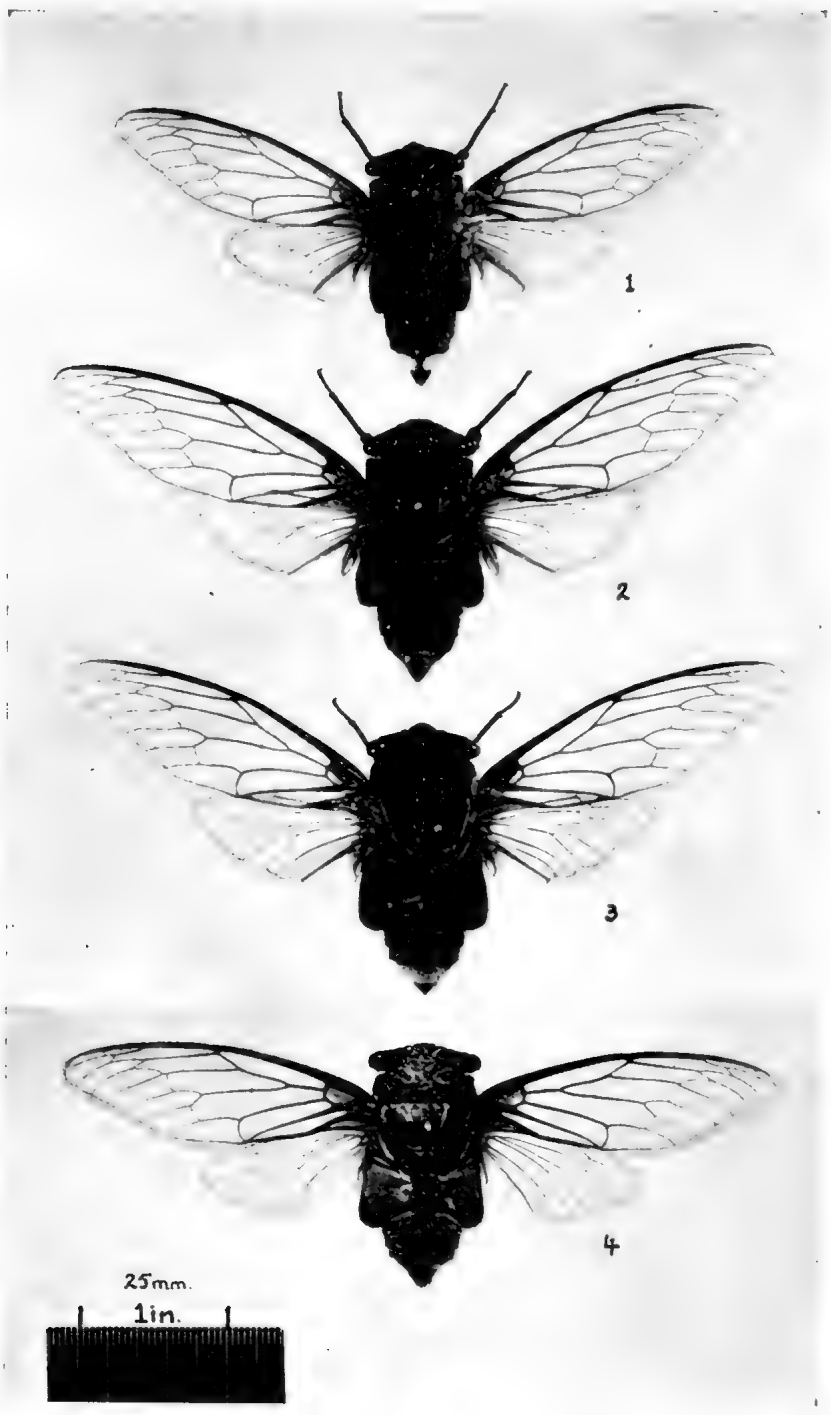

PLATE ?.

FIG. 1.—*Thopha colorata*, male.
2.—*Thopha saccata*, male.
3.—*Thopha sessiliba*, male.
4.—*Thopha nigricans*, male.

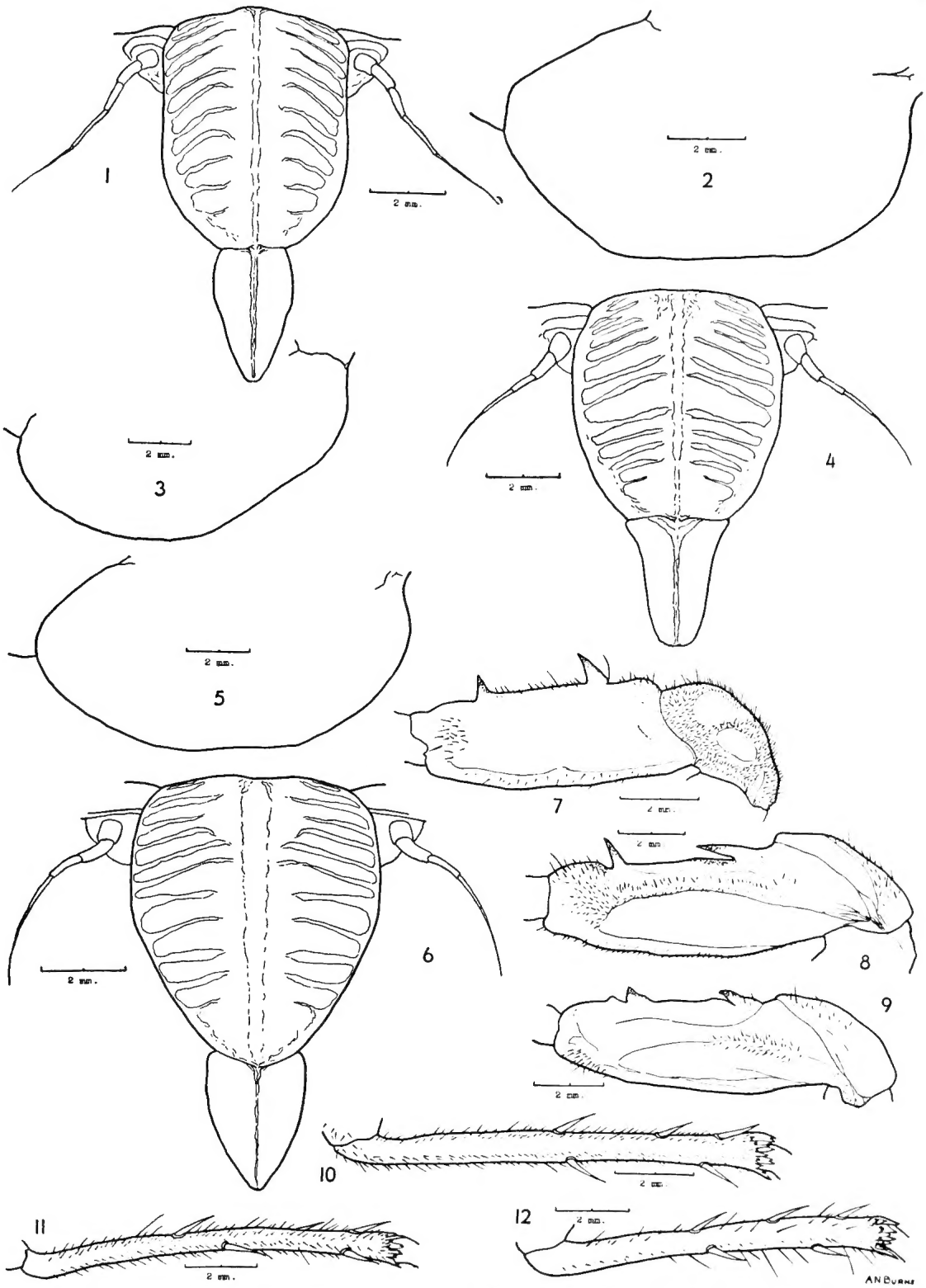

FIG. 1.—*Thopha sessiliba* (male), frons.
2.—*Thopha saccata* (male), operculum.
3.—*Thopha colorata* (male), operculum.
4.—*Thopha colorata* (male), frons.
5.—*Thopha sessiliba* (male), operculum.
6.—*Thopha saccata* (male), frons.

FIG. 7.—*Thopha colorata* (male), anterior femur.
8.—*Thopha saccata* (male), anterior femur.
9.—*Thopha sessiliba* (male), anterior femur.
10.—*Thopha saccata* (male), posterior tibia.
11.—*Thopha colorata* (male), posterior tibia.
12.—*Thopha sessiliba*, (male) posterior tibia.

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