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STUDIES ON RECENT PETRALIIDAE (BRYOZOA).

By

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(Figures 1-19.)

INTRODUCTION.

Tropical and sub-tropical Petraliidae have, within the last decade, assumed considerable prominence. Several authors¹ have remarked upon the unsatisfactory grouping of the species and the lack of accommodation for recently described forms.

To obtain satisfactory characters for subdivision, a study of the skeletal morphology of selected members of this group was undertaken. The author is chiefly indebted to the authorities of the Australian Museum, National Museum (Melbourne), South Australian Museum and United States National Museum for loan and exchange of relevant material, and to Mr. A. A. Livingstone (Assistant Zoologist, Australian Museum), for many helpful suggestions.

For the study of the skeletal morphology, dry specimens were incinerated over a gas flame and fragments were mounted in various positions, dissections being then carried out with the aid of fine needles to display the frontal, lateral and distal walls, the basal lamina and the structures pertaining to radicular insertion. It was found necessary to draw the preparations within the next two or three days, since they began to deteriorate if left much longer.

Family **PETRALIIDAE** Levinsen, 1909.

Petraliidae Levinsen, *Morph. Syst. Stud. Cheil. Bryozoa*, 1909, p. 350.

Petraliidae Levinsen, Canu and Bassler, *U.S. Nat. Museum, Bull.* 100, ix, 1929, p. 250.

Observations.—The author would restrict Petraliidae to include only those species which have a finely-perforated hyperstomial ovicell opening above the normal plane of the zooecial aperture, whose zoarium has some form of radicular attachment, and whose zooecia have an aperture with a pair of cardelles situated close to the proximal rim.

Ecology.

The unilaminate zoaria of all Petraliidae live in situations distinct from those of completely encrusting forms, since their radicles permit attachment to insecure and irregular substrata upon which completely encrusting species could not develop. Hundreds of the brilliant vermilion zoaria of *Mucropetraliella ellerii* (Macgillivray, 1869) have been observed on the reef at Point Leo, Shoreham (Western Port, Vic.), growing over masses of coralline algae or loosely adherent to calcareous sponges,

¹Hastings.—*Sci. Repts. Grt. Barrier Reef Exped.* (1928-29), *Polyzoa*, iv, 12, 1932, p. 435. Levinsen.—*Morph. Syst. Stud. Cheil. Bryozoa*, 1909, p. 351. Livingstone.—*Vidensk. Medd. fra Dansk Naturh. Foren.*, lxxxvii, 1929 p. 76.

ascidians and the under surface of boulders. The potentiality for development of radicles thus allows a wide choice of substrata and explains their abundance in littoral, shallow and deeper water, as recorded by Canu and Bassler². In the case of *Petralia livingstonei*, the radicles intertwine and agglutinate to form a filament used as an anchor on a sandy sea bottom, and this type of radicle development restricts the species to deeper water sandy bottoms, where currents probably exert some influence, as shown by its occurrence in numerous dredgings between 25 and 46 fathoms off the New South Wales Coast.³ Canu and Bassler⁴ have indicated the relationships of several species of this group to their substrata.

Distribution.

Probable ancestors of this group are to be found in the Lutetian (Middle Eocene) of France in the species described as *Petralia mucronata*, *P. convexa* and *P. immersa*, by Canu⁵, and in the Jacksonian (Upper Eocene) of North America in such forms as *Hippomenella radicata* Canu and Bassler and *H. alifera* Canu and Bassler⁶. In the Lower Miocene of Victoria true Petraliids occur, while *Petraliella bisinuata* (Smitt) and *P. bisinuata grandis* Canu and Bassler have been recorded from the Pliocene of Panama.⁷

In recent times, Petraliidae has become predominantly an Indo-Pacific group, its distribution closely following that of the warm ocean currents, and, except for its extension into the Gulf of Mexico, it has not yet been found in the Atlantic region. The absence of Petraliidae from the west coast of America is probably due to the proximity of the Chili and California cold currents.

Mucropetraliella, though very prolific in species in the tropics, extends north to Japan⁸ and Korea⁹, where it is represented by *M. armata* (Waters) and *M. aviculifera* (Marcus, 1923, *non* Hincks, 1891), respectively, and south to Bass Strait and New Zealand waters. The type genus, which probably represents a local developmental trend, is confined to south-eastern Australia from northern New South Wales to South Australia. An isolated occurrence is that of "*Petralia*" *soulieri* (Calvet, 1902) in the Mediterranean.

Radicles.

The radicles are developed by budding from the basal body wall, the resulting radicle bud becoming separated from the zooecium proper by a calcareous plate pierced by uniporous or multiporous septula. The radicle rudiments do not all necessarily develop, but are potentially functional and capable of great variation, even within the same species, depending on the substratum to which the radicle is to be adapted. Thus the length is very variable and also the attachment area varies in its extent and degree of ramification.

²Canu and Bassler.—Proc. U.S. Nat. Museum, lxxii, art. 14, 1928, pp. 78–82. Canu and Bassler.—U.S. Nat. Museum, Bull. 100, ix, 1929, pp. 255–266.

³Livingstone.—Rec. Austr. Museum, xv, 2, 1926, p. 169.

⁴Canu and Bassler.—Proc. U.S. Nat. Museum, lxxii, art. 14, 1928, pp. 78–82. Canu and Bassler.—U.S. Nat. Museum, Bull. 100, ix, 1929, pp. 255–266.

⁵Canu.—Bull. Soc. Geol. France, 4, xiii, 1914, pp. 301, 302.

⁶Canu and Bassler.—U.S. Nat. Museum, Bull. 106, 1920, pp. 386, 387.

⁷Canu and Bassler.—Proc. U.S. Nat. Museum, lxxii, art. 14, 1928, p. 13.

⁸Okada.—Sci. Repts. Tokyo Bunrika Daigaku, ii, 26, 1934, p. 14.

⁹Marcus.—Abh. Senck. Naturf. Ges., xxxv, 1923, p. 441.

In all Petraliidae, except *Petralia (sensu stricto)*, where they adhere and intertwine to form an anchoring filament, the radicles remain single and are individually attached to their substratum.

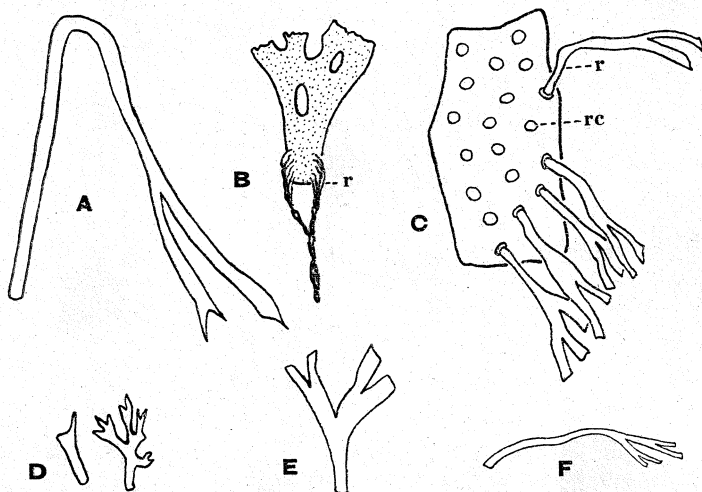


Figure 1.

Form of radicles from various species of Petraliidae. A. *Mucropetraliella (Poripetraliella) tuberosa*. $\times 30$. B. *Petralia livingstonei*. A colony showing the coalescence of radicles to produce the attaching filament. $\times \frac{2}{3}$. C. *Petralia livingstonei*. Basal lamina of a single zoecium from edge of the proximal region of a zoarium, showing origin and form of radicles. $\times 30$. D. *Hippopetraliella (Serripetraliella) chuakensis hastingsae*. $\times 30$. E. *Mucropetraliella vultur*. $\times 30$. F. *Mucropetraliella ellerii*. $\times 30$. r, radicle; rc, radicular chambers.

Skeletal Morphology.

Aperture.—The fundamental apertural type is regarded as being subcircular, with a pair of cardelles developed on the lateral margins close to the proximal rim. From this central type, various modifications are developed.

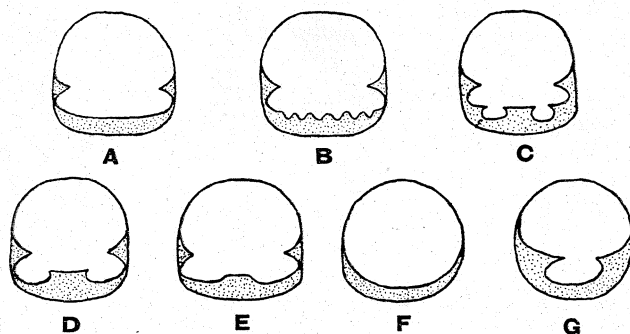


Figure 2.

Diagrammatic representation of the forms of aperture in Petraliidae. A. *Hippopetraliella*. B. *Hippopetraliella (Serripetraliella)*. C. *Petraliella*. D. *Mucropetraliella*. E. *Petralia livingstonei*. F. *Petralia undata*. G. *Sinupetraliella*.

The simplest type, represented by *Hippopetraliella dorsiporosa* (Busk) has well-developed cardelles and a slightly concave and entire proximal rim bounded by a smooth, flat, narrow transverse plate. The suboral plate then becomes sinuate, as in *Hippopetraliella* (*Serripetraliella*) *chuakensis* (Waters), which has about four sinuses. From this develops the state seen in *Petraliella* (*sensu stricto*), where only two well-developed sinuses occur in the suboral plate.

The lyrule is then formed by the elimination of the outer bounding denticles of the two sinuses of the previous stage, giving the structure typical of *Mucropetraliella*. In *Petralia livingstonei*, sp. nov., the cardelles and lyrule become weaker, and finally disappear altogether in *Petralia undata* Macgillivray, which has a simple circular aperture. In *Sinupetraliella* the lyrule alone has disappeared and the cardelles here extend lower down on the proximal rim to form a broad sinus, limited by the cardelles. In *Petralia*, *Mucropetraliella* and *Sinupetraliella* a mucro bearing an avicularium partly projects over the aperture, and is probably protective in function.

The order of description of the above stages does not necessarily represent the developmental trend of apertural structures in this group. In the genus *Petralia* (*sensu stricto*), which is here regarded as the most recent development of this group, it is suggested that the trend has culminated, in the genotype, in the loss of cardelles and lyrule.

Frontal.—The frontal is a tremocyst supported by an inseparable olocyst, both being perforated by several or numerous tremopores. The margins are areolated to a greater or less degree. In older zooezia, additional calcareous deposition by the ectocyst may tend to close the tremopores and ornament the surface with irregular tuberosities. In *Petralia* and *Mucropetraliella* the tremopores are less numerous and less regular than in *Hippopetraliella* and *Petraliella*, where they form a close pattern on the frontal, surrounded by polygonal ridges.

The frontal supports avicularia in very varied positions. They may be placed longitudinally to one side below the aperture (*Hippopetraliella* (*Serripetraliella*) *marginata*) or alongside it (*Petraliella bisinuata*), flanking the distal margins of the aperture (*Petraliella arafurensis*) or occupying portion of the lateral margins (*Hippopetraliella dorsiporosa*). In some species of *Mucropetraliella* they occupy almost any position on the frontal. In *Mucropetraliella laccadivensis* (Robertson), small avicularia are often situated at the tips of erect processes which may occur at any position on the frontal¹⁰.

Figure 3.

(Magnification $\times 25$.)

Dissections of various species to show lateral walls and associated structures. A, B. *Petralia undata*, showing numerous pores of multiporous septula of lateral wall and the single submarginal series of areolar pores. C, D. *Petralia livingstonei*. E. *Hippopetraliella dorsiporosa*, showing double row of multiporous septula in lateral wall. F, G. *Hippopetraliella* (*Serripetraliella*) *chuakensis hastingsae*, showing numerous multiporous septula in a single series along the lateral wall and the submarginal series of paired septula communicating with the lateral dietella. H, I. *Hippopetraliella* (*Serripetraliella*) *marginata*. J, K. *Petraliella bisinuata*, showing submarginal series of paired septula communicating with the lateral dietella. L. *Mucropetraliella elleri*. al, lateral rim of aperture; ap, areolar pores; avl, lateral avicularium; b, basal lamina; c, cardelle; d, distal wall; du, uniporous septula of distal wall; f, frontal; l, lateral wall; lm, multiporous septula of lateral wall; ly, lyrule; m, suboral mucro; md, pores of marginal dietella; re, radicular chamber; rep, primary radicular chamber; rsm, multiporous septula of radicular chambers; t, tremopore; za, aperture of zoecium.

¹⁰Robertson.—Rec. Indian Museum, xxii, 1, 1921, p. 56.

In *Mucropetraliella*, *Sinupetraliella* and *Petralia*, a suboral mucro supporting an avicularium is developed, varying greatly in size from the low prominence seen in *Petralia undata* to the tremendous globular mucro of *Mucropetraliella* (*Poripetraliella*) *tuberosa* (Busk). In these genera a small avicularium may occur on each lateral margin of the aperture, while the distal margin may develop four to eight spines. The avicularian chambers, in all the observed cases, communicate with the zooecia by uniporous septula.

Lateral Walls.—In all species examined, the zooecia communicate laterally by multiporous septula. The number of septula in each species is fairly constant, but the number of pores in each septulum varies greatly, the range in *Petralia undata* being from three to eleven.

Along the frontal edge of the lateral walls in *Petraliella* and *Hippopetraliella* a narrow dietella may be developed which communicates with the adjacent zooecia by a series of paired septula, varying in number from about eight to twelve. In *Petralia*, along the junction of the lateral walls and frontal, a regular series of single pores communicates with the areolae.

Distal Wall.—Scattered uniporous septula occur in *Petralia undata* and *Hippopetraliella chuakensis hastingsae*, and a varying number of multiporous septula in *Hippopetraliella dorsiporosa* and *Petraliella bisinuata*. In *Mucropetraliella*, a distal crescentic dietella with about ten uniporous septula is developed towards the basal side partly surrounding the primary radicular chamber.

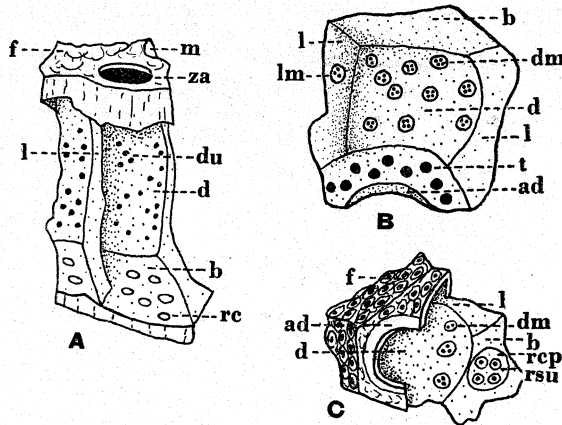


Figure 4.

(Magnification $\times 30$.)

Dissections of various species to show the distal wall and associated structures. A. *Petralia undata*, showing numerous uniporous septula of distal wall. B. *Hippopetraliella dorsiporosa*, showing multiporous septula of distal wall. C. *Petraliella bisinuata*. ad, distal rim of aperture; b, basal lamina; d, distal wall; dm, multiporous septula of distal wall; du, uniporous septula of lateral wall; f, frontal; l, lateral wall; lm, multiporous septula of lateral wall; m, suboral mucro; rc, radicular chambers; rep, primary radicular chamber; rsu, uniporous septula of radicular chamber; t, tremopore; za, aperture of zoecium.

Basal lamina.—In all groups, except *Petralia* and *Poripetraliella*, the basal lamina is very thin, slightly convex, and crossed transversely by slight undulations and striations. In *Petralia* and *Poripetraliella* the basal lamina is much thickened by additional calcareous deposition, and the numerous radicular septula are situated at the base of deep pits, the margins of which are in high relief.

Radicular insertion.—The radicles are inserted into more or less distinct chambers which, in many cases, are partly roofed by calcareous deposition, as is well seen in transparent dry specimens of *Petraliella bisinuata*. In other cases, the radicular plate begins at a short distance below the basal level of the distal wall of the zooecium and slopes proximally to the level of the basal lamina. The small accessory radicular chambers are usually surrounded by a slight ridge in the basal lamina.

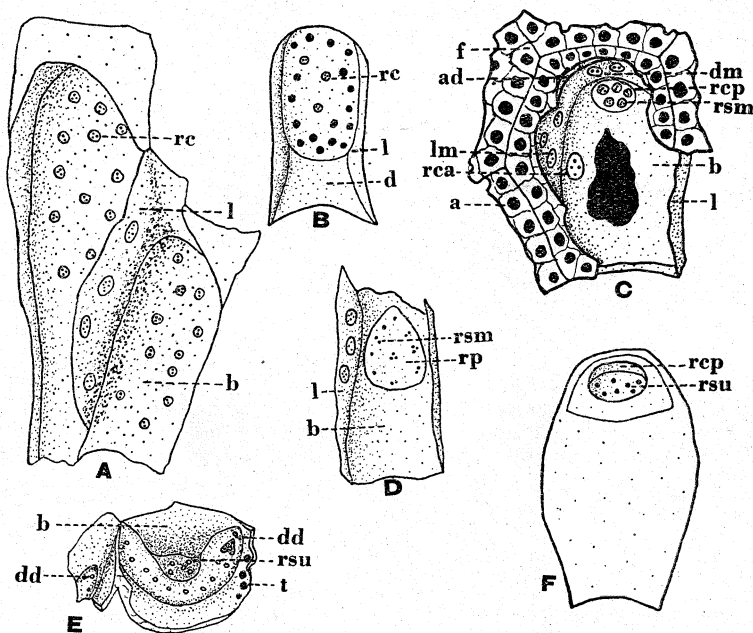


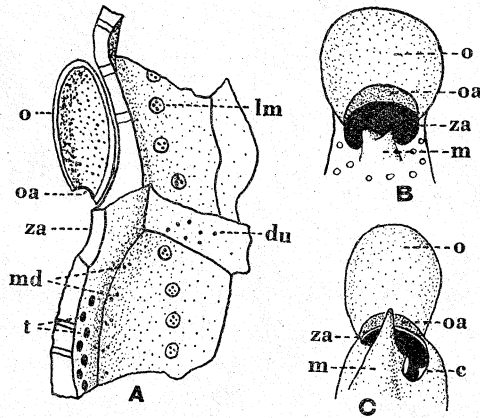
Figure 5.

(Magnification $\times 30$.)

Dissections of various species illustrating radicular insertion and associated structures. A. *Petralia livingstonei*, showing the numerous small radicular chambers, with few uniporous radicular septula, covering the whole of the basal lamina. B. *Petralia undata*, showing radicular chambers occupying only the distal two-thirds of the basal lamina. C. *Hippopetraliella dorsiporosa*, showing primary radicular chamber with multiporous septula and accessory radicular chamber with uniporous septula. D. *Hippopetraliella* (*Serripetraliella*) *marginata*, showing large primary radicular chamber with multiporous septula. E. *Mucropetraliella ellerii*, showing primary radicular chamber partly surrounded by distal crescentic dietella perforated by uniporous septula. F. *Petraliella bisinuata*, showing a well-developed roof restricting the opening to the primary radicular chamber. a, areolae; ad, distal rim of aperture; b, basal lamina; d, distal wall; dd, distal crescentic dietella; dm, multiporous septula of distal wall; f, frontal; l, lateral wall; lm, multiporous septula of lateral wall; rc, radicular chambers; rca, accessory radicular chamber; rcp, primary radicular chamber; rp, radicular plate; rsm, multiporous septula of radicular chamber; rsu, uniporous septula of radicular chamber; t, tremopore.

In all cases where there is a single radicular chamber, it is situated at the distal end of the zoecium, while if several are present there is generally a single larger (primary) radicular chamber situated distally, with the smaller (accessory) chambers scattered within the latero distal margins. The radicular plate may be pierced either by numerous scattered uniporous septula or by multiporous septula, but this character perhaps depends on the greater or less area of the radicular chamber which may occupy a very small area at the distal end or may extend over practically the whole of the basal lamina in the same zoarium, as in *Hippopetraliella dorsiporosa*.

The primary radicular chamber, with or without accessory chambers, occurs in *Petraliella*, *Hippopetraliella*, *Mucropetraliella* and *Sinupetraliella*, and appears to be the primitive type, since the Eocene forms of Europe and America have a single distal radicular plate. The addition of the accessory chambers is a more recent development.



(Figure 6.)

(Magnification $\times 30$.)

A. *Hippopetraliella* (*Serripetraliella*) *chuakensis hastingsae*, dissected to show aperture of ovicell opening above plane of aperture of the zoecium. B. *Mucropetraliella vultur*, showing ovicell. C. *Mucropetraliella ligulata*, showing ovicell. c, cardelle; du, uniporous septula of distal wall; lm, multiporous septula of laterall wall; m, suboral mucro; md, pores of marginal dietella; o, ovicell; oa, aperture of ovicell; t, tremopore; za, aperture of zoecium.

Poripetraliella represents an extension of the trend towards the development of accessory radicular chambers, for its radicular apparatus consists of a large primary radicular chamber with multiporous septula and numerous small radicular septula scattered over the basal lamina. In *Poripetraliella* the distal chambers bear radicles, but it is uncertain whether the accessory chambers, with three to four septula, are also functional. *Poripetraliella* forms a link between *Mucropetraliella* and *Petralia*.

In the latter, the radicular apparatus is confined solely to numerous small radicular septula, of which only those at the base of the zoarium have been observed to produce radicles.

The ovicell. The most constant feature of this group is the very finely and closely perforate ovicell which develops on the distal zoecium, scarcely causing

any depression on its frontal. It is hyperstomial and has a crescentic aperture opening above the plane of the zoecial aperture. The only variation of the ovicell noted in the observed species and in those of which they are described is in the size and degree of convexity.

Tabulation of Structure in Species Dissected.

Species.	Cardelles.	Lyrule.	Radicular Chambers.	Suboral Mucro.	Lateral Septula.	Lateral Dietellae.	Distal Wall.
<i>Undata</i> ...	Absent ...	Absent	Numerous radicular septula (2-4).	Present ...	6 multiporous (3-11).	Single areolar pores.	About 20 uniporous.
<i>Livingstonei</i> .	Well developed.	Weak	Numerous radicular septula (2-4)	Present ...	5 multiporous (4-7).	Single areolar pores.	?
<i>Bisinuata</i> ...	Well developed.	Sinus on either side of lyrule.	Primary and accessory; 4-7 uniporous septula.	Absent ...	9 multiporous (3-5).	About 10 paired septula on each side.	3 or 4 multiporous (3).
<i>Arafurensis</i>	Well developed.	Sinus on either side of lyrule.	Primary; multiporous septula.	Absent ...	?	?	?
<i>Marginata</i>	Well developed.	Absent	Primary; multiporous septula (2-3).	Absent ...	9 multiporous (2-7).	About 8 paired septula on each side.	?
<i>Dorsiporosa</i>	Weak ...	Absent	Primary, with multiporous septula (2-5); accessory.	Absent ...	9 multiporous in two rows (2-4).	?	About 8 multiporous (2-4).
<i>Chuakensis hastingsae</i> .	Well developed.	Absent	Primary and accessory, both uniporous.	Absent ...	9 multiporous (3-4).	About 12 paired septula on each side.	Scattered uniporous.
<i>Elleri</i>	Well developed.	Well developed	Primary; uniporous septula.	Well developed.	5 multiporous (3-5).	Absent	Crescentic dietella; 10 uniporous septula.
<i>Tuberosa</i> ...	Well developed.	Weak	Primary multiporous septula (3-4); accessory uniporous (2-3).	Very large	Multiporous	?	?

Note.—It was not possible to obtain all the details of structure for some of the species and where the structure has not been seen a query has been inserted. The bracketed numbers refer to either the number of pores in the multiporous septula or to the number of uniporous septula in a radicular chamber.

Key to the genera.

1. { Zoarium fenestrate *Petralia* Macgillivray.
- { Zoarium not fenestrate 2.
2. { Suboral mucro absent 3.
- { Suboral mucro present 4.
3. { Proximal rim entire *Hippopetraliella*, nov.
- { Proximal rim serrate (*Serripetraliella*), nov.
- { Proximal rim bisinuate *Petraliella* Canu and Bassler.
4. { Lyrule absent *Simupetraliella*, nov.
- { Lyrule present 5.
5. { Few radicular chambers *Mucropetraliella*, nov.
- { Primary and numerous accessory chambers (*Poripetraliella*), nov.

Systematic Description.Genus **Petralia** Macgillivray, 1869.*Petralia* Macgillivray, Trans. Proc. Roy. Soc. Victoria, ix, 1869, p. 141.*Petralia* Macgillivray, Trans. Proc. Roy. Soc. Victoria, xxiii, 1887, p. 212.(Not *Petralia* Canu and Bassler, U.S. Nat. Museum, Bull. 100, ix, 1929, p. 253.)Type (by monotypy): *Petralia undata* Macgillivray, 1869.

Diagnosis.—Zoarium unilaminate, fenestrate and attached by radicles arising from the proximal region only. Aperture circular, with or without cardelles and lyrule. A suboral mucro with avicularium is always present, while small avicularia may also occur on the lateral margins of the aperture. The zoecia are distinctly defined on the basal side, their surfaces being tuberculate and pitted with numerous small bordered radicular septula.

Observations.—Canu and Bassler's genus *Petralia* differs from that of Macgillivray. The description given applies solely to "*Lepralia*" *japonica* Busk, 1884, which was wrongly chosen as the genotype by Canu and Bassler, as pointed out by Hastings¹¹.

Canu and Bassler have referred to Levinsen as the major author of *Petralia*, but this is incorrect since no description of the genus is given by Levinsen. Levinsen¹² does, however, give an excellent general account of the features of the species which he refers to his new family Petraliidae, but makes no attempt at precise description of *Petralia*, which he uses in a very broad sense—" . . . I must provisionally refer them all to a single genus *Petralia* Macgillivray; but I do not doubt that this in time will be divided into several." Thus *Petralia* of Canu and Bassler is also not that of Levinsen.

To Macgillivray's original description is added in 1887, the presence of "a sharp denticle on each side below" in the aperture. This feature has not been seen in typical Victorian specimens of *P. undata* in the Macgillivray collection, but was probably added from specimens of *P. livingstonei* sp. nov.

The species referred to this genus are: *P. undata* Macgillivray, 1869, and *P. livingstonei* sp. nov.

***Petralia undata* Macgillivray, 1869.**

(Figure 7.)

Petralia undata Macgillivray, Trans. Proc. Roy. Soc. Vict., ix., 1869, p. 141.*Petralia undata* Macgillivray, in McCoy's Prodr. Zool. Victoria, dec. vi, 1881, p. 45, pl. lx, fig. 2.(Not *Petralia undata* Livingstone, Rec. Austr. Mus., xv, 2, 1926, p. 169, pl. xii, figs. 1-3 = *P. livingstonei* sp. nov.)

Diagnosis.—Zoarium unilaminate, forming a large biscuit-brown fan-shaped colony up to 10 cms. in width. The fenestrae are sub-circular and about 2 mms. in their greatest diameter.

Zoecium elongate-pyriform in outline. Frontal rugose, with a few scattered tremopores and a marginal series of about ten areolae on each side. Aperture circular, without cardelles or lyrule, surrounded by a narrow, smooth area which

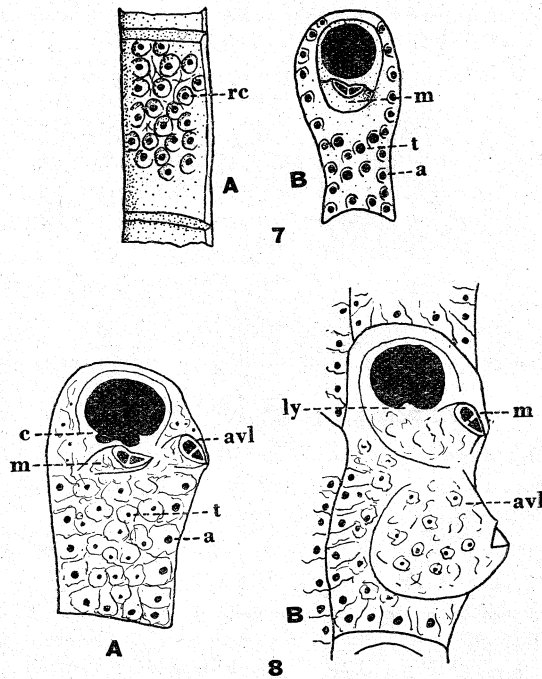
¹¹Hastings.—Sci. Repts. Grt. Barrier Reef Exped. (1928-29), iv, 12, Polyzoa, 1932, p. 436.¹²Levinsen.—Morph. Syst. Stud. Cheil. Bryozoa, 1909, p. 350.

expands proximally to form the elevated rugose mucro with pertaining avicularium. Basal lamina with about twenty radicular septula situated in deep pits in the distal two-thirds of the zooecium. Ovicell of large size, globular and loosely adherent to the distal zooecium.

Dimensions.—Zooecium, length 0.88 mm., greatest width 0.46; aperture, diameter 0.22.

Distribution.—Victoria: Queenscliff (type locality), Portland (Macgillivray); Western Port (J. Gabriel coll.); Barwon Heads (W. Baragwanath coll.). South Australia (Macgillivray).

Observations.—This species differs from *P. livingstonei* in the form of the zoarium, absence of cardelles and lyrule and the greater number of pores in the multiporous septula of the lateral walls.



Figures 7, 8.

(Magnification $\times 30$.)

Figure 7.—*Petralia undata*. A. Basal lamina showing salient ridges outlining the zooecia and the sunken radicular chambers restricted to the distal two-thirds of the zooecium. B. Zooecial detail. Figure 8.—*Petralia livingstonei*. A. Zooecial detail, showing suboral avicularium and lateral avicularium of a normal zooecium. B. Abnormal zooecium situated on the margin of a fenestra, showing displacement of the suboral mucro and the great development of the lateral avicularium. a, areolae; avl, lateral avicularium; c, cardelle; ly, lyrule; m, suboral mucro; rc, radicular chamber; t, tremopore.

***Petralia livingstonei*, sp. nov.**

(Figure 8.)

Petralia undata Livingstone (*non* Macgillivray), Rec. Austr. Mus., xv, 2, 1926, p. 169, pl. xii, figs. 1-3.

Diagnosis.—Zoarium unilaminar, forming a cream-coloured, elongate fan-shaped colony up to 5 cms. in length. The fenestrae are elongate-elliptical and about 5 mms. in their greatest diameter.

Zoecium subrectangular in outline. Frontal rugose, with several (about twelve) scattered tremopores and a marginal series of about eight areolae on each side. Aperture sub-circular, with a pair of moderately developed cardelles and a weak, narrow lyrule, surrounded by a narrow smooth band expanding proximally into the suboral mucro with pertaining avicularium. A small lateral avicularium is also usually present at the level of the mucro. When the zoecium borders a fenestra the lateral avicularium is greatly enlarged. Basal lamina with about twenty radicular septula scattered over the entire wall. Ovicell not observed.

Dimensions.—Zoecium, length 1.15 mms., greatest width 0.70; aperture, diameter 0.26.

Distribution.—New South Wales: S.W. off Eden at 45 fathoms (type locality), 3 to 4 miles off Eden at 25 to 30 fathoms, 12 to 22 miles N. $\frac{1}{2}$ E. from Green Cape at 39 to 46 fathoms (Livingstone); off Shoalhaven (J. Gabriel coll.). South Australia: Off Beachport at 200 fathoms (Sth. Austr. Mus. coll.). Tasmania: Off Launceston and Devonport (Austr. Mus. coll. No. E-6472).

Observations.—This species differs from the genotype in its different form of zoarium, greater zoecial dimensions, frontal detail and the presence of cardelles and lyrule. The species is named for A. A. Livingstone, Assistant Zoologist at the Australian Museum, whose generous assistance is gratefully acknowledged.

Genus ***Petraliella*** Canu and Bassler, 1927.

Petraliella Canu and Bassler, Proc. U.S. Nat. Museum, lxxix, Art. 14, 1927, p. 5.

Petraliella Canu and Bassler, U.S. Nat. Museum, Bull. 100, ix, 1929, p. 255, text figs. 105 A-F, 106 A, P.

Type (by original designation): *P.* (" *Escharella* ") *bisinuata* (Smitt, 1873).

Diagnosis.—Zoarium unilaminar, not fenestrated, creeping over algae and other unstable substrata to which it is attached by radicles arising from primary, or both primary and accessory, radicular chambers situated distally on each zoecium. Aperture sub-circular, with a pair of well-developed cardelles. Proximal rim indented by two large sinuses forming a pair of lateral bounding denticles and a median lyrule. Frontal with numerous regularly-scattered tremopores. No suboral mucro.

Observations.—The genus *Petraliella* is here much restricted from its original very wide application. As seen from the diagnosis, it admits forms with a bisinuate proximal rim and no suboral mucro. The following species are included in the genus:—

Petraliella bisinuata (Smitt, 1873).

Petraliella bisinuata grandis Canu and Bassler, 1928.

Petraliella buski, sp. nov.

Petraliella arafurensis, sp. nov.

Petraliella bisinuata (Smitt, 1873).

(Figure 9.)

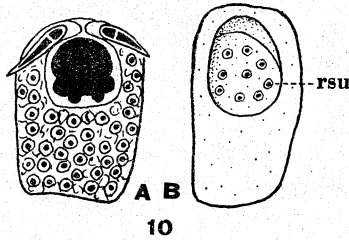
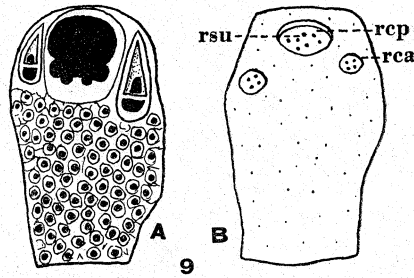
Escharella bisinuata Smitt, Kongl. Svenska Vetensk.—Akad. Handl., ii, (4), 1873, p. 59, pl. xii, fig. 229.

Petralia bisinuata (Smitt), Levinsen, Morph. Syst. Stud. Cheil. Bryozoa, 1909, pp. 350, 351.

Petraliella bisinuata (Smitt), Canu and Bassler, Proc. U.S. Nat. Museum, lxxii, Art. 14, 1928, p. 78, pl. xvi, figs. 1-5, pl. xxxiii, fig. 4, text figs. 12 A-H.

(Not *Mucronella bisinuata* Busk (*non* Smitt), Chall. Rep. Zool., x, 1884, pt. xxx, p. 157, pl. xix, fig. 5 = *Petraliella buski*, sp. nov.)

Diagnosis.—Zoarium unilaminar, colour bright vermilion when alive, light brown when dry. Zoecium subrectangular in outline. Frontal with numerous (60 to 70) regularly-placed tremopores situated within shallow pits. Aperture sub-circular, with moderately developed cardelles situated close to proximal rim on the lateral margins. The sinuses do not extend far into the suboral smooth plate which is comparatively wide in this species.



Figures 9, 10.

(Magnification $\times 30$.)

Figure 9.—*Petraliella bisinuata*. A. Zoecial detail. B. View of basal lamina, showing primary and accessory radicular chambers, both with uniporous septula. Figure 10.—*Petraliella arafurensis*. A. Zoecial detail. B. Basal lamina, showing large primary radicular chamber with uniporous septula. rca, accessory radicular chamber; rep, primary radicular chamber; rsu, uniporous septula of radicular chambers.

Avicularia somewhat variable, but usually a large one is placed longitudinally, extending on one side of the aperture and below the level of the proximal rim; a smaller longitudinal avicularium occurs on the opposite side of the aperture. The apices point distally.

The primary radicle is inserted into a definite distal chamber partly roofed by calcareous deposition and communicating with the zooecium by scattered uniporous septula. Accessory radicular chambers are also present. The closely and finely perforate ovicell is very globular and equals in length half that of the zooecium.

Dimensions.—Zooecium, length 1.14 mms., greatest width 0.57; aperture, length 0.28, width 0.25.

Distribution.—Recent: Gulf of Mexico at various localities from 21 to 30 fathoms (details, Canu and Bassler¹³); Florida at 14 to 30 metres (Smitt); Tortugas at 16 to 29 metres (Osburn).

Pliocene: Minnitimmi Creek on Bocas Island (Almirante Bay, Panama).

Observations.—The position of the avicularia, although not a rigid feature, characterises this species, together with the well-roofed radicular chamber and the large size of the zooecia.

***Petraliella buski*, sp. nov.**

Mucronella bisinuata Busk (*non* Smitt, 1873), Chall. Rep. Zool., x, 1884, pt. xxx, p. 157, pl. xix, fig. 5.

Petralia bisinuata (Busk) (*non* Smitt, 1873), Livingstone, Rec. Austr. Mus., xvi, 1, 1927, p. 66.

Observations.—Specimens of this species have not been seen by the author, Busk's figures and description alone forming the basis of comparison with specimens of *Petraliella bisinuata* (Smitt, 1873) from the Gulf of Mexico ("Albatross" station D 2405) obtained by exchange with the United States National Museum.

The following points of difference between the two species may be noted:—
1. The frontal of *P. buski* is more convex and has far fewer tremopores; 2. The zooecia are much more elongate in *P. bisinuata*; 3. The avicularia of *P. bisinuata* have a fairly constant disposition on either side of, and below, the aperture with the apices directed distally, whereas in *P. buski* they are arranged around the margins of the zooecia and on the frontal, showing no definite orientation. On these grounds, the "Challenger" species is regarded as distinct.

Distribution.—"Challenger" Station 190 (lat. 8° 56' S., long 136° 5' E.) at 49 fathoms, green mud (Arafura Sea) (Busk).

***Petraliella arafurensis*, sp. nov.**

(Figure 10.)

?*Mucronella bisinuata* Kirkpatrick (*non* Smitt, 1873), Sci. Proc. Roy. Dub. Soc., (n.s.), vi, 10, 1890, p. 612.

Diagnosis.—Zooecia sub-quadrate in outline. The slightly convex frontal has numerous (about 40) regularly-placed tremopores surrounded by polygonal

¹³Canu and Bassler.—Proc. U.S. Nat. Museum, lxxii, art. 14, 1928, p. 80.

ridges. The avicularia, with elongated triangular mandibles, are placed on either side of the distal rim of the aperture, pointing outward and slightly downward. Occasionally an avicularium may develop on the frontal.

The radicle is inserted into a usually rather large radicular chamber often occupying as much as half the area of the basal lamina and communicating by several uniporous septula with the zoecium. No accessory chambers have been observed. The ovicell is not known.

Dimensions.—Zoecium, length 0.8 mm., greatest width 0.57; aperture, length 0.23, width 0.22.

Distribution.—North-east Australia: Thursday Island (Aust. Mus. coll.).

Type Material.—Holotype and paratypes, Aust. Mus. Coll. No. U 510.

Observations.—Kirkpatrick's specimens of "*Mucronella bisinuata*" came from Albany Passage, Somerset, quite near the type locality of this species, and his form is more likely to be this species than *P. buski*, which occurs much further west.

This species differs from *P. bisinuata* in its smaller dimensions and from both the preceding species in the constant distal pair of avicularia directed outward and downward.

Genus **Hippopetraliella**, gen. nov.

Type: *H.* ("*Lepralia*") *dorsiporosa* (Busk, 1884).

Diagnosis.—Zoarium unilaminate, not fenestrated. Primary and often accessory radicular chambers are situated distally on each zoecium. Aperture subquadrate with a pair of cardelles situated on the lateral margins close to the entire, slightly concave proximal rim bounded by a fairly broad smooth plate. The suboral plate may be indented by numerous small sinuses (sub-genus *Serripetraliella*).

Observations.—The members of typical *Hippopetraliella* have an entire proximal rim, but the proximal rim in the sub-genus *Serripetraliella* shows numerous small indentations. The species placed in *Hippopetraliella* (*sensu stricto*) are:—

Hippopetraliella ("*Lepralia*") *dorsiporosa* (Busk, 1884).

Hippopetraliella ("*Petraliella*") *crassocirca* (Canu and Bassler, 1929).

Hippopetraliella dorsiporosa (Busk, 1884).

(Figure 11.)

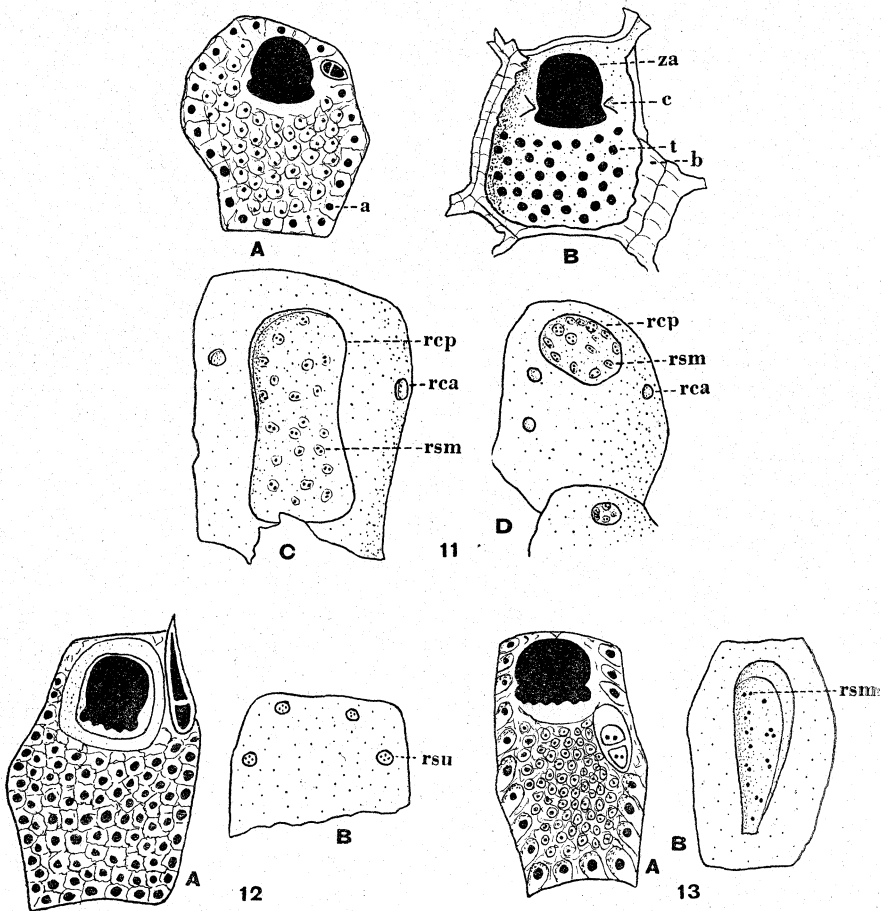
Lepralia dorsiporosa Busk, Chall. Rep. Zool., x, 1884, pt. xxx, p. 143, pl. xviii, fig. 4.

Lepralia dorsipora Busk, Kirkpatrick, Sci. Proc. Roy. Dub. Soc., (n.s.), vi, 10, 1890, p. 612.

Petralia dorsiporosa (Busk), Levinsen, Morph. Syst. Stud. Cheil. Bryozoa, 1909, p. 351.

Petraliella dorsiporosa (Busk), Canu and Bassler, U.S. Nat. Museum, Bull. 100, ix, 1929, pp. 250–253, text figs. 103 A, E, G.

Diagnosis.—Zoecium sub-ovate in outline. The slightly convex frontal has numerous (about sixty) tremopores, bounded by raised polygonal ridges, and a series of areolae around the margin. The small avicularia are placed transversely on either side of the aperture, the apices pointing outward.



Figures 11, 12, 13.

(Magnification $\times 30$.)

Figure 11.—*Hippopetraliella dorsiporosa*. A. Zoecial detail. B. View of frontal with basal lamina removed. C. Basal lamina, showing an extraordinarily large primary radicular chamber. D. View of basal lamina, showing primary and accessory radicular chambers. Figure 12.—*Hippopetraliella (Serripetraliella) chuakensis hastingiae*. A. Zoecial detail. B. View of basal lamina with scattered uniporous radicular septula. Figure 13.—*Hippopetraliella (Serripetraliella) marginata*. A. Zoecial detail. B. View of basal lamina, showing a large primary radicular chamber with multiporous septula. a, areolae; b, basal lamina; c, cardelle; rca, accessory radicular chamber; rep, primary radicular chamber; rsm, multiporous septula of radicular chamber; rsu, uniporous septula of radicular chamber; t, tremopore; za, aperture of zoecium.

The basal lamina is provided with a large distal primary radicular chamber and a few accessory latero-distal chambers. The distal radicular chamber may occupy as much as two-thirds of the area of the basal lamina and communicates with the zoecium by numerous few-pored multiporous septula. The ovicell is globular, circular in outline and is placed on the proximal third of the distal zoecium.

Dimensions.—Zoecium, length 0.95 mm., greatest width 0.80; aperture, length 0.28, width 0.25.

Distribution.—North-east Australia: "Challenger" Station 186 (Cape York, lat. 10° 30' S., long. 142° 18' E.) at 8 fathoms, coral mud (Busk); Albany Passage (Somerset, north Queensland) at 10 fathoms, channels between reefs at Murray Island from 15 to 20 fathoms (Kirkpatrick).

West Australia: 42 miles WSW off Cape Jaubert at 12 fathoms (Marcus).

Additional localities represented in the Australian Museum collection are: 5 to 8 fathoms at Murray Island (coll. Hedley and MacCulloch); Point Cartwright and Darnley Island (Queensland).

Sub-genus **Serripetraliella**, sub-gen. nov.

Type: *Hippopetraliella* (*Serripetraliella*) *chuakensis* (Waters, 1913).

Diagnosis.—This sub-genus possesses the main characters of *Hippopetraliella*, but the proximal rim is indented by several sinuses.

The species belonging to this sub-genus are:—

H. (*Serripetraliella*) *chuakensis* (Waters, 1913).

H. (*Serripetraliella*) *chuakensis hastingsae*, var. nov.

H. (*Serripetraliella*) *marginata* (Canu and Bassler, 1928).

H. (*Serripetraliella*) *chuakensis hastingsae*, var. nov.

(Figures 6A and 12.)

Petralia chuakensis Livingstone (*non* Waters), Rec. Austr. Mus., xv, 1, 1926, p. 99.

Petralia chuakensis Hastings (*non* Waters), Sci. Repts. Great Barrier Reef Exped. (1928–29), iv, 12, 1932, p. 436.

Observations.—As Hastings points out, there is practically no difference in the zoecial detail of the East African (typical form) and the north-eastern Australian specimens, except that the primary radicular chambers of Waters' specimens are much larger than in her specimens (accessory chambers are also present in the East African specimens according to Waters' figure¹⁴).

The following differences in zoecial detail are noted, viz., that the smooth band surrounding the aperture is narrower in var. *hastingsae* and does not show the slight median encroachment on the aperture which is seen in Waters' figure. A more fundamental difference is that, according to Waters' description, there are only five few-pored multiporous septula in the lateral walls, while in the present variety there is an average of nine septula with three to four pores. On these grounds it seems advisable to erect a new variety for the reception of the north Australian form.

¹⁴Waters.—Proc. Zool. Soc. London, 1913, pl. lxx, fig. 14.

Dimensions.—Zoecium, length 1.25 mms., greatest width 0.86; aperture, length 0.30, width 0.26.

Distribution.—Low Isles (Hastings), Daru Island (Torres Strait) (Livingstone). Additional specimens in the National Museum (Melbourne) are from the Barrier Reef and, in the Australian Museum, from Murray Island (coll. E. H. Mathews, 1926).

H. (*Serripetraliella*) *marginata* (Canu and Bassler, 1928).

(Figure 13.)

Petraliella marginata Canu and Bassler, Proc. U.S. Nat. Museum, lxxii, Art. 14, 1928, p. 80, pl. xvi, figs. 6–11, text fig. 12 I.

Observations.—Nothing is added to Canu and Bassler's fine study of this species, but the statement that the ovicell is closed by the operculum does not appear to be borne out by their excellent figures (pl. xvi, figs. 10, 11).

Distribution.—Various localities in the Gulf of Mexico from 26 to 43 fathoms (Canu and Bassler).

Genus **Mucropetraliella**, gen. nov.

Type: *M.* ("*Lepralia*") *ellerii* (Macgillivray, 1869).

Diagnosis.—Zoarium unilaminar, not fenestrate. Primary, and often accessory, radicular chambers with uniporous septula are situated distally on the basal lamina of each zoecium. The primary radicular chamber is partly surrounded on the distal border by a crescentic diatella. The aperture is sub-circular and has a pair of more or less well-developed cardelles and a median lyrule often asymmetrically placed. Frontal with numerous or several irregularly-scattered tremopores bounded by radiating ridges. A more or less well-developed suboral mucro projects over the aperture and supports an avicularium.

Observations.—This genus is characterized by the presence of the suboral mucro, lyrule and pair of cardelles. The following forms are placed in this genus:—

M. ("*Lepralia*") *ellerii* (Macgillivray, 1869).

M. ("*Mucronella*") *vultur* (Hincks, 1882).

M. ("*Mucronella*") *vultur biaviculata* (Waters, 1887).

M. ("*Petralia*") *armata* (Waters, 1913).

M. ("*Petralia*") *laccadivensis* (Robertson, 1921).

M. ("*Petralia*") *bennetti* (Livingstone, 1926).

M. ("*Petralia*") *serrata* (Livingstone, 1926).

M. ("*Petraliella*") *albirostris* (Canu and Bassler, 1927).

M. ("*Petralia*") *halei* (Livingstone, 1928).

M. ("*Petralia*") *neozelanica* (Livingstone, 1929).

M. ("*Petraliella*") *trita* (Canu and Bassler, 1929).

M. ("*Petraliella*") *robusta* (Canu and Bassler, 1929).

M. ("*Petraliella*") *philippinensis* (Canu and Bassler, 1929).

M. ("*Petraliella*") *falcifera* (Canu and Bassler, 1929).

M. ("*Petraliella*") *verrucosa* (Canu and Bassler, 1929).

M. ("*Petraliella*") *tubulifera* (Canu and Bassler, 1929).

M. ("*Petraliella*") *echinata* (Canu and Bassler, 1929).

M. nodulosa, sp. nov.

M. ligulata, sp. nov.

Mucropetraliella ellerii (Macgillivray, 1869)

(Figure 14.)

Lepralia ellerii Macgillivray, Trans. Proc. Roy. Soc. Vic., ix, 2, 1869, p. 135.

Lepralia ellerii Macgillivray, in McCoy's Prodr. Zool. Victoria, dec. iv, 1879, p. 31, pl. xxxvii, fig. 8.

Mucronella ellerii (Macgillivray), Trans. Proc. Roy. Soc. Vic., xxiii, 1887, p. 213.

Petralia ellerii (Macgillivray), Levinsen, Morph. Syst. Stud. Cheil. Bryozoa, 1909, p. 351.

Diagnosis.—Zooecium sub-quadrate in outline. The frontal, sloping regularly upward from the lateral and proximal margins to the suboral mucro, is ornamented by strong bifurcating ridges radiating from the mucro, between which are situated the tremopores (about 40). The mucro, overarching the proximal portion of the aperture, is small in extent and not very salient, but supports a small avicularium opening towards the aperture. On either side of the mucro on the proximal margin of the aperture there is often a small short protuberance followed by a small avicularium which varies in its position on the lateral margins of the aperture.

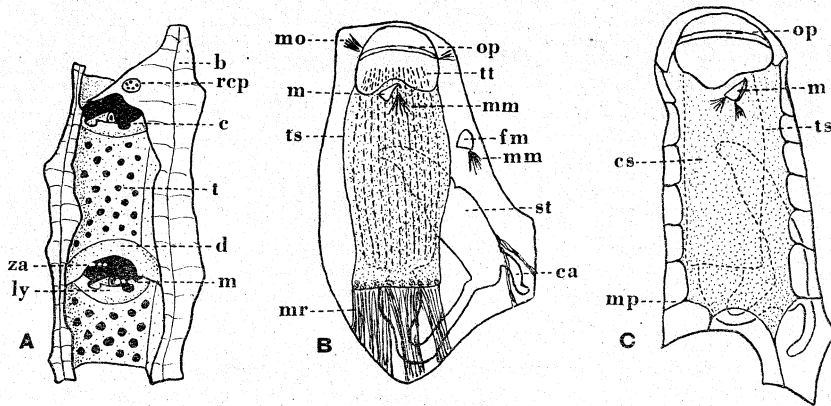


Figure 14.

Mucropetraliella ellerii. A. Apertural detail and structure of frontal as seen after removal of the basal lamina. $\times 30$. b, basal lamina; c, cardelle; d, distal wall; ly, lyrule; m, suboral mucro; rcp, primary radicular chamber; t, tremopore; za, aperture of zooecium. B. Anatomical detail seen below the level of the compensatrix. $\times 72$. C. Preparation showing compensatrix and associated parietal muscles. $\times 72$. ca, caecum; cs, compensatrix; fm, mandible of frontal avicularium; m, mandible of suboral avicularium; mm, muscles of avicularia; mo, opercular muscles; mp, parietal muscles; mr, retractor muscles of the polypide; op, operculum; st, stomach; ts, tentacle sheath; tt, tentacles.

The subcircular aperture has a broad shallow lyrule and sharply-pointed cardelles. The basal lamina of each zooecium is supplied with a single primary radicular chamber communicating with the zooecium by about five uniporous septula. The ovicell is broadly crescentic in outline and occupies the proximal half of the frontal of the distal zooecium.

Dimensions.—Zooecium, length 0.72 mm., greatest width 0.65; aperture, length 0.25, width 0.31.

Distribution.—Victoria: Williamstown, Warrnambool (Macgillivray); Port Phillip (Waters); Point Leo (Shoreham, Western Port), San Remo, Balnarring (Western Port) (Stach coll.). Tasmania (Waters). South Australia (Macgillivray).

Observations.—The variations noted are as follows: The avicularia at the sides of the aperture may be both absent, or only one may be present. The protuberances on either side of the mucro may be so slightly developed as to be scarcely noticeable. Occasionally an avicularium occurs on the frontal distal to an ovicell. The small size of the mucro is a very characteristic feature.

Having the opportunity of collecting living material of this species, stained decalcified mounts were prepared, and the following points were noted:—

(a) *Compensatrix.*—In adult zooecia the compensatrix is a much elongated sac attached to the lateral body wall by about fourteen bundles of parietal muscles and to the proximal body wall by a pair of parietal muscle bundles.

(b) *Polypide.*—The polypide has the usual large number of tentacles (26) typical of Petraliidae. It is interesting to note that this species has a similar long, slender caecum to that figured by Hastings¹⁵ for *Sinupetraliella litoralis* (Livingstone).

(c) *Proximal musculature.*—The retractor muscles of the polypide appear to be arranged in definite bundles. A large bundle is attached to that side of the base of the tentacle sheath opposite to which the alimentary canal opens out, while two smaller bundles are attached to the base of the tentacle sheath and extend on either side of the oesophagus to their attachment on the proximal region of the body wall. From the outer side of the stomach, beyond the caecum, a pair of muscle bands are developed, the more distal one attached to the lateral region of the body wall and the proximal one to the proximal region of the body wall. The function of the latter pair of muscles appears to be for the proximal and lateral displacement of the lower regions of the alimentary canal when protrusion of the polypide takes place.

Mucropetraliella vultur (Hincks, 1882) (*sensu stricto*).

(Figures 6B and 15.)

Mucronella vultur Hincks, Ann. Mag. Nat. Hist., (5), x, 1882, p. 98, pl. viii, fig. 2.

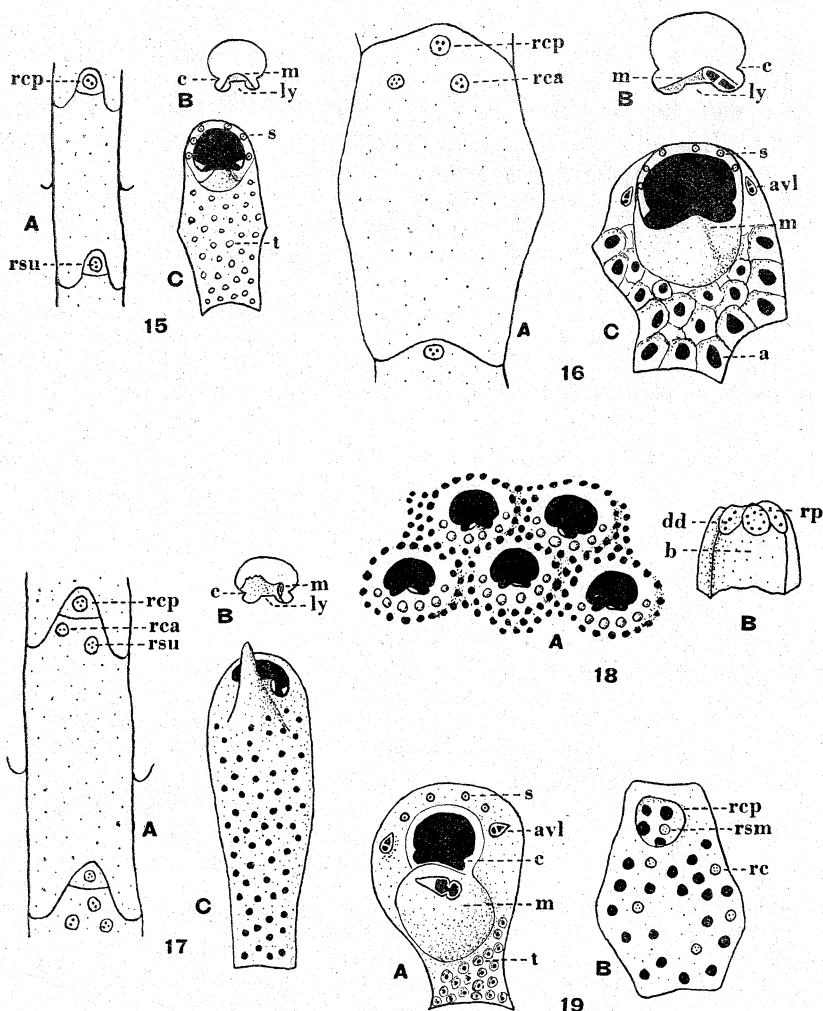
Mucronella ellerii var. *vultur* Waters, Ann. Mag. Nat. Hist., (5), xx, p. 195.

Petralia vultur (Hincks), Livingstone, Rec. South Austr. Museum, iv, 1, 1928, p. 123, text fig. 34.

Diagnosis.—The zooecia are elongate, subrectangular in outline, and about twice as long as broad. The frontal becomes increasingly convex from the proximal margin as it approaches the mucro. The mucro has a squat protuberance near the avicularium, projecting slightly over the proximal rim.

The distal rim of the aperture bears about six spinous processes. The lyrule is moderately broad, but projects much further into the aperture than is the case in *M. ellerii*. Primary radicular chambers only have been observed, and these communicate with the zooecium by uniporous septula. The trace of the distal dietella is conspicuous on the basal lamina. The longitudinal and transverse diameters of the finely perforate ovicell are approximately equal.

¹⁵Hastings.—Sci. Repts. Grt. Barrier Reef Exped. (1928–29), iv, 12, Polyzoa, 1932, text fig. 15 D.



Figures 15-19.

(Magnification $\times 30$.)

Figure 15.—*Mucopetraliella vultur*. A. View of basal lamina showing roofed primary radicular chamber. B. Apertural detail. C. Zooecial detail. Figure 16.—*Mucopetraliella halei*. A. View of basal lamina, showing primary and accessory radicular chambers. B. Apertural detail. C. Zooecial detail. Figure 17.—*Mucopetraliella ligulata*. A. View of basal lamina, showing roofed primary radicular chamber and accessory radicular chambers. B. Apertural detail. C. Zooecial detail. Figure 18.—*Mucopetraliella nodulosa*. A. Zooecial detail. B. Interior view of basal lamina. Figure 19.—*Mucopetraliella (Poripetraliella) tuberosa*. A. Zooecial detail. B. View of basal lamina, showing primary radicular chamber with multiporous septula and numerous accessory radicular chambers. a, areolae; avl, lateral avicularium; b, basal lamina; c, cardelle; dd, distal crescentic dietella; ly, lyrule; m, suboral mucro; rc, radicular chamber; rca, accessory radicular chamber; rep, primary radicular chamber; rp, radicular plate; rsm, multiporous septula of radicular chamber; rsu, uniporous septula of radicular chamber; s, spine trace; t, tremopore.

Dimensions.—Zoecium, length 0.85 mm., greatest width 0.41; aperture, length 0.20, width 0.25; ovicell, longitudinal diameter 0.47, transverse diameter 0.50.

Distribution.—Victoria: Port Phillip Heads, Portland, Warrnambool (Macgillivray); Western Port (J. Gabriel coll.). South Australia: 7 miles south-west from Newland Head (Encounter Bay) at 20 fathoms (Livingstone); off Beachport at 200 fathoms (Sth. Aust. Mus. coll.). New South Wales: Taylor Bay (Whitelegge).

Observations.—The above description of Hincks' species (*sensu stricto*) is based on Victorian material in the Macgillivray collection and material from Western Port dredged by J. Gabriel. Normally the mucro is quite small and rarely attains the convexity of many of its congeners. Frontal avicularia occur very rarely in the series examined and no accessory radicular chambers were noted.

Within recent years, Livingstone has erected three varieties of this species (var. *serrata*, var. *bennetti*¹⁶, and var. *noezelanica*¹⁷) which we agree, as he has suggested, should be raised to specific status. Waters' *Mucronella ellerii* var. *biaviculata*¹⁸ is obviously the typical *M. vultur*, except that the squat protuberance of the mucro bears a small avicularium, and it is here regarded as being a variety of *M. vultur*.

Mucropetraliella halei (Livingstone, 1928).

(Figure 16.)

Petralia halei Livingstone, Rec. South Austr. Museum, iv, 1, 1928, p. 123, text fig. 35.

Note.—A discovery of further material in a moderately well-preserved condition permits a more complete description of this species to be given. Livingstone's single fragment, in a very much abraded condition, did not permit a full study of this species. The present specimens also lack the ectocyst and accompanying structures, while the ovicell still remains unknown.

Diagnosis.—The zoecia are broadly pyriform in outline. The frontal is deeply areolated and has a few tremopores scattered below the proximal margin of the broad convex mucro which possesses a moderately large avicularium, and projects slightly over the proximal rim.

The broad aperture has a shallow, blunted lyrule only seen from the interior. On the distal margin six spine traces are present, while situated proximally to them are a pair of small lateral avicularia directed distally. The basal lamina has a primary and usually two accessory radicular chambers communicating with the zoecia by uniporous septula.

Dimensions.—Zoecium, length 1.04 mms.; greatest width, 0.88; aperture, length 0.32, width 0.42.

Distribution.—South Australia: Beachport (Livingstone); off Beachport at 200 fathoms (Sth. Aust. Mus. coll.).

Observations.—This species is readily distinguished by the broad zoecia, enormous aperture and broad low mucro.

¹⁶Livingstone.—Rec. Austr. Museum, xv, 1, 1926, pp. 95–96.

¹⁷Livingstone.—Vidensk. Medd. fra Dansk Naturh. Foren., lxxxii, 1929, p. 74.

¹⁸Waters.—Ann. Mag. Nat. Hist., 5, xx, 1887, p. 194.

Mucropetraliella ligulata, sp. nov.

(Figures 6C and 17.)

Diagnosis.—The zooecia are large, pyriform and very attenuated, the length being more than three times the greatest width. The frontal, with numerous scattered tremopores, is slightly convex and develops a mucro with a long, slender spine projecting forward and upward over the aperture. A small avicularium is developed laterally at its base. The portion of the base of the spine opposite the avicularium extends distally over the aperture, completely concealing the cardelle. No spine traces on the distal rim of the aperture were noted in the present series. Internally, the lyrule and cardelles are seen to agree closely with those of *M. vultur*.

The basal lamina shows a central primary radicular chamber and usually two or three accessory chambers, communicating with the zooecia by uniporous septula and partly surrounded by the distal dietella. The longitudinal diameter of the finely perforate ovicell is much greater than its transverse diameter.

Dimensions.—Zooecium, length 1.45 mms.; greatest width 0.45; aperture, length 0.19, width 0.27; ovicell, longitudinal diameter 0.51, transverse diameter 0.39.

Distribution.—South Australia: Off Beachport at 200 fathoms (Sth. Aust. Mus. coll.).

Observations.—This distinctive form attains almost twice the length of *M. vultur* (Hincks), and is particularly characterised by its slender zooecia and the great length of the spinous process of the suboral mucro which, in the figure, is considerably foreshortened owing to its tendency to project upward.

Type Material.—Syntypes: Sth. Aust. Mus. Coll, Regd. No. L. 1; two fragments, one bearing an ovicell.

Mucropetraliella nodulosa, sp. nov.

(Figure 18.)

Diagnosis.—The zooecia are elongate pyriform in outline, with the proximal region much constricted. The frontal has a few (about twelve) scattered tremopores separated by salient polygonal ridges. The mucro is of small size and hides the lyrule. Surrounding the proximal rim are a series of six protuberances placed symmetrically with regard to the longitudinal axis of the zooecium. The basal lamina has primary radicular chambers communicating with the zooecia by about seven uniporous septula and surrounded by a well-marked distal dietella.

Dimensions.—Zooecium, length 0.57 mm., width 0.33; aperture, length 0.14, width 0.21.

Distribution.—Western Australia: Perth (Aust. Mus. Coll.).

Observations.—This species somewhat resembles *M. ellerii* (Macgillivray), but is readily distinguished by the protuberances below the proximal rim and the fewer tremopores.

Type Material.—Holotype: Aust. Mus. Coll., Regd. No. U 2732.

Sub-genus **Peripetraliella**, sub-gen. nov.

Type: *Mucropetraliella* (*Poripetraliella*) *tuberosa* (Busk, 1884).

Diagnosis.—Zoarium unilaminar, not fenestrate. The primary radicular chambers communicate with the zooecia by a few multiporous septula, while numerous accessory radicular chambers are scattered over the basal lamina. The aperture possesses a lyrule and cardelles and a suboral mucro is present.

Observations.—This group, represented solely by the type, differs from *Mucropetraliella* (*sensu stricto*) in the multiporous septula of the primary radicular chamber and in the presence of numerous accessory radicular chambers occupying the remainder of the basal lamina. Its structure strongly supports the view that the genus *Petralia* is a fairly recent developmental trend in south-eastern Australian waters from a *Mucropetraliellid* stock, the present species providing a link between *Mucropetraliella* and *Petralia* by the proliferation of the accessory radicular chambers. The habitat and mode of attachment of *Petralia* is probably due to the loss of the primary radicular chamber, while the fenestration of the zoarium offers less resistance to currents than would an entire flat lamina.

Mucropetraliella (**Poripetraliella**) *tuberosa* (Busk, 1884).

(Figure 19.)

Lepralia tuberosa Busk, Chall. Rep. Zool., x, 1884, pt. xxx, p. 143, pl. xvii, fig. 7.

Petralia tuberosa (Busk), Levinsen, Morph. Syst. Stud. Cheil. Bryozoa, 1909, p. 351.

Diagnosis.—Zooecium pyriform in outline. Frontal with a number of small bordered tremopores in the region proximal to the rotund mucro, which supports a large avicularium. The distal rim of the aperture bears about four spine traces, below which, on either side of the aperture, is a small avicularium.

The basal lamina has a large distal primary radicular chamber communicating with the zooecium by about five multiporous septula each with three or four pores and numerous accessory chambers, with three or four pores, scattered over the remainder of the area of the basal lamina.

Dimensions.—Zooecium, length 1.02 mms., greatest width 0.71; aperture, length 0.23, width 0.27.

Distribution.—New South Wales: "Challenger" Station 163 B (off Port Jackson at 35 fathoms on hard ground) (Busk); Watson's Bay (Whitelegge); Broughton Island at 25 fathoms (Goldstein coll.); Manly Beach (Stach coll.).

Observations.—Superficially, this species resembles *M. halei* (Livingstone), but it is readily distinguished by the smaller dimensions of the aperture and the smaller and more numerous tremopores, apart from the difference in the radicular apparatus.

Genus **Sinupetraliella**, gen. nov.

Type: *S.* ("*Petralia*") *litoralis* (Livingstone, 1932).

Diagnosis.—Zoarium unilaminar, not fenestrate. Aperture with a pair of cardelles and no lyrule, the sinus thus formed being asymmetrical owing to the

greater development of one of the cardelles. Frontal with numerous bordered tremopores. A more or less well-developed suboral mucro, supporting an avicularium, partly conceals the aperture.

Observations.—This genus is characterised by the presence of a suboral mucro and absence of a lyrule. The following species are classed here :—

- S. (“*Petralia*”) *litoralis* (Livingstone, 1932).
- S. (“*Petraliella*”) *gigantea* (Canu and Bassler, 1929).
- S. (“*Petraliella*”) *grandicella* (Canu and Bassler, 1929).
- S. (“*Petraliella*”) *elongata* (Canu and Bassler, 1929).

INCERTAE SEDIS.

“*Petralia*” *soulieri* (Calvet, 1902).

Mucronella soulieri Calvet, Trav. Inst. Zool. Université Montpellier, (2), xi, 1902, p. 61, pl. ii, figs. 3, 4.

Petralia soulieri (Calvet), Barroso, Bol. Real Soc. Espanola de Hist. Nat., xxv, 4, 1925, p. 179, figs. 3–5.

Observations.—Barroso’s excellent study of this species shows it to belong to Petraliidae. Its exact position is uncertain, but it appears to be related to *Mucropetraliella*. Unusual features recorded by Barroso are the uniporous septula of the lateral walls and the absence of cardelles and lyrule. The former character has not been recorded in any other member of Petraliidae, but the character of the radicular pores, presence of a suboral mucro and the aperture of the ovicell opening above the plane of the zoecial aperture appear to refer it to Petraliidae.

Possibly, as Barroso points out, there is a close structural relationship between this species and “*Petralia*” *mucronata* Canu, 1913¹⁹ from the Lutetian (Middle Eocene) of France, and the former species may be a relict of the European Lower Tertiary Petraliid fauna. This, however, is mere supposition and a re-examination of the species concerned is necessary.

¹⁹Canu.—Bull. Soc. Geol. France (4) xiii, 1913, p. 301.