Memoirs of the National Museum of Victoria https://doi.org/10.24199/j.mmv.1962.25.06

 1 May 1962

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 Pleurobranchaeca 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.

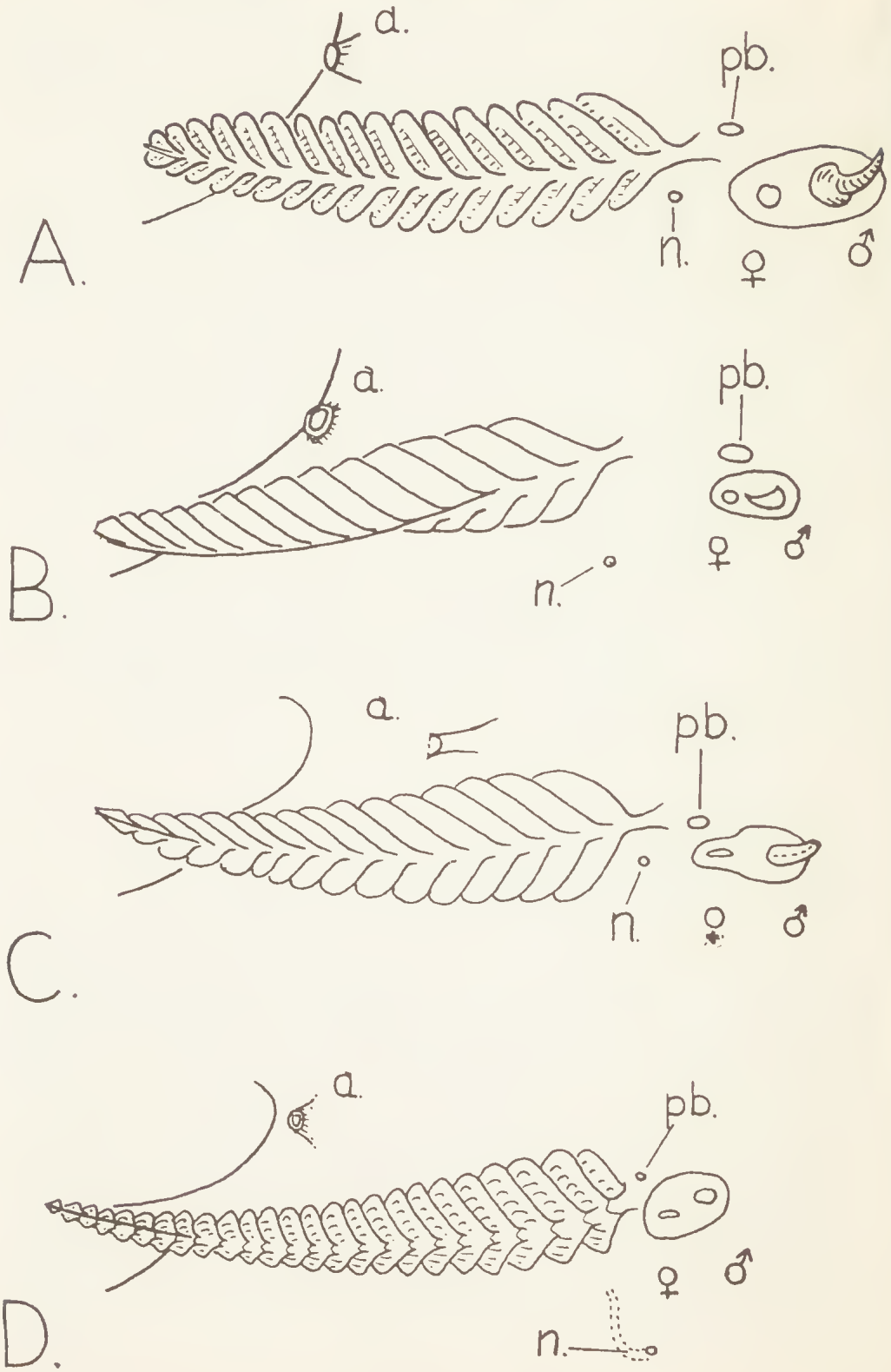
Finally it must be stated that the species of *Berthella* are paler coloured than those of the preceding genus but are never as pale as the following one. *Berthellina* varies from yellow to bright orange, *Berthella* from pale lemon-yellow to rosey-yellow to dull yellow, and in *Berthellinops* the colour is cream, or pure white with purple trim.

(3) *Berthellinops* gen. nov.

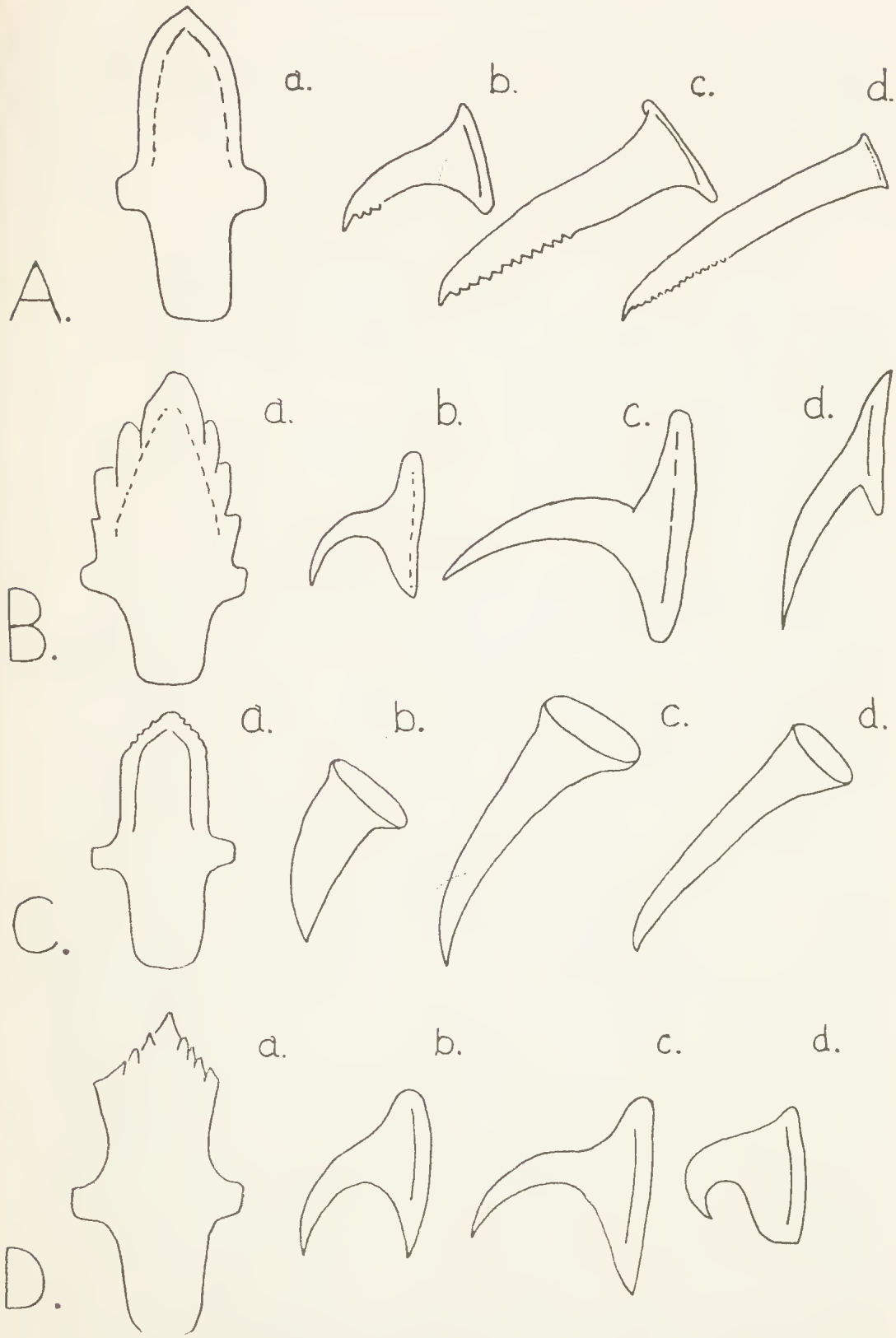
This new genus is proposed for the reception of a single cold-temperate water species at present known only from the central western coastline of Victoria.

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.

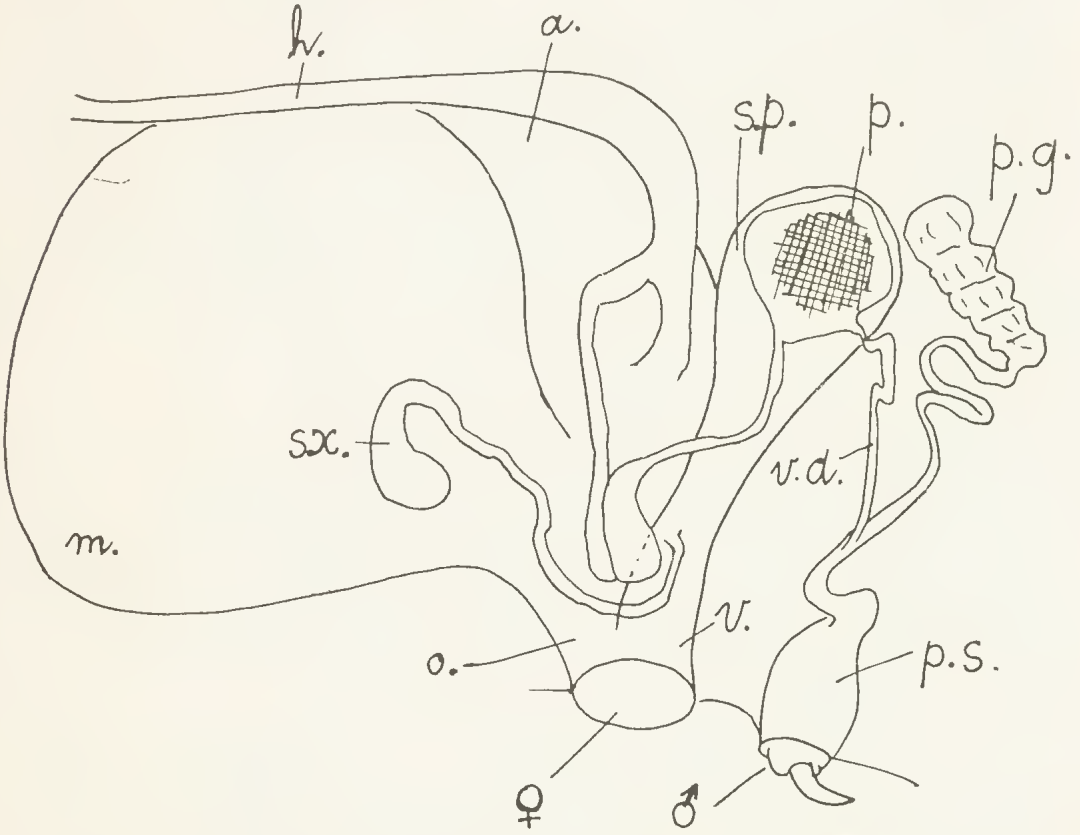


Fig. 3.—*Berthellina citrina* (Rüppell et Leuckart). Distal genital mass.

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 $\frac{2}{3}$ 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 $\frac{2}{3}$ 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.

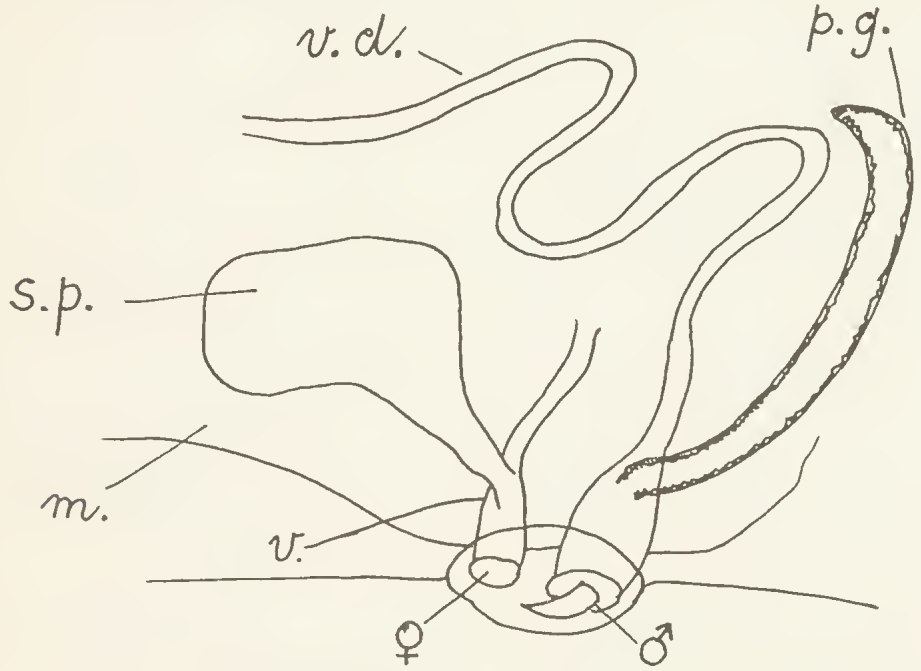


Fig. 4.—*Berthella postrema* sp. nov. Distal portion of distal genital mass.

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 $\frac{1}{2}$ to $\frac{1}{3}$ 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.

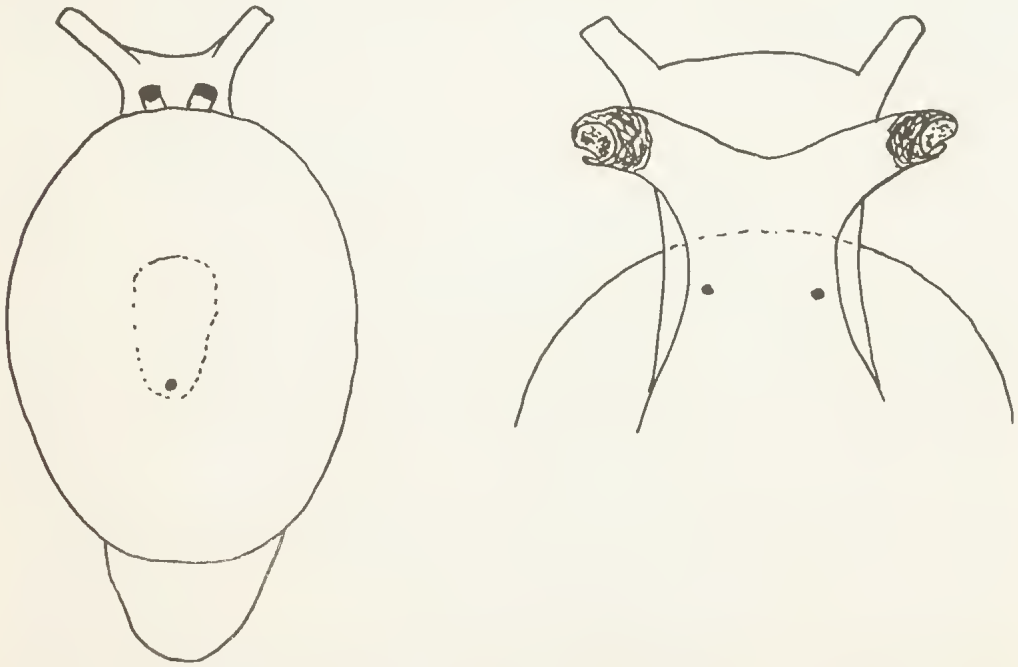


Fig. 5.—*Berthellinops serenitas* sp. nov. Dorsal view of holotype and detail of head, rhinophores and velum.

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.

REFERENCES.

Allan, J., 1959.—*Australian Shells* (revised edn.), XXI + 487 pp. 44 pl. Melbourne (Georgian House).

Baba, K., 1949.—*Opisthobranchia of Sagami Bay, &c.* 194 + 7 pp. 50 pl. Tokyo (Iwanami Shoten).

Bergh, R., 1907.—The Opisthobranchia of South Africa. *Trans. S. Afr. Phil. Soc.,* 17 (1), 1-144, pl. 1-14.

Burn, R., 1957.—On some Opisthobranchia from Victoria. *J. Malac Soc. Aust.,* 1, 11-29.

Eales, N., 1937.—Apparent viviparity in Pleurobranchoides. *Proc. Malac. Soc. Lond.,* 22 (6), 371-374.

Eales, N., 1938.—A systematic and anatomical account of the Opisthobranchia. *John Murray Exped. Sci. Rep.,* 5 (4), 77-122, pl. 1.

Gardiner, A., 1936.—Engel's Paper on 'The English Species of the Family Pleurobranchidae'. *J. Conch.,* 20 (7), 195-198.

Hirase, S., 1937.—A New Berthella from Japan. *Proc. Malac. Soc. Lond.,* 22 (4), 177-181.

Krauss, F., 1848.—*Die Sudafrikanischen Mollusken.* 72 pp. Stuttgart.

Marcus, E., 1955.—Opisthobranchia from Brazil. *Bol. Fac. Fil. Ci. Letr. Univ. S. Paulo,* Zoologia No. 20, 89-200, pl. 1-30.

Marcus, E., 1957.—On Opisthobranchia from Brazil (2). *J. Linn. Soc. Lond.,* Zoology, 43, No. 292, 390-486.

Marcus, E., 1959.—Lamellaracea und Opisthobranchia. *Lunds Universitets Arsskrift.,* N. F. Avd. 2, 55 (9), 1-135.

Marcus, E. et E., 1955.—Sea-Hares and Side-Gilled Slugs from Brazil. *Bol. Inst. Oceanogr.,* 6 (1-2), 3-33, pl. 1-8.

Mattox, N., 1953.—A new species of Pleurobranchus, &c. *Nautilus,* 66 (4), 109-114, pl. 9-10.

Mörch, O., 1863.—Contributions à la faune malacologique des Antilles Danoises. *J. Conchyliol.,* 11, 21-43.

Odhner, N., 1926.—Die Opisthobranchien. *Further Zool. Res. Swed. Antarct. Exp.,* 1901-1903, 2 (1), 1-100, pl. 1-3.

Odhner, N., 1939.—Opisthobranchiate Mollusca from the western and northern coasts of Norway. *K. Norske Vidensk. Selsk. Skr.,* 1939, No. 1, 1-99.

O'Donoghue, C., 1924.—Report on the Opisthobranchiata from the Abrolhos Islands, Western Australia. *J. Linn. Soc. Lond.*, Zool., 35, No. 237, 521-579, pl. 27-30.

O'Donoghue, C., 1929.—Report on the Opisthobranchiata. *Trans. Zool. Soc. Lond.,* 22 (6), 713-841.

O'Donoghue, C., 1929.—Opisthobranchiate Mollusca collected by the South African Marine Biological Survey. *S. Afr. Fish. Mar. Biol. Surv.,* Report No. 7 (1928-1929), 1-84, pl. 1-8.

Pease, W., 1861.—New species of Molluscs, &c., *Proc. Zool. Soc., Lond.,* 242-247.

Pilsbry, H., 1896.—*Manual of Conchology,* 16, 1-262 + 7, pl. 1-74. Philadelphia (Conchol. Sect. Ac. Nat. Sci.).

Quoy, J. et Gaimard, P., 1832.—*Voyage de decouvertes de l' " Astrolabe ".* Zool., 2-3, 1-644, atlas of plates.

Rüppell, E. et Leuckart, F., 1828.—Neue Wirbelloser Thiere des Rothen Meeres. *Atlas zu der Reise im Nordlichen Afrika,* 1, Abt. Zool., Teil 5. Frankfurt.

Thiele, J., 1931.—Opisthobranchia. *Handb. Syst. Weichtierkunde,* 1,377-461.

Utinomi, H., 1958.—*Coloured Illustrations of Sea Shore Animals of Japan.* XVII + 167 pp. 64 + XII pl. Osaka (Hoikusha).

Vaysièrre, A., 1896.—Description de quelques éspèces nouvelles ou peu connues de Pleurobranchidés. *J. Conchyliol.,* 44, 113-137, pl. 4-5.

Vaysièrre, A., 1898.—Monographie de la famille des Pleurobranchidés. *Ann. Sci. Nat. Zool.,* sér. 8, 8, 209-402, pl. 13-28.

White, K., 1946.—On three new species of Pleurobranchidae from Karachi. *Proc. Malac. Soc. Lond.,* 27 (1), 52-56, pl. 5.

White, K., 1952.—On a collection of Molluscs from Dry Tortugas, Florida. *Ibid.,* 29 (2-3), 106-120, pl. 6.

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.

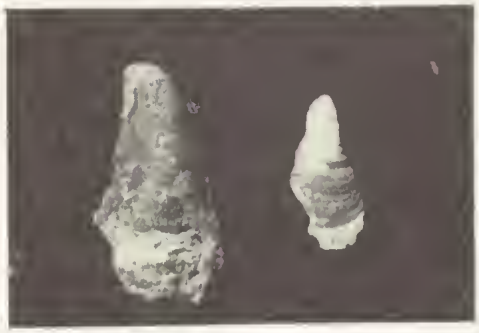
1. *Bethellina citrina* (Rüppell et Leuckart) shells of two specimens, the larger from Manly Baths, N.S.W., 15th November, 1958; Reg. No. F20, 143; the smaller from Long Reef, N.S.W., 16th November, 1958; Reg. No. F20, 141. x 5, dorsal view.
2. *Ibid.* Ventral view.
3. *Berthella postrema* sp. nov., 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.

1

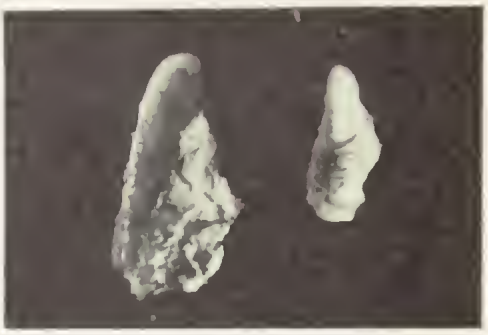
2

3

4



1



2

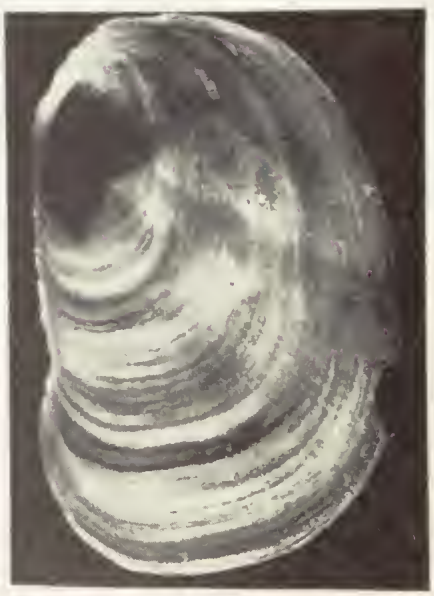
3

4

5

6

7



8