TWO SPECIES OF BRYOZOA CTENOSTOMATA FROM THE SALTON SEA[1]

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While in the process of sorting the invertebrate animals collected at various stations in the Salton Sea, Mr. Richard H. Linsley, biologist with the University of California Salton Sea Laboratory, noted three collecting bottles covered with colonies of actenostome bryozoan. Upon receipt of this material from Mr. Linsley, it was discovered that not one, but two species of Bryozoa Ctenostomata were represented, namely *Nolella blakei* Rogick, 1949 and *Victorella pavida* Kent, 1870. In each instance, the only prior report of the species in the United States had been from the Atlantic coast.

The author wishes to take this opportunity to express his gratitude to Mr. Richard H. Linsley of the University of California Salton Sea Laboratory for his interest and cooperation in not only providing the specimens, but in also furnishing a faunal list of associated invertebrates. To Dr. Mary D. Rogick of the College of New Rochelle, I acknowledge my appreciation for her generous aid in confirming the identification of *Nolella blakei*.

Nolella Cosse, 1855

Nolella blakei Rogick, 1949

1949 *Nolella blakei* Rogick, Biol. Bull., vol. 97, no. 2, pp. 158-168, pl. 1, figs. 1-4, pl. 2, figs. 5-8, pl. 3, figs. 9-14, pl. 4, figs. 15-19.

Colonies of *Nolella blakei* were found growing in great profusion covering the walls of a test bottle suspended in the Salton Sea for a period of one month at a depth of about one meter.

The zoids, or individuals of the colony, are cylindrical, arising from an irregular flattened adnate base. In over-all dimensions, including the basal area, the mature zoids range from individuals as short as 320 microns to those that have attained a length of 1150 microns. In width the variation is not extreme, ranging from 110 microns to 140 microns. The cuticle of the older zoids is almost imperceptibly covered with a fine grained layer of silt, to the extent of being moderately argillaceous. The basal portion of the younger zoids are decidedly expanded and flattened, exhibiting from 6 to 14 lateral branches. Some of these lateral branches

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are short, diminutive and narrow. Others are wider, longer, provided with a diaphragm or septum, and constitute a stolonal connection to an adjacent zoid. The longer, older zoids have a much less pronounced basal expansion with a reduced number of lateral branches.

The polypide is provided with 8 tentacles. The lower portion of the cardium is expanded immediately before it joins the caecum, to form a grinding organ that is more the nature of a proventriculus than a gizzard (pl. 6, fig. 1). *Geographical distribution*: Atlantic. Lagoon Pond, Martha's Vineyard, Massachusetts. August 1946. Collector, Mary D. Rogick.

Occurence: Salton Sea, California, station 6, north end of the Salton Sea, 33° 31'N - 116° 02'W, depth 1.2 meters. Salinity 32.5/00 fairly constant. August 1955. Collector, Richard H. Linsley, University of California Salton Sea Laboratory.

Victorella Kent, 1870

Victorella pavida Kent, 1870

1870 *Victorella pavida* Kent, Quart. Jour. Micro. Sci., vol. 10, n.s., pp. 34 - 39, pl. 4, figs. 1-3.

1880 *Victorella pavida,* Hincks, Hist. Brit. Mar. Polyzoa., pp 561, 562, pl. 79, figs. 4-7.

1885 *Victorella pavida,* Bousfield, Ann. Mag. Nat. Hist., ser. 5, vol. 16, pp. 401-407, pl. 12, figs. 1-3.

1887 *Victorella pavida,* Kraepelin, Abh. Geb. Naturw., Hamburg, band 10, pp. 93-96, pls. 3, 4, figs. 75, 78, 91, 92, 118.

1887 *Paludicella Müller*i Kraepelin, Abh. Geb. Naturw., Hamburg, band 10, pp. 158-160 (footnote), text figs. a & b.

1907 *Victorella pavida,* Annandale, Rec. Ind. Mus., vol. 1, pp. 200-203 text figs. 3 & 4.

1908 *Victorella bengalensis* Annandale, Rec. Ind. Mus., vol. 2, pp. 11-13, fig. 1.

1911 *Victorella pavida,* Annandale, Fauna Brit. India, pp. 194, 195.

1911 *Victorella pavida,* Annandale, Rec. Ind. Mus., vol. 6, pp. 196, 197, pl. 13, fig. 5.

1911 *Victorella müller*i, Annandale, Rec. Ind. Mus., vol. 6, p. 196, pl. 13, fig. 4.

1911 *Victorella bengalensis,* Annandale, Rec. Ind. Mus., vol. 6, p. 197, pl. 8, figs. 3, 7 & 8.

1915 *Victorella bengalensis,* Annandale, Mem. Ind. Mus., vol. 5, p. 125.

1932 *Victorella pavida,* Osburn, Ohio Jour. Sci., vol. 32, no. 5, p. 445, pl 1, fig. 5.

1936 *Victorella pavida,* Vorstman, Flora en Fauna Zuiderzee, supp., pp. 148, 149, text figs. 5, 6.

1940 *Victorella pavida,* Marcus, Danmarks Fauna, Mosdyr, pp. 329, 330, text fig. 173.

1944 *Victorella pavida,* Osburn, Chesapeake Biol. Lab. pub. 63, pp. 17-20, pl. 5, and text fig. 10.

1951 *Victorella pavida,* Braem, Zoologica, Stuttgart, band 37, heft 102, pp. 7-23, pl. 1, figs. 2-8, pl. 2, figs. 10-12, figs. 14-20, pl. 3, figs. 22-35, pl. 4, figs. 36-44.

1951 *Tanganella Mülleri* Braem, Zoologica, Stuttgart, band 37, heft 102, pp. 23-33, pl. 1, fig. 9, pl. 5, figs 45-53, pl. 6, figs. 54-61, pl. 8, figs. 69, 70.

1951 *Victorella pavida* forma *symbiotica,* Lacourt, Expl. Hydrobiol. Lac Tanganika, Res. Sci., vol, 3, fasc. 2, pp. 24, 25.

1953 *Victorella pavida,* Marcus, Arq. Museu Nac., vol. 42, pp. 312, 313, pl. 8, fig. 94.

1954 *Victorella pavida,* Brattstrom, Lunds Univer. Arsskrift, Avd 2, band 50, nr. 9, pp. 1-29, 1 pl., 4 text figs.

1956 *Victorella pavida,* Toriumi, Sci. Rep. Tôhoku Univer., 4, ser. (Biology), vol. 22, no. 2, p. 82, figs 1-3.

The zoaria or colonies of *Victorella pavida* form a luxuriant tan to yellowish brown colored mat upon the substratum. The specimens in this collection were removed from the sides of two test bottles, each exposed for a period of 30 days in the Salton Sea at a depth of about one meter. In 1944 Osburn described colonies of *Victorella pavida* from Chesapeake Bay as capable of "spreading over almost any sort of substratum on which it can find attachment". The abundance of this species during the warm summer months is enough so as to regard it as a potential fouling organism.

The zoids of *Victorella pavida* are variable in their dimensions, a factor that has been noted by several of the earlier authors (Bousfield, 1885; Osburn, 1944; Braem, 1951; and Marcus, 1953). With regard to those collected from the Salton Sea, short repent, mature individuals with a total length of only 345 microns were found. Within the same colony, many exceedingly elongated individuals were measured. The longest was found to have a length of 4850 microns. In width the variation is not great, ranging from 126 microns to 196 microns.

The tall zoids are cylindrical, arising from limited expanded portions of the stolon. The basal expansion may exhibit two, three or even four short lateral branches. A number of the longer mature zoids (primary) have functional secondary zoids budding directly from the cuticle. While the secondary zoids never attain the maximum length of the primary individuals, in all other anatomical respects they can be considered as normal members

of the colony (pl. 6, fig. 2). *Geographical distribution:* The only place in the United States from which *Victorella pavida* has been reported prior to this time is Chesapeake Bay, Maryland (Osburn, 1932, 1944). For an excellant summary of the worldwide distribution of this species see Brattstrøm, 1954.

Occurence: Salton Sea, California, station 7, south side of Mullet Island, 33° 13.5′N - 115° 36.5′W, depth 1.0 meters, October 1955. Station 8, .75 miles north east of Mullet Island, 33° 14′N - 115° 35.7′ W, depth 0.8 meters, August 1955. Salinity at stations varies considerably due to the influence of the water from the mouth of the nearby Alamo River. Brackish.

Associated invertebrates: Neanthes succinea (Frey & Leuckart), *Balanus amphitrite saltoensis* Rogers, *Brachionus plicatilis* Müller, and *Cyclops dimorphus* Kiefer.

Taxonomic affinity: As was noted above, the zoids of *Victorella pavida* exhibit considerable variation in length. The short individuals of the colony, *ie* the younger zoids, appear to be anatomically identical with the zoids of the species described in 1887 by Kraepelin as *Paludicella Mülleri,* later referred to as *Victorella mülleri* by Annandale, 1911, and in 1951 redescribed by Braem as *Tanganella Mülleri.* The taxonomic history of *Victorella mülleri* is diverse. While a few authors have accepted it as a well-defined species, the majority are of the opinion it is at least very closely related, if not identical with *Victorella pavida.* Most authors who have studied the European material have considered the two identical. Brattström, 1954, pp. 8-12, summarizes the various views, including the work of Kraepelin (1887) who described *Paludicella Mülleri;* Braem, (1911) who at that time considered *Victorella mülleri* a growth phase of *Victorella pavida;* Annandale, (1911) who stated that while four "species" can be distinguished in the genus *Victorella,* it might be better to regard them as varieties or as subspecies of *Victorella pavida.* Annandale also found with regard to *Victorella mülleri,* intermediate stages between the "form *mülleri*" and the *Victorella* associated with it, *V. pavida.* Brattström (1954) also reviews the work of Vanhöffen, (1917) who considered *Victorella mülleri* a growth form of *V. pavida,* as did Ulrich, (1926). Marcus (1940) and Valkanov (1943) also considered the two as being identical. Toriumi (1956) stated that *Victorella mülleri* is a "phenotype" of *V. pavida.*

Although Osburn (1944) did not have the opportunity to discuss *V. mülleri,* his figures 10c, 10d, and 10f of early growth stages, lend support to the authors who consider the two species identical. The close similarity of Osburn's figures mentioned and those of Braem (1951), plate 5, fig. 47 of *Tanganella Mülleri* is unmistakable. Osburn's (1944) measurements of *V. pavida* from

Chesapeake Bay correspond very closely to those given later by Braem for the Greifswald material.

Annandale (1911) separated *Victorella pavida* from *V. mülleri* on the premise that *V. mülleri* has parietal muscles present in the distal tip of the zoids, whereas *V. pavida* does not. Examination of the Salton Sea specimens, as well as slides made by Osburn from the Chesapeake Bay collection reveal Annandale's assertion to be erroneous. *Victorella pavida* possesses parietal muscles in the distal tip of the zoids.

It seems paradoxical that one author can derive two genera from material considered by other authors to be a single well known and widely distributed species. Braem (1951) erected the genus *Tanganella* on the basis of, (a) the morphology of the cardia and the presence of a sphincter muscle in the foregut of the polypide; (b) the small size of the zoids; and (c) the number of the "Kragenfalten".

With regard to item (a) above, Braem, reported a ventricose enlargement of the cardia in *V. pavida* with the conclusion that it is a grinding mill lacking in dentition *ie* proventriculus. This agrees with findings of earlier authors such as, Osburn, 'proventriculus,' (1944); Marcus, 'tyggemave,' (1940); and Bousfield, 'gizzard,' (1885). With reference to *Tanganella Mülleri,* Braem makes no mention of a proventriculus, although the sphincter musculature of the foregut is thoroughly discussed. However, two of Braem's illustrations of *T. Mülleri* (pl. 5, figs. 49 and 51) show every indication of the presence of a proventricular division of the cardia. Examination of the Salton Sea collection and the Chesapeake Bay specimens, and a comparison with Braem's work indicates that essentially there is no marked anatomical dissimilarity that would separate a species *mülleri* from *Victorella pavida* let alone warrant the erection of a separate genus.

Consider next Braem's second item, the length of the zoid. As shown by many earlier authors as well as by the examination of the Salton Sea material this is not a valid criterion for the separation of a distinct genus. In a given colony both short zoids of the *mülleri* type occur in numbers intermingled with the predominate greatly elongated individuals considered typical of *Victorella pavida.* The *mülleri* type zoid is to be considered as a growth phase encountered in the younger colonies of *Victorella pavida.*

The third item, the "Kragenfalten" or collar folds, are subject to a high degree of individual variation. There are variations produced in the contraction of individual zoids such as differences produced by various fixatives and preservatives. These variations are much too great to stand as a reliable criterion.

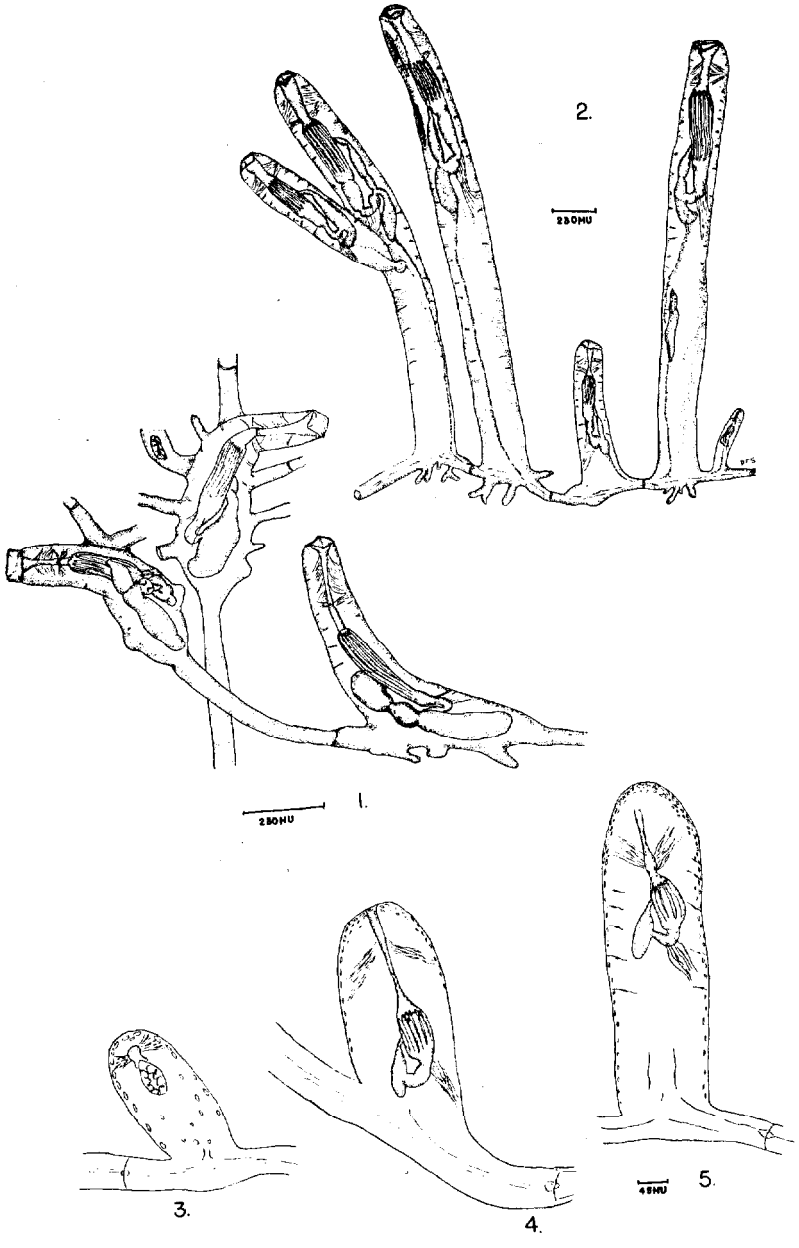

PLATE 6

The conclusions of Braem (1951) in view of the above discussion seem to be extreme. In my opinion, *Victorella pavida* Kent, 1870 and *Tanganella Mülleri* Braem, 1951 are to be considered as identical.

In a paper on post-larval development with relation to the classification of the ctenostome Bryozoa, Soule (1954) noted that the specimens of *Victorella* then available were inadequate for the study of the developing polypide. However, with an abundance of new material from the Salton Sea collection, it is now possible to follow the post-larval development of the polypide within the forming zoids. As a result of the study, certain modifications in the ctenostome classification are in order.

The scheme of classification as developed in the earlier paper is based upon the sequence of appearance of the three major muscle groups; parietal, retractor, and the apertural, as the polypide is being formed. It was noted in the 1954 paper that there are two basic systems of procedure in the sequence of appearance of the major muscle groups. This divides the ctenostomes into two divisions, the incrusting group called Carnosa, and the stolonate group known as Stolonifera. In the 1954 classification, the genus *Victorella* was included in the first division, Carnosa, under the family Victorellidae, along with the genera *Paludicella, Pottsiella,* and *Arachnoidia.* This must be changed. Upon the examination of Salton Sea specimens, *Victorella pavida,* it was found that the *apertural* muscle group appeared first as the polypide developed (pl. 6, fig. 3). The second muscle group to makes its appearance is the *retractor,* (pl. 6, fig. 4), and a little later the *parietal* group appeared (pl. 6, fig. 5). This sequence of muscle group develop-

DESCRIPTION OF FIGURES ON PLATE 6

Fig. 1. *Nolella blakei.* A portion of a colony illustrating the morphology of three mature zoids.

Fig. 2. *Victorella pavida.* A portion of a colony showing the morphology of four mature primary zoids. Note the variation in length. One primary zoid has given rise to a secondary zoid.

Fig. 3. *Victorella pavida.* Early developing zoid. Note incipient polypide. With regard to the musculature, only the apertural muscle group is in evidence.

Fig. 4. Further development of a zoid. Tentacles forming. Polyide assuming characteristic morphology. The second muscle group to make its appearance, the retractor, has been added.

Fig. 5. A developing zoid in a yet later stage, exhibiting the addition of third and last muscle group to appear, the parietal.

ment is typical of the sequence that occurs in the division Stolonifera, obviously ruling out *Victorella* as a member of the division Carnosa. The classification is modified as follows.

BRYOZOA Ehrenberg, 1831
Suborder CTENOSTOMATA Busk, 1852
Division I. CARNOSA Gray, 1841

Family ALCYONIDIIDAE Johnston, 1849
Alcyonidium Lamouroux, 1813
Benedenipora Pergens, 1888
Lobiancopora Pergens, 1888

Family FLUSTRELLIDAE Hincks, 1880
Flustrella Gray, 1848
Elizerina Lamouroux, 1816

Family PHERUSELLIDAE Soule, 1953
Pherusella Soule, 1951

Family CLAVOPORIDAE Soule, 1953
Clavopora Busk, 1874

Family PALUDICELLIDAE Allman, 1844
Paludicella Gervais, 1836
Pottsiella Kraepelin, 1887

Family ARACHNIDIIDAE Hincks, 1880
Arachnidium Hincks, 1877
Arachnoidia Moore, 1903
Platypolyzoon Annandale, 1912
Sundanella Braem, 1939
Anguinella van Beneden, 1845
? Hislopia Carter, 1858

Division II. STOLONIFERA EHLERS, 1876
Group A. Vesicularina Waters, 1910

Family NOLELLIDAE Harmer, 1915
Nolella Gosse, 1855
Victorella Kent, 1870

Family VESICULARIIDAE Johnston, 1838
Vesicularia Thompson, 1830
Amathia Lamouroux, 1812
Bowerbankia Farre, 1837
Zoobotryon Ehrenberg, 1831
?Avenella Dalyell, 1847
?Cryptopolyzoon Dendy, 1889
Group B. Valkerina Silén, 1942

Family WALKERIIDAE Bassler, 1953
Walkeria Fleming, 1823
Aeverrillia Marcus, 1941
Monastesia Jullien, 1888

Family MIMOSELLIDAE Hincks, 1851
Mimosella Hincks, 1851
Hypophorella Ehlers, 1876

Family BUSKIIDAE Hincks, 1880
Buskia Alder, 1857

Family TRITICELLIDAE G.O. Sars, 1874
Triticella Dalyell, 1848
Farrella Ehrenberg, 1834

Group C. Terebriporina Soule, 1953

Family TEREBRIPORIDAE d'Orbigny, 1847
Terebripora d'Orbigny, 1847
Spathipora Fischer, 1866

Family IMMERGENTIIDAE Silén, 1946
Immergentia Silén, 1946

Family PENETRANTIIDAE Silén, 1946
Penetrantia Silén, 1946

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