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Three New Species Of Burrowing Bryozoans (Ectoprocta) From The Hawaiian Islands

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ABSTRACT: Recent collecting in the waters off the Hawaiian Islands under the auspices of a National Science Foundation Grant GB 5208, has produced the first records of penetrating bryozoans in the mid-Pacific. Two are known species: *Penetrantia parva*, described from New Zealand (Silén, 1946), and *Immergentia zelandica minuta* Soule, 1950, described from Zamboanga, Philippine Islands. Three new species are included in this report: *Terebripora varians*, *Penetrantia operculata*, and *Immergentia angulata*.

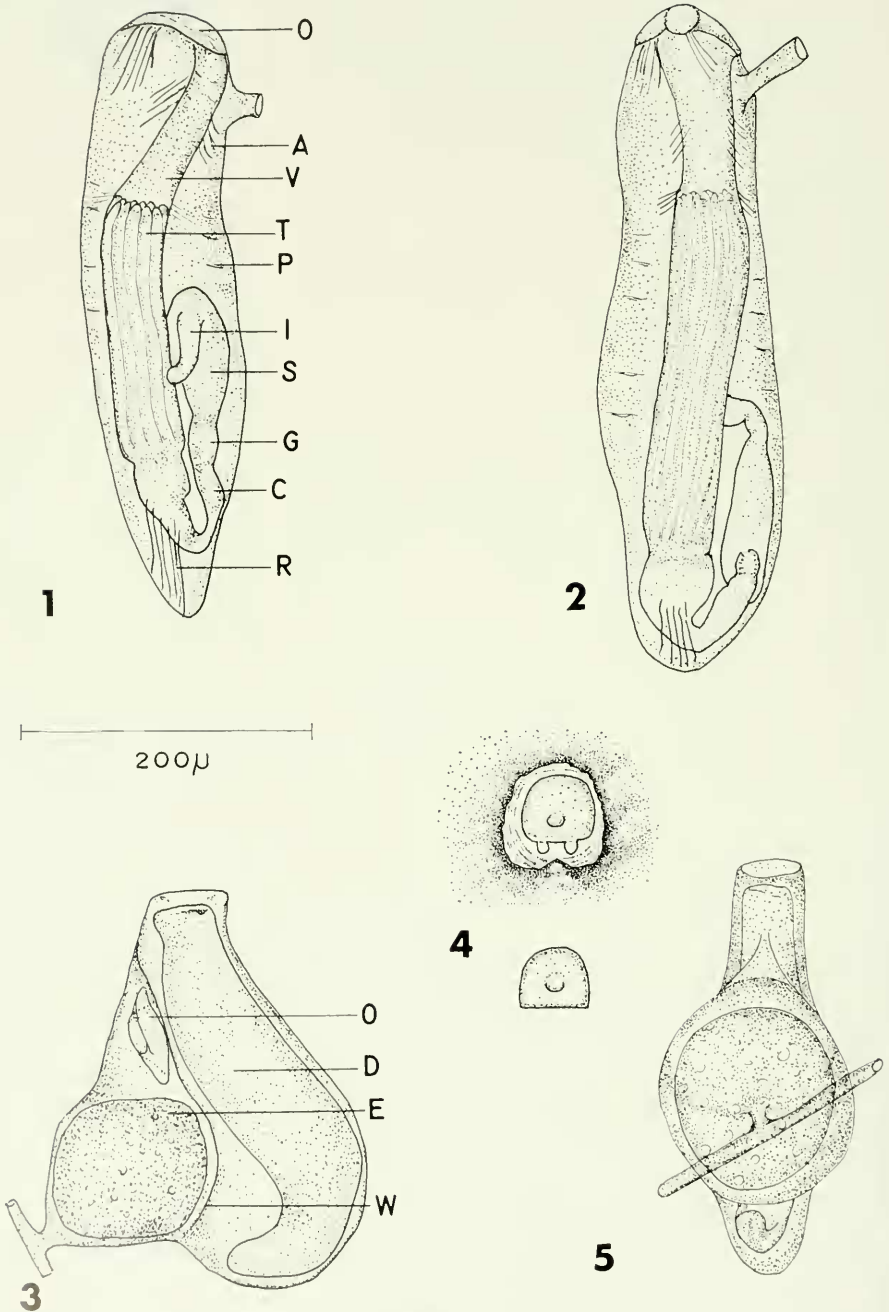
INTRODUCTION

D'Orbigny first described the tracings on mollusk shells made by burrowing bryozoans, and erected the genus *Terebripora* in 1847, but it was not until the work of Marcus (1938) that the anatomy of the zooids became known. Marcus (1938) reported one of d'Orbigny's species, *Terebripora ramosa*, in Brazilian waters that had first been described from Chile and Peru. Two new genera and twelve new species have since been described and the anatomy of the zooids figured (Silén, 1946, 1947; Soule, 1950a, 1950b; Soule and Soule, 1968).

Past distribution records, although sparse, suggest that the species may be widely distributed. For example, Bobin and Prenant (1954) found *Terebripora comma* Soule, 1950, described from California, in the Mediterranean. Soule

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FIGURE 1. *Penetrantia parva* Silén; autozoid.FIGURE 2. *Penetrantia operculata*, new species; autozoid with knobbed operculum.

found *Penetrantia concharum* and *Penetrantia densa*, described originally from Sweden and South Africa respectively, in California waters (Soule, 1950). A new species, *Terebripora eltaninae* Soule and Soule, 1968, was recently described from the Antarctic, inhabiting *Cephalodiscus*.

The authors wish to express their appreciation to James McVey, Stanley Swerdloff, and Greg Stanton, of the Department of Zoology, University of Hawaii, whose efforts were responsible for the collection of the bryozoans reported in this paper. We also wish to thank Mr. James Smola for his assistance in the preparation of serial sections.

METHODS AND MATERIALS

Gastropod shells showing the surface tracings of burrowing bryozoans were immediately fixed and preserved in neutral formalin when collected in the field. Transported to the laboratory, the gastropods were identified and examined wet under a dissecting microscope. Each specimen was given an identifying number and carefully broken into small fragments. The fragments were examined wet and some fragments were air-dried to preserve a record of the surface traces while the remainder were decalcified in 5 percent trichloroacetic acid, then washed in several changes of tap and distilled water, and stored in 70 percent ethanol. Some of the decalcified material was then stained with azo-carmin, dehydrated, and mounted for anatomical studies. The remaining decalcified material was dehydrated, imbedded in paraffin and serial sections were cut at 3-4 microns. These were stained with hematoxylin and eosin, and examined histologically as well as for accurate tentacle count.

SYSTEMATIC ACCOUNTS

Genus *Penetrantia* Silén, 1946

Penetrantia parva Silén, 1946.

(Figure 1.³)

Penetrantia parva SILÉN, 1946, pp. 4-5, fig. 7.

The Hawaiian specimens agree in all respects with Silén's description. The autozooids range in length from 400 to 440 microns, and are pointed proximally.

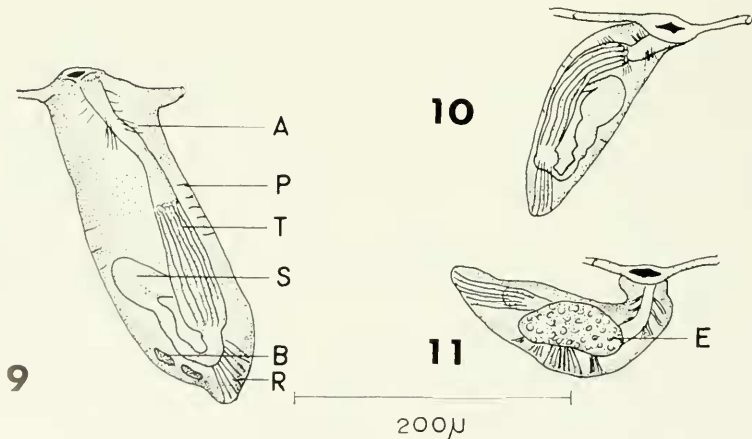
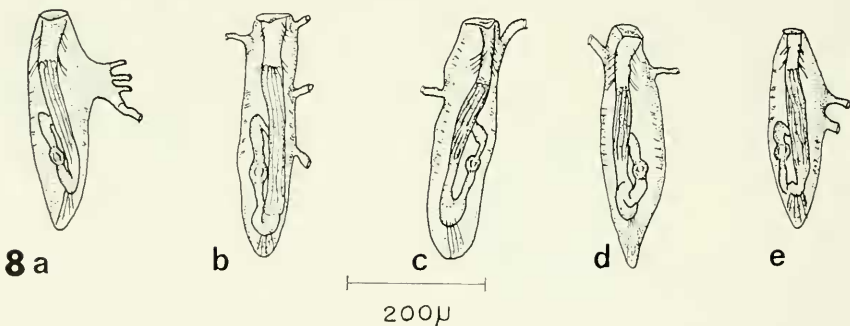
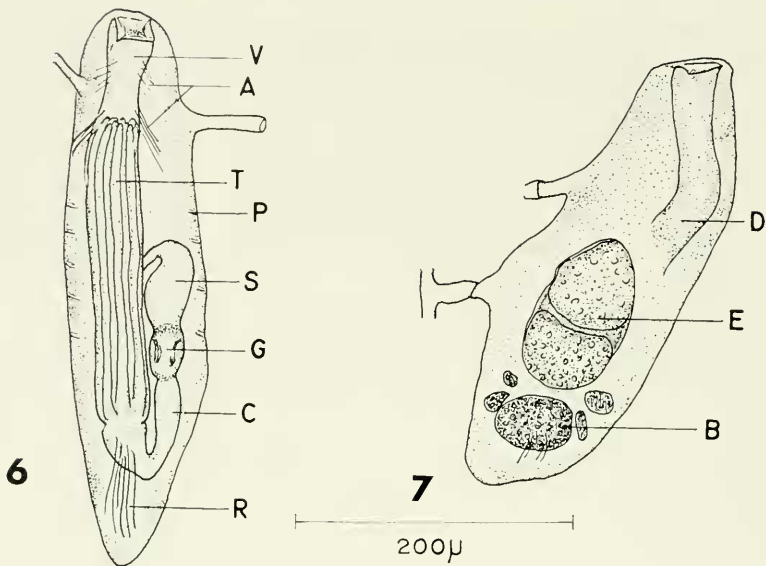
³ A, apertural muscles; B, brown body; C, cardia; D, degenerate polypide; E, ovum or embryo; G, gizzard; I, intestine; O, operculum; P, parietal muscles; R, retracter muscles; S, stomach; T, tentacles; V, vestibule; W, wall of embryo chamber.

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FIGURE 3. *P. operculata*, new species; gonozoid showing separate embryo chamber with ovum and with stolon attached. Operculum is freed from aperture and lies in embryo chamber when polypide degenerates.

FIGURE 4. *P. operculata*, new species; aperture in shell, with aperture of zoid beneath shell surface. Note knobbed operculum, central denticle (lyrula), and lateral denticles (cardelles).

FIGURE 5. *P. operculata*, new species; gonozoid showing attachment of embryo chamber.



The gonozoids are short; 210 to 220 microns in length, with the tip of the degenerate polypide extending below the embryo chamber.

OCCURRENCE. Pokai Bay, 0.5 miles off Waianae, Oahu; depth 25 feet. Collected 26 July 1967 in shell of *Conus* species. Off Naue, Kauai; depth 30 feet, water temperature 80°F., in shell of *Conus ebraeus*.

Penetrantia operculata Soule and Soule, new species.

(Figures 2, 3³, 4, 5, 12, 13.)

MATERIAL. Holotype, Allan Hancock Foundation bryozoan number 150. Paratype, Allan Hancock Foundation bryozoan number 150.1.

DIAGNOSIS. Burrowing colonial ectoproct bryozoans with the autozooids and gonozoids connected by "stolons." Autozooids elongated, cylindrical, bluntly rounded proximally, and with the aperture closed by a massive knobbed operculum. Tentacle number is 12. Gonozoids short, the degenerate polypide curled around under the embryo chamber.

DESCRIPTION. The colonies of *Penetrantia operculata* consist of feeding autozooids and numerous reproductive gonozoids. The mature functional feeding autozooids measure from 450 to 500 microns in length, and 100 to 110 microns in width. Each autozoid possesses a polypide bearing 12 tentacles and a typical U-shaped digestive tract. The digestive tract is provided with a small gizzard opening into the stomach. The muscular system consists of the retractor muscle group, scattered parietal muscle fibers, and the apertural muscle group. The aperture is closed by a distinctive thick operculum. Each operculum is provided with a centrally placed, raised knob.

The gonozoid is short, measuring 220 to 230 microns in length. It has a bulbous embryo chamber containing the ovum and a polypide that is curved, curling proximally under the reproductive body. The musculature and the polypide retrogress and are non-functional. The operculum is conspicuous, loosely associated with the degenerate polypide mass.

The openings on the surface of the mollusk shell, produced by the zooids of *Penetrantia operculata* are well spaced, almost circular, with a blunt projection extending into the opening from the lower rim. The aperture of the zoid proper

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FIGURE 6. *Terebripora varians*, new species; normal zoid.

FIGURE 7. *T. varians*, new species; zoid in reproduction, with degenerate polypide, developing ovum, and brown body.

FIGURE 8. *T. varians*, new species; a, b, c, d, e, showing variety of stolon attachments on individuals.

FIGURE 9. *Immergentia zelandica minuta* Soule; normal zoid.

FIGURE 10. *Immergentia angulata*, new species; zoid angled away from viewer. Note size as compared with *Immergentia zelandica minuta*.

FIGURE 11. *I. angulata*, new species; zoid in reproduction.

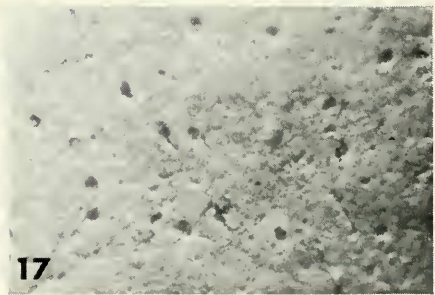
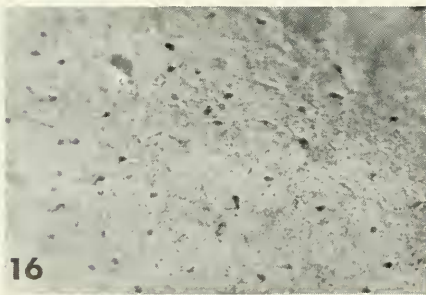
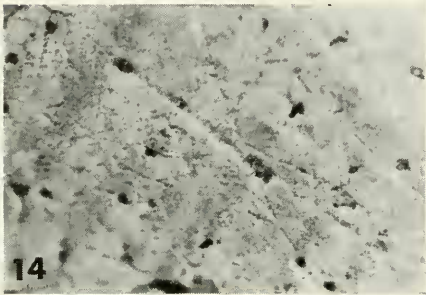
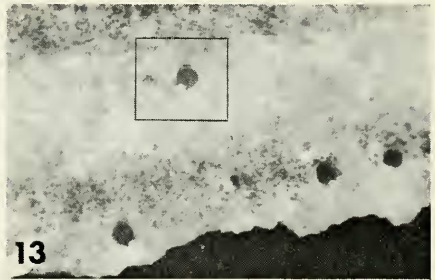
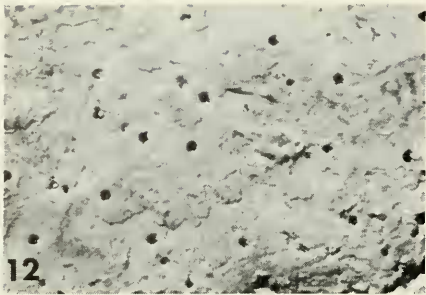


FIGURE 12. *Penetrantia operculata*, new species; apertures in shell, $\times 25$.

FIGURE 13. *P. operculata*, new species; apertures in shell, showing submerged zoid aperture with median denticle and cardelles, operculum with knob, $\times 50$.

FIGURE 14. *Terebripora varians*, new species; irregular shell apertures and stolon traces, $\times 25$.

FIGURE 15. *T. varians*, new species; irregular apertures in shell, $\times 50$.

FIGURE 16. *Immergentia angulata*, new species; apertures in shell and stolon traces, $\times 25$.

FIGURE 17. *I. angulata*, new species; ovoid apertures in shell and short stolon traces, $\times 50$.

lies below the shell surface and bears a prominent median denticle (lyrula), as well as lateral hinge denticles (cardelles) for articulation of the operculum. The stolonial tracings form an indistinct, irregular meshwork. The surface markings are similar to those of *Penetrantia concharum*, as illustrated by Silén, 1947 (fig. 1).

Penetrantia operculata differs from previously described species in that each of the autozooids possesses the thick, knobbed operculum, and the gonozoid bears the non-functional polypide flexed, curving under the embryo chamber. Autozooids of *P. operculata*, new species, *P. densa* Silén, 1946, and of *P. brevis* Silén, 1946, all have 12 tentacles.

OCCURRENCE. Haena Bay, Kauai; collected 1 July 1967, depth 20 feet, water temperature 80°F. In shell of *Conus striatus*.

Genus *Terebripora* d'Orbigny, 1847

Terebripora varians Soule and Soule, new species.

(Figures 6³, 7³, 8a-e, 14, 15.)

MATERIAL. Holotype, Allan Hancock Foundation bryozoan number 151. Paratype, Allan Hancock Foundation bryozoan number 151.1.

DIAGNOSIS. Stolonate, burrowing colonial Ectoprocta, with cylindrical zooids that taper to a narrow proximal end. The zooids are connected by short multiple secondary stolons that join the elongated primary stolons. There are 11 tentacles.

DESCRIPTION. Colonies stolonate, possessing lengthy primary stolons which have internodes placed at irregular intervals so that the stolonial segments are of variable length. The primary stolons anastomose to form an extensive meshwork. A notable feature of this species is the presence of multiple secondary stolons, up to 4 in number, which arise from diverse localities on a single zooid and unite with the primary stolon. The stolonial diameter ranges from 10 to 15 microns.

The polypide includes a digestive tract with a prominent grinding organ, or gizzard, and bears a circle of eleven tentacles. The musculature consists of the apertural group, the parietals, and the retractor group. The length of the functional zooids ranges from 370 to 400 microns, with the width from 60 to 75 microns. Many of the zooids possess one or more small "brown bodies." Zooids in reproduction were scarce: two were found, each with a rounded ovum and a degenerated polypide.

Surface tracings on the mollusk shell formed by the zooid apertures and stolons of *Terebripora varians* are not distinctive. The openings are well spaced, and are irregularly ovoid. The stolons produce a faint mesh-like trace among and connecting the rounded perforations.

Terebripora varians differs from other species of *Terebripora* with known anatomy in the possession of multiple secondary stolons which arise from varying

anatomical areas on the zoid. It is this character that provides its name. The zooids of *Terebripora varians* are larger than those of *T. comma* and *T. ramosa*, but smaller than those of *T. eltaninae*. *Terebripora varians* has 11 tentacles, *T. comma* has 8 tentacles, *T. ramosa* has 12 tentacles, and *T. eltaninae* has 10 tentacles.

OCCURRENCE. Haena Bay, Kauai; collected 1 July 1967, depth 20 feet, water temperature 80°F., in shells of *Conus striatus*. Off Keaukaha, Hilo, Hawaii; collected 15 July 1967, depth 25 feet, water temperature 81°F., in shells of *Conus* species?.

Genus *Immergentia* Silén, 1946

Immergentia zelandica minuta Soule, 1950.

(Figure 9³.)

Immergentia zelandica Silén var. *minuta* SOULE, 1950, p. 367, fig. 6.

Colonies with small zooids, ranging in length from 210 to 250 microns, slightly longer than those from the Philippine Islands. A distinct, finger-like projection is present, forming the proximal extremity. There are 9 tentacles. A number of zooids with an ovum and degenerate polypide were present.

OCCURRENCE. Haena Bay, Kauai; collected 1 July 1967, depth 20 feet, water temperature 80°F., in shells of *Conus striatus* and *Cypraea* species?.

Immergentia angulata Soule and Soule, new species.

(Figures 10, 11, 16, 17.)

MATERIAL. Holotype, Allan Hancock Foundation bryozoan number 152. Paratype, Allan Hancock Foundation bryozoan number 152.1.

DIAGNOSIS. Colonial, stolonate burrowing ectoproct bryozoan. Zooids extremely small, acutely curved at the distal end below the aperture, and tapering to a pointed proximal termination. The tentacle number is 8.

DESCRIPTION. Colonies are stolonate, with the zooids joined by an irregular anastomosing meshwork of delicate hollow stolons having a diameter of 7–8 microns. Functional zooids are short, ranging from 180 to 200 microns in length and 50 to 55 microns in width. The zooids characteristically are bent acutely in the distal region immediately below the junction of the apertural region with the stolon. The proximal extremity is tapered to a point. In functional zooids the polypide is U-shaped. There are 8 tentacles. "Brown bodies" are present in many of the zooids. The musculature consists of a well developed retractor group, parietals, and an apertural group. Zooids with developing ova and a degenerate polypide were scattered among the feeding zooids. The musculature, especially in the retractor group, shows evidence of hypertrophy in the zooids with reproductive bodies.

The openings made by the zooids are very small. They are ovoid, narrowing toward the thread-like trace made by the stolon. The openings are well spaced.

They offer no special characteristics that would distinguish them from other species of *Immergentia* or even from *Terebripora*.

Immergentia angulata possesses zoids that are the smallest of any that have been described, and are the only ones to show the acute bend at the distal end. Also, in having 8 tentacles, *I. angulata* differs from *Immergentia californica* Silén, 1946 and *I. philippinensis* Soule, 1950, which have 10 tentacles, and *I. suecica* Silén, 1947, *I. zelandica* Silén, 1946, and *I. zelandica minuta* Soule, 1950 with 9 tentacles.

OCCURRENCE. Keaukaha, Hilo, Hawaii; collected 15 July 1967, depth 45 feet, water temperature 81°F., in shell of *Pisania tritonoides*.

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