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SOME LITTORAL BARNACLES FROM THE TUAMOTU,
MARSHALL, AND CAROLINE ISLANDS¹

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A small number of barnacles collected by the Pacific Science Board expeditions at three localities—Ngarumaoa Island, Tuamotu Islands; South Loi Island, Marshall Islands; and Ifaluk Atoll, Caroline Islands—was sent to the author for identification. In all, there are seven species: three from the Caroline Islands, one from the Marshall Islands, and four, including one new species, from the Tuamotu Islands. In addition, a few barnacles collected by the *Albatross* at Makemo, Tuamotu Islands, were borrowed from the U. S. National Museum (USNM) to compare with the new material. Although the collection is small, it is of considerable interest as nothing is known of the barnacles of these islands except for *Lithotrya nicobarica* Reinhardt, which was reported from Makemo as *Lithotrya pacifica* Borradaile by Pilsbry (1907). The collection from Ngarumaoa Island contains *Lithotrya nicobarica* Reinhardt, *Lithotrya valentiana* (Gray), *Verruca cookei* Pilsbry, previously known from the Hawaiian Islands, and a new species of *Chthamalus*, which is of special interest as it is the first member of the genus to possess a true calcareous basis. A few small specimens of this species were also found on *Lithotrya nicobarica* from

¹Contribution No. 210 from the Department of Oceanography, University of Washington, Seattle, Wash.

Makemo. The one species from the Marshall Islands is *Tetraclita pacifica* Pilsbry, originally described by Pilsbry (1928) as *Tetraclita wireni pacifica* from Necker and Wake Islands. The barnacles from the Carolines are *Chthamalus hembeli* (Conrad), *Tetraclita squamosa squamosa* (Bruguère), and *Lithotrya nicobarica* Reinhardt.

Genus *Lithotrya* Sowerby, 1822²

Sewell (1926), after a detailed study of a large number of specimens of *Lithotrya nicobarica*, lists all the known species and subspecies of *Lithotrya* except *L. dorsalis*, *L. truncata*, *L. valentiana*, and *L. rhodiopus* as synonyms of *L. nicobarica* Reinhardt. However, at the end of his paper, he states that it is his belief that *L. dorsalis* and *L. nicobarica* cannot be differentiated. Nilsson-Cantell (1933) compared *L. dorsalis* from Bonaire and various museums with *L. nicobarica* from several localities, and he believes that these two species are distinct. Cannon (1935) has shown that *L. truncata* is a synonym of *L. valentiana*. *L. rhodiopus* is known only from Darwin's (1851) description of imperfect specimens so that its position is still doubtful. The valid species in the genus *Lithotrya* are, therefore, *L. dorsalis*, *L. nicobarica*, *L. valentiana*, and possibly *L. rhodiopus*.

Lithotrya nicobarica Reinhardt

- Lithotrya nicobarica* Reinhardt, 1850, p. 1, pl. 1, figs. 1-3.—Darwin, 1851, p. 359, pl. 8, fig. 2.—Gruvel, 1905, p. 99.—Hoek, 1907, p. 122, pl. 9, fig. 9.—Annandale, 1916, p. 131, pl. 7, fig. 2.—Nilsson-Cantell, 1921, p. 219; 1934a, p. 45.—Sewell, 1926, pp. 269-300, 18 figs., pls. 14, 15.—Hiro, 1937, p. 44.
- Lithotrya cauta* Darwin, 1851, p. 356, pl. 8, fig. 3.
- Lithotrya pacifica* Borradaile, 1900, p. 798, pl. 51, figs. 3, 3a.—Hoek, 1907, p. 126, pl. 9, figs. 13, 13a, 14.—Pilsbry, 1907, p. 6.
- Lithotrya dorsalis* var. *maldivensis* Borradaile, 1903, p. 441.
- Lithotrya dorsalis* var. *rugata* Borradaile, 1903, p. 441.
- Lithotrya conica* Hoek, 1907, p. 124, pl. 9, figs. 10-12.

LOCALITIES.—Ngarunaoa Island, Raroia Atoll, Tuamotu Islands; collected by J. P. E. Morrison, July 11, 1952, on outer reef flats, with *Chthamalus calcareobasis* and *Verruca cookei* (11 specimens, USNM 96480).

Makemo, Tuamotu Islands; collected by the *Albatross*, Oct. 21 1899, on the reef, with *Chthamalus calcareobasis* (7 specimens, USNM, 32885).

South end of Falarik Island, Ifaluk Atoll, Caroline Islands; collected by F. M. Bayer, Oct. 22, 1953, dug out of large rock just inside high reef (2 specimens, USNM 99341).

² For synonymy, see Darwin (1851, p. 332).

REMARKS: Several of the specimens are larger than the largest (greatest carinorostral diameter of the capitulum, 11.5 mm.) examined by Sewell (1926). The specimens from Ngarumaoa Island vary in carinorostral diameter from 6 mm. to 16 mm.; those from Makemo, from 11 mm. to 18 mm.; and the two from the Ifaluk Atoll, from 15 mm. to 16 mm. Externally, the specimens show most of the variations figured by Sewell. The cirri and mouthparts of a specimen with a carinorostral diameter of 18 mm. from Makemo are of special interest as the specimen was in the last stage before molting. The new long spines of the cirri are situated close to each ramus with their ends pointed distally and not "with their upper ends enclosed within the old spines, but with their lower ends projecting inwards, beyond the bases of the old spines, and inverted like the fingers of a glove hastily pulled off" as stated by Darwin (1854, p. 157). The labrum has 60 teeth. Sewell found 40 teeth on a small specimen and 42 on one of the largest, so he concluded that there is little change in the number of teeth with advancing age. The palps have rounded ends with doubly serrate spines on the ends and upper margins. In one mandible, between the first and second tooth, the new edge has 25 pectinations and the old edge has 13, some of which are broken off; between the second and third tooth the new edge has 9 pectinations and the old edge has 3. The other mandible has 19 pectinations on the new edge and 12 on the old edge between the first and second tooth, and 10 on the new edge and 8 on the old edge between the second and third tooth. There is also a greater number of pectinations on the new edge of the inferior angle than on the old edge. Sewell has pointed out that the ratio of the number of pectinations between the first and second tooth to the number between the second and third tooth is not a valid diagnostic character as the rate changes with advancing age. The number of spines in the middle group on the inner maxilla is also greater (17 instead of 10) in this specimen than in Sewell's largest specimen, although the number above the notch, in the notch, and on the inferior angle is the same. The outer maxilla has a slight notch without spines. One caudal appendage has 19 segments, the other has 11 segments. In a specimen with a carinorostral diameter of 16 mm., one caudal appendage has 27 segments and the other has 20 segments. Both specimens have five pairs of spines and seven or eight small spines between the pairs on the median segments of the sixth cirrus. Sewell found four pairs of spines and six or seven small spines in the largest specimen.

Lithotrya valentiana (Gray)

Conchotrya valentiana Gray, 1825, p. 102.

Anatifa truncata Quoy and Gaimard, 1834, p. 636, pl. 93, figs. 12-15.

Lithotrya valentiana Darwin, 1851, p. 371, pl. 8, fig. 5.—Gruvel, 1902, p. 250.—Barnard, 1924, p. 48.—Cannon, 1935, pp. 1–17, 7 figs., 2 pls.—Hiro, 1937, p. 42, 1 fig.

Lithotrya truncata Darwin, 1851, p. 366, pl. 9, fig. 1.—Hoek, 1907, p. 127.—Nilsson-Cantell, 1921, p. 213, fig. 34.

Lithotrya truncata longicaudata Nilsson-Cantell, 1921, p. 216, fig. 35a.

LOCALITY: Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; collected by J. P. E. Morrison, July 8, 1952 (1 specimen, USNM 96481).

REMARKS: Greatest diameter of capitulum, 5.5 mm., greatest height, 6.5 mm. Laterals wanting; one membranous filament on one side and two on the other side.

Genus *Verruca* Schumacher, 1817³

Verruca cookei Pilsbry

PLATE 1, FIGURES a–j

Verruca cookei Pilsbry, 1928, p. 308, 2 figs., pl. 25, fig. 9.

LOCALITY: Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; collected by J. P. E. Morrison, July 11, 1952, on outer reef flats; on *Lithotrya nicobarica*; with *Chthamalus calcareobasis* (2 specimens).

REMARKS: The specimens, one about 1.8 mm. in carinorostral diameter, the other 2.2 mm., were situated between two growth ridges on the scutum of *Lithotrya nicobarica* with the long (carinorostral) axis parallel to the base of the scutum. These specimens differ somewhat from the typical form. Both have the right-hand, instead of the left-hand, scutum and tergum fixed, and both are elongate in the carinorostral axis, instead of subcircular (pl. 1, a, b). In the larger specimen, the upper articular ridge of the movable scutum is about a third of the tergal margin, the second articular ridge is a little over two-thirds the tergal margin, and the third ridge extends to the base (pl. 1, c). Internally, the upper part of the valve is hollowed out, the tergal margin is slightly inflected in the upper part, and the occludent margin is strongly inflected (pl. 1, b). The movable tergum is triangular in shape instead of quadrangular as in the type; the third articular ridge is low in the upper part (pl. 1, e). Internally, the occludent margin is inflected (pl. 1, d). In the fixed scutum (pl. 1, f), the adductor ridge, which is narrower than in the type, extends obliquely from the base of the narrow rostral margin to the inner part of the thick tergal margin. The straight plate of the fixed tergum (pl. 1, g) is higher than the adductor ridge of the scutum. The rostrum (pl. 1, i, j) has three teeth on the carinal margin and seven fine ridges on the

³ For synonymy, see Pilsbry (1916, p. 15).

upper part of the scutal margin. Plate 1,*i* also shows a crack extending from the apex of the plate to the basal margin, and a heavy deposit of calcareous material covering the crack can be seen on the inner side (pl. 1,*j*). The carina (pl. 1,*h*) has three teeth on the rostral margin and several fine ridges on the upper part of the tergal margin. In the smaller specimen, a narrow projection of the carinal margin of the rostrum fits into a furrow on a slightly broader projection of the rostral margin of the carina; the adductor ridge of the fixed scutum is very prominent.

The mouthparts and cirri agree, for the most part, with Pilsbry's description. The larger specimen, which contained eggs, has 10 segments in the caudal appendages and 5 pairs of spines on the posterior cirri. The smaller specimen has 6 segments in the caudal appendages and 5 pairs of spines on one or two segments of the sixth cirrus and 4 pairs on the rest.

Genus *Chthamalus* Ranzani

Chthamalus Pilsbry, 1916, p. 293 (synonymy).

DIAGNOSIS: Compartments six; rostrum and carina with alae; rostralaterals triangular, without alae, the sheath having a narrow projection. Carinolaterals wanting. Basis membranous or calcareous; sometimes membranous basis covered with a calcareous layer formed of the inflected basal edges of the compartments.

Labrum with concave or straight edge, toothed or spinose. Mandible with lower part pectinated. First two pairs of cirri short, densely spinose, the third pair much longer and bearing spines like those of the posterior cirri.

TYPE: *Chthamalus stellatus* (Poli).

Chthamalus hembeli (Conrad)

Euraphia hembeli Conrad, 1837, p. 261, pl. 20, fig. 13.

Chthamalus hembeli Darwin, 1854, p. 465, pl. 18, figs. 5a-5e.—Weltner, 1897, p.

272.—Gravel, 1905, p. 205.—Pilsbry, 1916, p. 324, pl. 76; 1928, p. 310, pl. 26, fig. 6.—Nilsson-Cantell, 1921, p. 290, fig. 55.

LOCALITY: Reef north of northwest end of Falarik Islet, Ifaluk Atoll, Caroline Islands; collected by D. P. Abbott, 1953, from big rock on outer reef flat 125 ft. in from breaker line (1 specimen, USNM 99340).

REMARKS: The external surface is corroded, more or less covered with worm tubes, and the orifice is worn down. Only one suture, which shows interlocking teeth, is discernible on the exterior, but all sutures are visible on the inside. The basis is completely covered by a nonstriate calcareous layer which is continuous with the inner

protuberance; upper and lower margins spinose. Second maxilla (pl. 1, *n*) with notch; spines absent in notch, elsewhere pectinated.

Cirrus I with 9 segments in anterior ramus, 7 in posterior; anterior, 2 segments longer than posterior; long spines pectinate on both rami, plumose on pedicel. Anterior ramus with short thick spines on the anterior and posterior borders of the basal 5 segments and similar but shorter spines on the distal sutures of all segments. Cirrus II with subequal rami of 7 and 9 segments; both rami with long pectinate spines and fine, multifid spinules on the distal sutures; anterior ramus with a few short thick spines on the posterior distal angles of the basal 3 segments. Cirrus III with subequal rami of 14 and 17 segments with 3 pairs of spines on the anterior borders and multifid spinules on the distal sutures. Posterior cirri with 3 pairs of spines and a small spine between each pair on the anterior borders, one or two long spines and several short thicker ones on the posterior distal angles, and multifid spinules on the distal sutures. Rami of cirrus IV with 18 and 19 segments, cirrus V, 20 and 17 segments, and cirrus VI, 20 and 19 segments. Penis with 2 tufts of terminal spines and a few fine spines scattered on the segments.

DISCUSSION: This species is very closely allied to *Chthamalus hembeli* (Conrad) as shown especially by the similarity of the scuta, the sutures, and the mandible. The main difference between the two species is the presence of a true calcareous basis in *C. calcareobasis*. Darwin (1854) examined five old specimens and three separated valves of a young specimen of *C. hembeli*. The old specimens had flat, wide, calcareous bases which were continuous with the inner laminae of the parietes, but in the young specimen (basal diameter about 18 mm.) he states: "there was no appearance of any tendency in the parietes thus to grow inflected." He believed that in a series of specimens some would be found with a flat narrow ledge as in *C. intertextus* and some with increasingly wider ledges until the edges met in the middle and coalesced into a continuous plate.

Pilsbry (1916) examined two large specimens and three opercular valves and the body of another specimen. He describes the basis as follows: "'Basis membranous, but surrounded by a ledge formed by the inflected basal edges of the parietes,' or in old individuals the inflected edges of the compartments cover the whole base with a strong whitish calcareous layer. The false basis does not, of course, show radial furrows or lines, but is quite smooth." Pilsbry does not identify the source of his quotation, which is undoubtedly from Darwin (1854), but for another barnacle. Darwin (1854, p. 467) in the diagnosis of *C. intertextus* states: "basis membranous, but surrounded by a ledge formed by the inflected basal edges of the parietes." As seen in the paragraph above, Darwin believed that *C. hembeli* goes



a



b



c



d



e



f



g



h



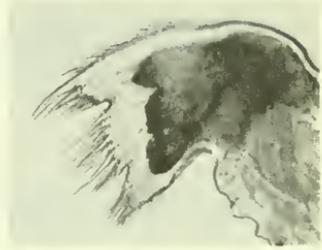
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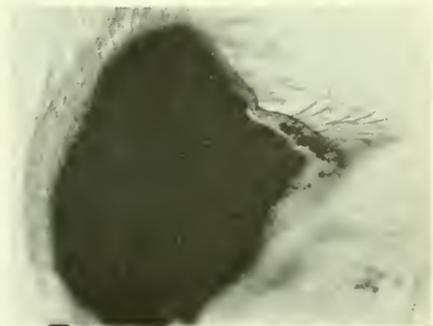
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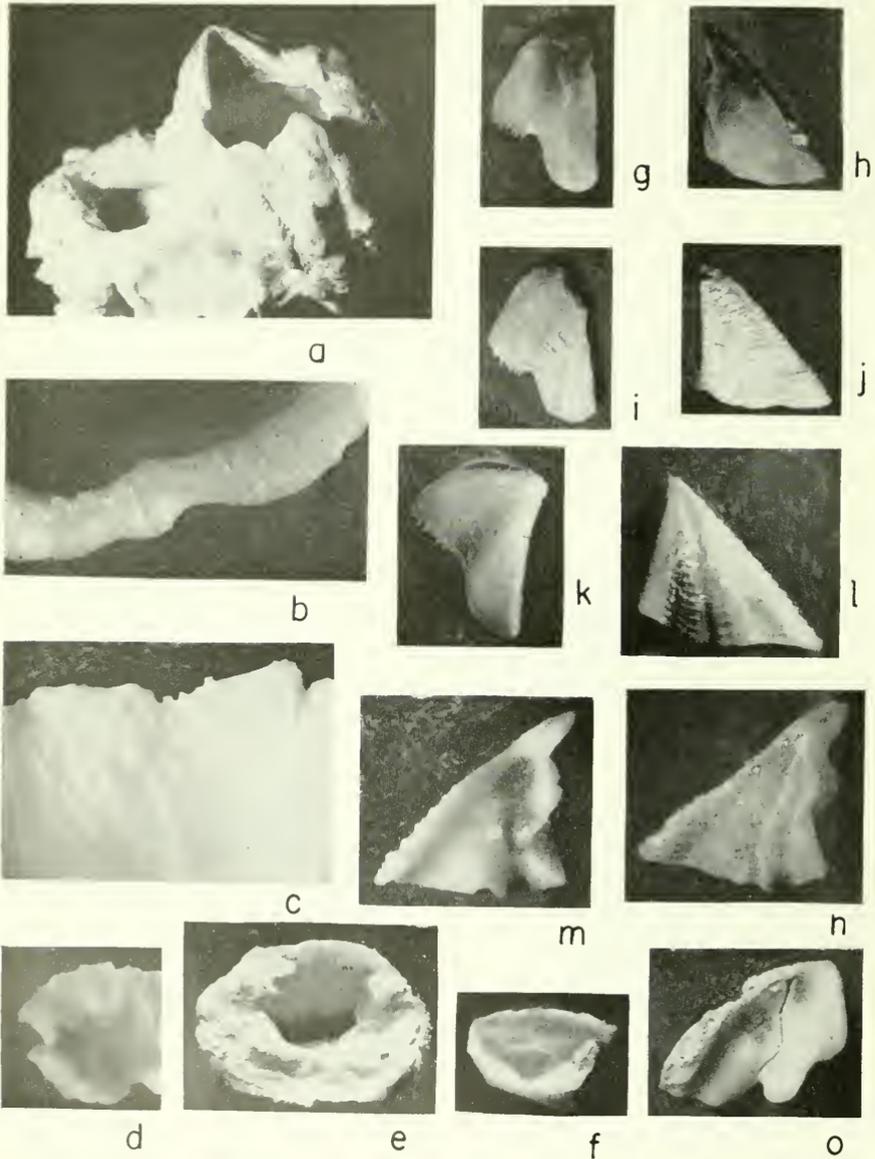


l



n

a-j, *Ferruca cookei* Pilsbry, $\times 20$. a, Apical view; b, basal view, same specimen; c, d, internal views of movable scutum and tergum; e, external view of movable tergum; f, g, internal views of fixed scutum and tergum; h, external view of carina; i, j, external and internal views of rostrum. k-n, *Chthamalus calcareobasis*, new species, $\times 62$. k, Labrum and palpi; l, mandible; m, first maxilla; n, second maxilla. All photographs by Eugene E. Collias.



Chthamalus calcareobasis, new species. *a*. Apical view of holotype (specimen on right side), $\times 2$; *b*. basal view of rostrum and rostrolateral, $\times 10$; *c*. internal view of edge of basis (shown in *d*), $\times 10$; *d*. internal view of basis, $\times 2$; *e*. basal view, showing part of basis, $\times 3$; *f*. internal view of cup-shaped basis, $\times 2$; *g-j*, internal and external views of opercular plates of holotype, $\times 3$; *k, l*, external views of tergum and scutum of a young specimen, $\times 10$; *m-n*, internal and external views of scuta of another young specimen, $\times 10$; *o*, internal view of scutum and tergum, $\times 3$.



a



c



e



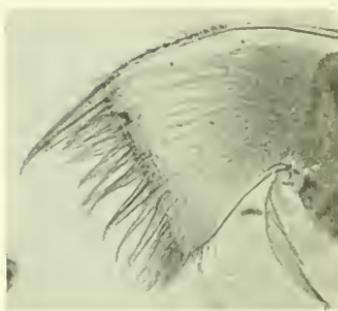
f



b



d



g



h



i

Tetraclita pacifica Pilsbry. a, Basal view, $\times 2$; b, internal view of outer lamina, $\times 10$; c, lateral view of spines, $\times 7$; d, longitudinal section of outer lamina, $\times 20$; e, f, external views of scutum and tergum, $\times 3$; g, first maxilla, $\times 62$; h, mandible, $\times 62$; i, second maxilla, $\times 62$.

through this stage before the continuous plate found in old individuals is formed, but so far no one has seen the earlier stages in the formation of the basis. Nilsson-Cantell (1921) examined 3 specimens, one of which was only 25 mm. in diameter, but he does not mention whether this specimen had a continuous basis or not.

Another striking difference between *C. calcareobasis* and *C. hembeli* is the prominent spur on the tergum of *C. calcareobasis*; in fact, the spur is much more prominent than is usual for the genus. Further differences are found in the maxillae, palpi, and the cirri. In *C. calcareobasis* the spines of the first maxilla are differentiated by size into 3 groups and the notches are prominent, whereas, in *C. hembeli*, the spines, which are very numerous, vary much less in size and the notches are insignificant. The second maxilla of *C. calcareobasis* has a small notch without spines, but in *C. hembeli* there is no notch. The rami of the second cirrus of *C. calcareobasis* are subequal instead of very unequal as found for *C. hembeli* by both Pilsbry (1916) and Nilsson-Cantell (1921), and the sixth cirrus has 3 pairs of spines instead of 4 and does not have the bunches of short spines between the paired spines as found in *C. hembeli*.

Genus *Tetraclita* Schumacher³

Tetraclita Pilsbry, 1916, p. 248 (synonymy).

Tetraclita squamosa squamosa (Bruguère)

Balanus squamosa Bruguère, 1789, p. 170.

Tetraclita porosa viridis Darwin, 1854, p. 329.—Kruger, 1911, p. 61, pl. 4, fig.

41b.—Nilsson-Cantell, 1921, p. 364; 1930, p. 17; 1931, p. 115; 1934a, p. 71; 1934b, p. 61, 1938, p. 76.

Tetraclita squamosa squamosa Pilsbry, 1916, p. 251.

Tetraclita squamosa viridis Broch, 1922, p. 337.—Hiro, 1937, p. 66, figs. 13a, 13b; 1939, p. 271.

LOCALITY: Ifaluk Atoll, Caroline Islands; collected by F. M. Bayer, Sept. 20, 1953, on the outer reef of Ella Island (4 specimens, USNM 99342).

Tetraclita pacifica Pilsbry emend.

PLATE 3, a-i

Tetraclita wireni pacifica Pilsbry, 1928, p. 312, pl. 26, figs. 1-5.

LOCALITY: South Loi Island, Kwajalein Atoll, Marshall Islands; collected by F. S. McNeil, 1951-52 (11 specimens, USNM 96486).

SUPPLEMENTARY DIAGNOSIS: This species differs from all other species of *Tetraclita* by a combination of the following characteristics: the small number of tubes in the parietes, the presence of calcareous spines in the parietal tubes, and the inconspicuous adductor ridge of the scutum.

SUPPLEMENTARY DESCRIPTION: Shell conical with small or moderately large orifice; wall finely ribbed in young, rugose and often corroded in adult. Color white or white tinged with Prussian red. Radii narrow, transversely grooved in young, inconspicuous or obliterated in adults. Sheath Prussian red, usually long; inner lamina faintly ribbed internally. Tubes in parietes arranged in a row of large quadrangular tubes, radially elongate, and a varying number of small triangular or round tubes near the outer lamina. In a specimen with a carinorostral diameter of 18 mm. (pl. 3,*a*), the number of large tubes is 11 in the rostrum, 8 in one lateral and 9 in the other, and 6 in the carina; the number of small tubes is 6 in the rostrum, 5 in one lateral and 7 in the other, and 2 in the carina. In specimens with maximum diameters of 21 mm., 26 mm., and 30 mm., some plates have a third series of tubes formed by the bifurcation of the septa of the second series of tubes. In a specimen with a carinorostral diameter of 26 mm., the number of large tubes is 12 in the rostrum, 6 in one lateral and 7 in the other, and 8 in the carina. The number of small tubes in the second series is 9 in the rostrum, 1 in one lateral and 2 in the other, and 5 in the carina. The number of tubes in the third series is 3 in the rostrum, 2 in the carina, and none in either lateral. Large tubes not filled up even at apex of shell; many of tubes with calcareous spines in 1 to 6 rows extending nearly to apex of tubes on the inside of the outer lamina and less frequently scattered on the sides of the septa and the outside of the inner lamina; small tubes occasionally with 1 to 2 rows of spines. Spines straight or curved with pointed, single or double ends (pl. 3,*b,c*). The spines, which are hollow, extend from the outer edge of the outer lamina to the inner edge where they project into the cavity of the tube; maximum length of free part of spine, 1.3 mm. Figure 3,*d*, a section through the outer lamina, shows the cavity in the upper spine and the surface of the spine below it. Outer lamina often ridged at base, occasionally ridges extend short way up tube; septa sometimes finely denticulate near outer lamina. The two smallest specimens with carinorostral diameters of 2.5 mm. and 6.0 mm. have a single row of tubes without spines. The next largest specimen, with a carinorostral diameter of 15 mm., has 14 secondary tubes near the outer lamina. Basis calcareous, radially ridged internally near outer edge.

Carinorostral diameter of type, 21.1 mm. Carinorostral diameter of largest specimen from the Marshall Islands, 21 mm., lateral diameter, 30 mm.; height of rostrum, 20 mm., height of carina, 10 mm.

Scutum (pl. 3,*e*) with occludent margin longer than basal. Externally, white with narrow growth ridges, alternate ones forming oblique teeth on occludent margin, faint longitudinal striations, and either a shallow longitudinal furrow or translucent area in middle of

valve. Internally, white with Prussian red at apex and sometimes extending down middle; articular ridge low, slightly reflexed, about half the length of tergal margin; articular furrow narrow; adductor ridge short, very low or represented by mere thickening of the valve; crests for lateral depressor prominent, 4 in number; crests for rostral depressor finer, more numerous.

Tergum (pl. 3,*f*) narrow, beaked. Spur narrow with rounded end, one side united with basiscutal angle and other side sloping gradually to the slightly oblique basal margin. Externally, white with shallow depression running to spur. Internally, articular ridge extremely narrow and low; articular furrow moderately wide; scutal margin slightly inflected; crests for depressor prominent.

Labrum with concave, spinose margin bearing 7 to 10 teeth. Palp concave above and convex below with rounded end; spines on end and upper margin pinnate, decreasing in length but increasing in width proximally. Mandible (pl. 3,*h*) with 4 teeth or sometimes with a rudimentary fifth tooth close to the spinate inferior angle; second and third teeth double; the smaller of each double tooth and the fourth tooth with either serrate edge or thickened edge if projections have been worn down. Lower margin of mandible spinose; upper margin with small tuft of spines. First maxilla (pl. 3,*g*) with small notch filled with small spines below upper large pair, about 7 pairs of medium-sized spines below notch, followed by small spines on lower fourth of valve; upper and lower margins spinose. Second maxilla (pl. 3,*i*) with slight notch, without spines; spines shorter above and below notch than on rest of margin.

Cirrus I with anterior ramus nearly twice as long as posterior, long spines and a few short spines on distal sutures finely pinnate on ends; pedicel with plumose spines. Cirrus II with subequal rami, spination like cirrus I. Cirrus III with very unequal rami, posterior about a third longer than anterior ramus; spines on upper segments pinnate; spines on lower segments slender and pinnate or thicker and serrate; pedicel with plumose spines on anterior borders of both segments and a tuft of plumose spines on the posterior distal angle of the lower segment. Posterior cirri with 3 pairs of spines, some pinnate, a few fine spines on the anterior border of each segment, and a tuft of short spines on the posterior distal sutures. Penis with a few spines encircling the orifice and scattered over the segments.

NUMBER OF SEGMENTS IN THE CIRRI

Diameter	I	II	III	IV	V	VI
25 mm.	18, 9	10, 9	19, 24	20, 19	21, 22	23, 22
26 mm.	16, 8	9, 9	12, 21	—	—	24, 23

REMARKS: Pilsbry (1928, p. 313) states that the wall of *Tetracrita wireni pacifica* has "a single series of square or squarish tubes, in most of them some laminae and often slender spines projecting from the outer layer of the wall"; and yet his figure of the type specimen (pl. 26, fig. 1) clearly shows several small secondary tubes near the outer lamina. The specimens from the Marshall Islands also show one or two series of secondary tubes. Therefore, Pilsbry's subspecies cannot be a subspecies of *Tetracrita (Tesseropora) wireni*, which has a single row of tubes, and it is proposed to raise it to specific rank in the subgenus, *Tetracrita*, in which the wall has several rows of tubes.

Tetracrita pacifica may be considered the connecting link between these two subgenera, showing the first step in the formation of a multilayer wall; in other species of the subgenus *Tetracrita*, this stage occurs in very young individuals. The structure of the wall, with the exception of the development of secondary tubes, is very similar to that of *T. rosea* and *T. wireni*, the two species in the subgenus *Tesseropora*. The tubes in the first row are similar in size and shape to those in the single row in *T. rosea* and *T. wireni*, and calcareous spines and laminae instead of laminae alone have been developed to strengthen the outer wall.

Literature cited

ANNANDALE, NELSON

1916. Three plates to illustrate the Scalpellidae and Iblidae of Indian seas, with synonymy and notes. Mem. Indian Mus., vol. 6, pp. 127-131, pls. 5-8.

BARNARD, K. H.

1924. Contributions to the crustacean fauna of South Africa. No. 7, Cirripedia. Ann. South African Mus., vol. 20, pp. 1-103, pl. 1.

BORRADAILE, LANCELOT ALEXANDER

1900. On some crustaceans from the South Pacific. Part 5. Arthrostracans and barnacles. Proc. Zool. Soc. London (1900), pp. 795-799, pl. 51.

1903. Marine crustaceans. Part 7: The barnacles (Cirripedia). In Gardiner, The fauna and geography of the Maldive and Laccadive Archipelagoes, pp. 440-443, 2 figs.

BROCH, HJALMAR

1922. Studies on Pacific cirripedes. Vid. Medd. Naturh. Foren. Kjøbenhavn, vol. 73, pp. 215-358, 77 figs.

BRUGUIÈRE, JEAN GUILLAUME

1789. Histoire naturelle des Vers, vol. 1. Encyclopédie Méthodique . . . Zoology.

CANNON, H. GRAHAM

1935. On the rock-boring barnacle, *Lithotrya valentiana*. In, Scientific reports of the Great Barrier Reef Expedition, 1928-29. Vol. 5, No. 1, 17 pp., 7 figs., 2 pls.

CONRAD, T. A.

1837. Descriptions of new marine shells from Upper California. Journ. Acad. Nat. Sci. Philadelphia, vol. 7, pp. 227-268, pls. 17-20.

DARWIN, CHARLES

1851. A monograph on the sub-class Cirripedia . . . The Lepadidae; or, pedunculated cirripedes. xi+400 pp., 10 pls.
 1854. A monograph on the sub-class Cirripedia . . . The Balanidae (or sessile cirripedes); the Verrucidae, etc. viii+684 pp., 30 pls.

GRAY, J. EDWARD

1825. A synopsis of the genera of Cirripedes arranged in natural families, with the description of some new species. Ann. Philos., new ser., vol. 10, pp. 97-107.

GRUVEL, ABEL

1902. Revision des Cirrhipèdes appartement à la collection du Muséum d'Histoire Naturelle. Nouv. Arch. Mus. Hist. Nat. Paris. ser 4, vol. 4, pp. 215-312, 18 figs., 8 pls.
 1905. Monographie des Cirrhipèdes, ou Théocostracés. xii+472 pp., 427 figs.

HIRO, FUJIO

1937. Cirripeds of the Palao Islands. Palao Trop. Biol. Sta. Studies, vol. 1, pp. 37-72, 14 figs., 1 pl.
 1939. Studies on the cirripedian fauna of Japan. IV. Cirripeds of Formosa (Taiwan), with some geographical and ecological remarks on the littoral forms. Mem. Coll. Sci., Kyoto Imp. Univ., ser. B, vol. 15, pp. 245-284, 16 figs.

HOEK, PAULUS PERONIUS CATO

1907. The Cirripedia of the *Siboga* Expedition. A. Cirripedia Pedunculata. In Weber, *Siboga-Expeditie* . . . , No. 31a, pp. 1-127, 10 pls.
 1913. The Cirripedia of the *Siboga* Expedition. B. Cirripedia Sessilia. In Weber, *Siboga-Expeditie* . . . , No. 31b, pp. 129-275, 2 figs., 17 pls.

KRÜGER, PAUL

1911. Beiträge zur Cirripedenfauna Ostasiens. In Doflein, Beiträge zur Naturgeschichte Ostasiens. Abh. Akad. Wiss., Math.-Phys., suppl. 2, pt. 6, pp. 1-72, 132 figs., pls. 1-4.

NILSSON-CANTELL, CARL AUGUST

1921. Cirripeden-Studien. Zur Kenntnis der Biologie, Anatomie und Systematik dieser Gruppe. Zool. Bidr. Uppsala, vol. 7, pp. 75-395, 89 figs., 3 pls.
 1930. Cirripèdes. Résultats scientifiques du voyage aux Indes Orientales Néerlandaises de LL. AA. RR. le Prince et la Princesse Léopold de Belgique. Mém. Mus. Hist. Nat. Belgique, hors ser., vol. 3, fasc. 3, pp. 1-24, 7 figs.
 1931. Revision der Sammlung recenter Cirripeden des naturhistorischen Museums in Basel. Verh. Naturf. Ges. Basel, vol. 42, pp. 103-137, 8 figs., 1 pl.
 1933. Cirripeds from Bonaire. Zool. Jahrb. (Abt. Syst. . . .), vol. 64, pp. 503-508, 2 figs.
 1934a. Indo-Malayan cirripeds in the Raffles Museum, Singapore. Bull. Raffles Mus., No. 9, pp. 42-73, 7 figs., pl. 5.
 1934b. Cirripeds from the Malay Archipelago in the Zoological Museum of Amsterdam. Zool. Meded. Leiden, vol. 17, pp. 31-63, 12 figs.
 1938. Cirripedes from the Indian Ocean in the collection of the Indian Museum, Calcutta. Mem. Indian Mus., vol. 13, pp. 1-81, 28 figs., 3 pls.

PILSBRY, HENRY AUGUSTUS

1907. The barnacles (Cirripedia) contained in the collections of the U. S. National Museum. U. S. Nat. Mus. Bull. 60, x+122 pp., 36 figs., 11 pls.
1916. The sessile barnacles (Cirripedia) contained in the collections of the U. S. National Museum; including a monograph of the American species. U. S. Nat. Mus. Bull. 93, xi + 336 pp., 99 figs., 76 pls.
1928. Littoral barnacles of the Hawaiian Islands and Japan. Proc. Acad. Nat. Sci. Philadelphia, vol. 79, pp. 305-317, 4 figs., pls. 24-26.

QUOY, J. R. C., AND GAIMARD, P.

1834. Zoologie, vol. 3, Mollusques. In Voyage . . . de L'*Astrolabe*.

REINHARDT, J. T.

1850. Om Slaegten Lithotryas Evne til at bore sig ind i Steenblokke. Vid. Medd. Naturh. Foren., Kjøbenhavn, vol. 1, pp. 1-8.

SEWELL, R. S. SEYMOUR

1926. A study of *Lithotrya nicobarica* Reinhardt. Rec. Indian Mus., vol. 28 pp. 269-330, 18 figs., pls. 14, 15.

WELTNER, WILHELM

1897. Verzeichnis der bisher beschriebenen recenter Cirripedenarten. Mit Angabe der im berliner Museum vorhandenen species und ihrer Fundorte. Arch. Naturg., vol. 1, pp. 227-280.