

POLYCHAETOUS ANNELIDS  
PART VI. PARAONIDAE, MAGELONIDAE, LONGOSOMIDAE,  
CTENODRILIDAE, AND SABELLARIIDAE  
(PLATES 27-42)

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The five families reported below are small, each known through comparatively few species or genera. All save the Sabellariidae are represented by species rarely encountered even in large collections. The Paraonidae, Magelonidae, and Longosomidae, new family, and perhaps also the Ctenodrilidae have their affinities with the spioniform chaetopods. The occurrence of each of these is of particular interest because their presence has remained unknown from the areas where found. One species, *Longo-soma catalinensis*, new genus and species, is believed to represent a group for which a new family name is proposed. Twenty-six species of the Sabellariidae are discussed; among them, four species and one subspecies are believed to be new.

The following station numbers of the *Velero III* are represented. Those stations for which information has been given in previous reports are merely listed; the others are given with locality data.

St. 10-33. *Phragmatopoma attenuata*, new species

St. 15-33. *Phragmatopoma attenuata*, new species

St. 28-33. *Lygdamis nesiotes* Chamberlin

St. 30-33. Osborn Bay, Osborn Island, Galapagos.

*Idanthysus pennatus* (Peters)

St. 56-33. Flamingo Bay, Charles Island, Galapagos.

*Idanthysus pennatus* (Peters)

St. 69-33. *Idanthysus pennatus* (Peters)

St. 80-33. Duncan Island, Galapagos. Shore.

*Idanthysus pennatus* (Peters)

St. 94-33. *Idanthysus pennatus* (Peters)

St. 101a-33. Darwin Bay, Tower Island, Galapagos. Shore.

*Idanthysus pennatus* (Peters)

St. 129-34. *Idanthysus pennatus* (Peters)

St. 229-34. Cobita Bay, Colombia. Shore.

*Phragmatopoma attenuata*, new species

St. 239-34. *Idanthysus pennatus* (Peters)

St. 258-34. Puerto Culebra, Costa Rica. In coral clumps.

*Idanthysus pennatus* (Peters)

St. 261-34. Tangola-Tangola, Mexico. In coral.

*Idanthysus pennatus* (Peters)

St. 288-34. *Phragmatopoma moerchi* Kinberg

St. 403-35. Manta, Ecuador. Shore, reefs.

*Phragmatopoma attenuata*, new species

St. 413-35. *Idanthysus pennatus* (Peters)

St. 414-35. *Idanthysus pennatus* (Peters)

St. 433-35. *Idanthysus pennatus* (Peters)

St. 435-35. *Idanthysus pennatus* (Peters)

St. 444-35. *Idanthysus pennatus* (Peters)

St. 447-35. *Idanthysus pennatus* (Peters)

St. 464-35. *Idanthysus pennatus* (Peters)

St. 610-37. *Sabellaria cementarium* Moore

St. 829-38. Independencia Bay, Peru. In 10 fms, sand, algae, shells.

*Phragmatopoma moerchi* Kinberg

St. 831-38. Same. Rocky shore.

*Phragmatopoma moerchi* Kinberg

St. 832-38. *Phragmatopoma moerchi* Kinberg

St. 847-38. 9½ mi. south of Zorritos Light, Peru. Rocky shore.

*Phragmatopoma moerchi* Kinberg

St. 859-38. Port Utria, Choco, Colombia. In coral.

*Idanthysus pennatus* (Peters)

St. 886-38. *Sabellaria cementarium* Moore

St. 891-38. *Sabellaria cementarium* Moore

St. 900-39. *Longosoma catalinensis*, new genus and species

St. 901-38. *Sabellaria cementarium* Moore

*Sabellaria gracilis*, new species

*Phragmatopoma californica* (Fewkes)

St. 903-38. *Magelona californica*, new species

St. 904-38. *Phragmatopoma californica* (Fewkes)

St. 906-38. *Sabellaria gracilis*, new species

St. 912-39. Pyramid Cove, San Clemente Island, California. Shore.

*Phragmatopoma californica* (Fewkes)

St. 913-39. *Phragmatopoma californica* (Fewkes)

St. 972-39. *Sabellaria cementarium* Moore

St. 1159-40. *Sabellaria gracilis*, new species

St. 1189-40. *Phragmatopoma californica* (Fewkes)

St. 1191-40. *Sabellaria cementarium* Moore

St. 1193-40. *Phragmatopoma californica* (Fewkes)

St. 1206-40. Dutch Harbor, San Nicolas Island, California. Rocky shore.

*Phragmatopoma californica* (Fewkes)

St. 1208-40. *Phragmatopoma californica* (Fewkes)

St. 1209-40. *Phragmatopoma californica* (Fewkes)

St. 1210-40. *Sabellaria cementarium* Moore

St. 1218-40. *Phragmatopoma californica* (Fewkes)

St. 1221-40. Avalon, Catalina Island, California. Shore.

*Phragmatopoma californica* (Fewkes)

St. 1222-41. *Phragmatopoma californica* (Fewkes)

St. 1274-41. *Sabellaria cementarium* Moore

St. 1280-41. 2½ mi. east of South Point, Santa Rosa Island, California.  
In 15-21 fms.

*Sabellaria cementarium* Moore

St. 1283-41. *Sabellaria cementarium* Moore

St. 1284-41. *Sabellaria cementarium* Moore

St. 1367-41. Whites Cove, Catalina Island, California. Shore.

*Phragmatopoma californica* (Fewkes)

St. 1370-41. Same. Rocky shore.

*Phragmatopoma californica* (Fewkes)

St. 1390-41. 4½ mi. southwest of East Point, Santa Rosa Island, California. In 43-45 fms, green mud.

*Magelona pacifica* Monro

St. 1406-41. *Phragmatopoma californica* (Fewkes)

St. 1410-41. 3 mi. east of South Point, Santa Rosa Island, California.  
In 17-20 fms, sand and kelp.

*Sabellaria cementarium* Moore

St. 1413-41. 2 mi. southwest of Cardwell Point, San Miguel Island, California. In 34-35 fms, mud.

*Magelona pacifica* Monro

*Sabellaria cementarium* Moore

St. 1415-41. *Sabellaria cementarium* Moore

St. 1417-41. *Sabellaria cementarium* Moore

St. 1418-41. 3½ mi. northeast of San Pedro Point, Santa Cruz Island, California. In 46-47 fms, sand.

*Sabellaria cementarium* Moore

St. 1419-41. 1 mi. north of west end of Anacapa Island, California. In 45-47 fms.

*Sabellaria cementarium* Moore

St. 1431-41. Whites Cove, Catalina Island, California. Dredged, sand.

*Phragmatopoma californica* (Fewkes)

St. 1437-41. *Sabellaria gracilis*, new species

St. 1438-41. Newport Harbor Channel, California. Shore.

*Ctenodrilus serratus* (Schmidt)

St. 1441-41. Corona del Mar, California. Shore, in muddy sand flats, north of biological station.

*Aricidea pacifica*, new species

## Family Paraonidae

This small family has affinities with the Orbiniidae and Spionidae. Three genera are generally recognized, including (1) *Aricidea* Webster (1879), (2) *Cirrophorus* Ehlers (1912), and (3) *Paraonis* Grube (1872) with subgenus *Paraonides* Cerruti (1909). The genus *Aricidea* Johnson (1901) is herein referred to the Spionidae (see below).

### KEY TO GENERA OF PARAONIDAE

1. Prostomium with a median antenna . . . . . 2
1. Prostomium without a median antenna . . . . . *Paraonis*
2. Some posterior segments with acicular notopodial hooks . . . . . *Cirrophorus*
2. Posterior segments without specialized hooks in notopodia, with or without crotchets or lyre setae . . . . . *Aricidea*

Several species in the genus *Aricidea* have been recorded from the American east coast, including *A. fragilis* Webster (1879, p. 255), *A. nolani*, and *A. quadrilobata*, both by Webster and Benedict (1887, pp. 739-740) (but see below), and an unidentified one, questionably of this genus, from British Columbia (Berkeley, 1927, p. 413). The last is characterized in having branchiae on segments 5 to 17, anterior segments are provided with rather heavy, simple setae in both rami, and posterior neuropodia have heavy, simple hooks; it may represent an unnamed species. *Aricidea alata* Treadwell (1902, p. 202), from Puerto Rico, has been earlier referred to the spionids (Hartman, 1941, p. 293).

*Aricidea megalops* Johnson (1901, p. 413), from Washington, was based on a single specimen. It is characterized in having foliaceous lobes in both notopodia and neuropodia, the dorsal anterior ones largest; slender, pointed setae are in both rami throughout, except the last 2 or 3 segments, and hooded crotchets in neuropodia from the eighteenth segment. The prostomium is broadly rounded in front, has an occipital ten-

tacle and a pair of large eyes. Branchiae are present from segments 2 to 27. These statements suggest a representative of the spionids, possibly of the genus *Laonice* Malmgren, from which the large, paired palpi had fallen away. The conspicuous, interramal pouches, characteristic of *Laonice*, were not mentioned, but perhaps were overlooked. The presence of branchiae from the second segment, the 2 large eyes and occipital tentacle, the large foliaceous lobes of parapodia, and the distribution of setae and hooks are typical of representatives of the Spionidae.

Two other species have been described recently from the Asiatic north Pacific: they are *Aricidea ramosa* and *A. antennata*, both by Annenkova (1934, pp. 657-658). *A. ramosa* is unique in having a prostomial antenna that is 5-lobed. *A. antennata* has lobed parapodial structures in anterior segments, recalling those of the Orbiniidae. Setal structures were not defined. They are therefore not incorporated in the key below.

KEY TO SPECIES OF ARICIDEA FROM THE WESTERN HEMISPHERE

- 1. Notopodia and neuropodia provided with only simple, pointed setae throughout . . . . . 2
- 1. Posterior neuropodia provided with heavy simple hooks. *A.* sp., Berkeley . . . . .
- 2. With long, postsetal, neuropodial lobe in branchial region (pl. 27, fig. 5) . . . . . *A. fragilis*
- 2. Without long, postsetal, neuropodial lobes . . . . . 3
- 3. Branchiae number about 60 pairs . . . . . *A. pacifica*
- 3. Branchiae number only 13 to 20 pairs . . . . . *A. nolani*

The collections of the Allan Hancock Foundation include individuals of *A. fragilis* Webster and *A. pacifica*, new species.

**Aricidea fragilis** Webster  
Plate 27, Figs. 4, 5

Webster, 1879, pp. 255-257, pl. 9, figs. 127-132.  
? *A. quadrilobata* Webster and Benedict, 1887, pp. 739-740, pl. 7, figs. 93-96.

*Collections.*—Beaufort, North Carolina (many).

Mature individuals measure 40 mm or longer, have 50 to 60 pairs of branchiae, first present from the fourth setiger. Branchiae increase in size, going back, are thick, tapering, cirriform in shape and bordered with fine cilia, but the tip is smooth. Dorsal cirri have a low protuberance on their ventral side near the base (pl. 27, fig. 5) but are long, cirriform

throughout the length of the body. In anterior and branchial regions, neuropodia have a characteristic postsetal lobe (called ventral cirrus by Webster) which reaches its maximum development at about the thirty-second parapodium (pl. 27, fig. 5), thereafter gradually diminishes and is absent some distance behind the branchial region. Ventral cirri are absent, as typical of the genus. The prostomium is anteriorly rounded, has 2 tiny black eyespots in front, a pair of nuchal organs near its posterior margin, and a cirriform median antenna (pl. 27, fig. 4).

*A. quadrilobata* Webster and Benedict (1887, p. 739) from Eastport, Maine, was originally described from individuals only 5 to 6 mm long, but "with large irregularly polygonal eggs, clear white, with distinct nucleus," hence supposedly mature. Branchiae were described as first present from the fourth, continued through 9 segments. A unique feature, shown in the figures, but not discussed in the text, is the presence of a setal lobe in neuropodia, through the branchial region and continued some distance in the postbranchial region, just as in *A. fragilis*. Similarly, setae are entirely slender, pointed. *A. quadrilobata* resembles *A. fragilis* closely except in its very small size and reduced number of branchiae, both of which may have no specific significance; their identity is suggested.

*Aricidea nolani* Webster and Benedict (1887, p. 740), also from Eastport, Maine, was described from specimens measuring only about 7 mm long. Branchiae are present from the fourth setiger, continued through 13 to 20 segments. It differs from *A. fragilis* especially in lacking the postsetal neuropodial lobe (called ventral cirrus by Webster and Benedict) in the branchial region. Although this species has been questionably referred to *A. fragilis* (Fauvel, 1936, p. 65), it may be distinct in this respect.

*A. fragilis* inhabits burrows in fine sandy shoals, at low water line, often associated with species of *Scoloplos*, from which it is most readily distinguished in being notably slenderer and smaller.

*Distribution*.—Eastern America, from New England, south to North Carolina; intertidal.

### ***Aricidea pacifica*, new species**

Plate 27, Figs. 8, 9

*Collection*.—1441-41 (1).

The body is broad, depressed in the anterior region, less flattened in the postbranchial portion. Anterior end, through 50 segments, is more or less tightly coiled up, the rest of the body irregularly twisted, the total length difficult to estimate, but approximately 31 mm for 133 segments

(posteriorly incomplete). The prostomium is broadly trilobed in front, the anterior margin truncate but somewhat pushed out of its normal shape. Its median antenna is slender, cirriform, inserted near the middle of the prostomial length, and extends back to the fourth setigerous segment. There are seemingly no eyespots, though there are splashes of pigment where they might be expected.

Branchiae are first present from the fourth setiger, continued posteriorly to the sixty-fourth, thereafter abruptly absent; they total about 60 pairs. They are small at first, increase rapidly in size, come to be thick, coarse, covered over with long cilia except at their tapered distal ends. One from the seventeenth parapodium is shown in pl. 27, fig. 8.

Parapodial lobes are thick, short, in branchial segments, reduced to low ridges thereafter. Ventral cirri are absent. Dorsal cirri are well developed from the first, but greatly exceeded in length and thickness by the branchiae from the fourth setiger. They come to be increasingly longer so as to extend distally about two thirds as far as the longest setae. Behind the branchial region, dorsal cirri are still long, but slenderer.

Setae in both rami are long, slender, distally pointed, through at least 133 segments. Lyre setae, hooded hooks, or acicular spines are absent. In anterior branchial segments setae form dense fascicles, thickest in neuropodia, where they are arranged in 3 or 4 vertical ranks through about the thirty-sixth segment, but fewer thereafter. Notosetae resemble neurosetae except that the first are slender and less stiff; also, they consist largely of finer ones lacking a wing, and some with (pl. 27, fig. 9a) a limbate area. Neurosetae are more sharply geniculate (pl. 27, fig. 9b). Setae in posterior fascicles are entirely fine, silky.

*A. pacifica* may be characterized as follows. Branchiae are present from the fourth setiger, number about 60 pairs; parapodial lobes are short, inconspicuous throughout; setae consist of only slender, pointed ones, but the ventral ones in branchial segments are stiffer, more strongly bent than others; the prostomial antenna is long, cirriform, extends back to the fourth setiger. At least 3 other species belong to the group in which setae are only slender, pointed. They are *A. fragilis* and *A. nolani* (see above), and *A. belgicae* (Fauvel, 1936, pp. 29-31) (see Monro, 1939, p. 127). *A. pacifica* differs from *A. fragilis* in lacking long, postsetal neuropodial lobes. *A. belgicae* has only about 13 pairs of branchiae and the prostomial antenna is very short, also branchiae have a slender, terminal papilla. *A. nolani* is too incompletely known to permit comparison (see above).

*Holotype*.—AHF no. 70.

*Type locality*.—Newport, California, intertidal, in beds of eel grass.

*Distribution*.—Southern California.

### Family Magelonidae

The Magelonidae constitute a small, unique group, contained in a single genus, *Magelona* Müller. Their affinities are most notably with the Spionidae on the one hand and the Chaetopteridae on the other; specialization has produced a variety of structures known nowhere else. The paired palpi, reminiscent of the spionids, are greatly prolonged and heavily papillated. The body consists of 2 regions, an anterior one of 9 setigers provided with only simple, pointed setae, and a posterior one of many segments provided with only simple, hooded hooks. The ninth segment is more or less specialized, often shorter than the others, somewhat constricted, and may have setae differing from those in front. The prostomium is a great, flat, spatulate lobe, shovellike in appearance and operation, with or without frontal horns at its anterolateral margins. The proboscis is a large, eversible, spherical, or oval sack, smooth or somewhat papillated. Parapodia are biramous throughout, notopodia and neuropodia resemble each other, but the postsetal lamellae, which may be cirriform to more or less foliaceous, may differ in the 2 rami. In so far as known, the body tapers posteriorly and ends in a pair of elongate cirri (pl. 28, fig. 11); for some species described, the posterior end remains unknown.

The first record of any magelonid was that of F. Müller (1858, p. 215) when *Magelona papillicornis* was recorded from Brazil. This species has since been widely reported from other parts of the world, including western and southern Europe, eastern America, and other places, but at least some of these records might be questioned. Other species have been described from widely separated places. They are as follows.

1. *M. papillicornis* F. Müller (Fauvel, 1927, p. 64, with synonymy).
2. *M. longicornis* Johnson (see below).
3. *M. rosea* Moore (1907, pp. 201-204, pl. 16) from New England.
4. *M. obockensis* Gravier (see below).
5. *M. cincta* Ehlers (1912, pp. 111-112, pl. 15) from south Africa.
6. *M. pacifica* Monro.
7. *M. japonica* and its variety *koreana* Okuda (1937, pp. 247-250, figs. 23, 24) from Korea.
8. *M. pitelkae* Hartman (Hancock Pacific Exped., vol. 10, no. 2).
9. *M. californica*, new species.

*M. longicornis* Johnson (1901, pp. 414-415, pl. 11) from near Seattle, Washington, remains incompletely known. It is not certain whether the prostomium has frontal horns, but it was described as

flattened, grooved in the middorsal line, the anterior tip expanded. The setae of the ninth segment were not clearly described. The statement concerning setae is ambiguous; it reads: "The anterior [region of the body] in front of the ninth somite, with capillary, double-bordered setae in both fascicles; the posterior, back of and *including the ninth somite* [italics by me] with uncini both above and below. Ninth somite shorter than the others, and marked by a deeper constriction, with a pair of comb-like fascicles of short, stiff, capillary setae." If "including" above actually means "excluding," the statement has meaning, but the nature of setae in the ninth remains obscure. The proboscis was described as smooth and uncini bidentate. This is herein regarded as a species *incertae sedis*.

*M. obockensis* Gravier (1906, pp. 163-166) from the Red Sea has been regarded as a variety of *M. papillicornis* (Monro, 1933, p. 1048).

KEY TO SPECIES OF MAGELONA MÜLLER

- 1. Prostomium with frontal horns at anterior end . . . . . 2
- 1. Prostomium without frontal horns (pl. 28, fig. 10) . . . . . 3
- 2. Hooded hooks tridentate; anterior parapodia with cirriform lobes  
. . . . . *M. japonica* Okuda
- 2. Hooded hooks bidentate; anterior parapodia with large, foliaceous lobes . . . . . *M. pacifica*
- 3. Setae in ninth segment with broad tip . . . . . 4
- 3. Setae in ninth segment distally tapering . . . . . 5
- 4. Special setae in ninth segment mucronate . . . . .  
. . . . . *M. papillicornis* Müller
- 4. Special setae in ninth segment not mucronate . . . . . *M. pitelkai*
- 5. Prostomium smooth, lacks longitudinal ridges . . . . .  
. . . . . *M. cincta* Ehlers
- 5. Prostomium marked dorsally with longitudinal ridges or also transverse grooves . . . . . 6
- 6. Parapodial lobes conspicuous, foliaceous in anterior and posterior regions; prostomium with longitudinal ridges and transverse grooves . . . . . *M. rosea* Moore
- 6. Parapodial lobes inconspicuous, small in anterior and posterior regions (pl. 28, fig. 13); prostomium with broad, low, longitudinal ridges (pl. 28, fig. 10) but without transverse grooves . . . . . *M. californica*

**Magelona pacifica** Monro

Monro, 1933, pp. 1048-1049, fig. 2.

*Collections*.—1390-41 (1); 1413-41 (1).

*M. pacifica* is characterized in having frontal horns on the prostomium; its dorsal surface is marked with longitudinal ridges and transverse grooves, as originally shown; parapodia have broad, foliaceous lobes in anterior segments already from the first, and in posterior segments. Dorsal and ventral cirri, located at the outer extremities of parapodial rami, are obvious, the ventral cirri slightly the larger. The notopodial, postsetal lamella is a broad, foliaceous lobe directed downward toward the interramal space; it increases in size posteriorly to the ninth segment. The specialized ninth segment has a similar, though smaller, postsetal lamella and smaller dorsal and ventral cirri. From the tenth segment the lamellae are developed in both rami, take an interramal, though postsetal, position. Dorsal and ventral cirri continue in their normal positions, but are increasingly smaller going back. Setae of the ninth segment are long, pointed, with narrow wing.

*Distribution*.—*M. pacifica* has heretofore been known only from Gorgona Island, Panama, in the intertidal zone (Monro, 1933). The present collections are from Santa Rosa and San Miguel islands, southern California, in 14 and 35 fms.

**Magelona pitelkai** Hartman

Hartman, 1944, Hancock Pacific Exped., vol. 10, no. 2.

*Collections*.—Tomales Bay, California (several); Bolinas Bay, California (1).

*Distribution*.—Central California; at low water line.

**Magelona californica**, new species

Plate 28, Figs. 10-14

*Collections*.—903-38 (1); Mission Bay, California, shore (1); 1450-42 (2).

The general form is long, slender, threadlike; length (preserved) of a complete individual of 108 segments is 27 mm. The dorsum is marked with paired patches, each consisting of fine, black specks; they are distributed immediately within and behind each setal fascicle; similar patches are at the sides of the body, midway between successive parapodia. Anterior segments are slenderer than the first few posterior ones. The distinction between the 2 regions is more or less sharp (pl. 28, fig. 10).

The prostomium is depressed, spatulate, with broadly rounded, frontal margin, unmarked save by a pair of elongate, triangular areas at the sides of the middorsum (pl. 28, fig. 10). There are no visible eyes. The paired palpi are papillated, resemble those of other species.

Parapodia are inconspicuous throughout, provided with flattened lamellae in both rami. Those of the anterior region are as large as, or somewhat larger than, those in posterior segments. In the anterior region they are distinctly postsetal in position; in the posterior region they are interramal, though still postsetal (pl. 28, fig. 13). Dorsal and ventral cirri appear to be absent. Parapodia of the first 9 setigers have only long, pointed setae (pl. 28, fig. 12); those of the ninth resemble those in front. Posterior parapodia, from the tenth, are provided with spreading fascicles of hooded uncini (pl. 28, fig. 13) in which the distal end is bidentate, the secondary tooth thick and more conspicuous than usual (pl. 28, fig. 14). The posterior end terminates in a pair of lateral, digitate cirri at the sides of the anal aperture (pl. 28, fig. 11).

*M. californica* is characterized in having the prostomium anteriorly rounded, with simple, triangular swellings on its dorsal surface; setae of the ninth segment are simple capillaries, resembling those of the first few segments; uncini are distally bidentate, the secondary tooth thick, conspicuous; dorsal and ventral cirri are seemingly absent; parapodial lobes are small throughout. It is distinguished from other species as indicated in the key (see above). Its color in life is dull pale pink.

*Holotype*.—AHF no. 56.

*Type locality*.—Mission Bay, California.

*Distribution*.—Mission Bay, Anaheim Slough and Newport Bay, California; intertidal.

### Longosomidae, new family

The only known representative, *Longosoma catalinensis*, new genus and species, is characterized in having an anterior region of 9 setigerous segments, each provided with notopodia and neuropodia and from the second with a pair of long, tentacular cirri; this is followed by a region in which the segments are greatly prolonged (hence the generic name). In so far as known, setae are entirely simple, pointed, save some in the first neuropodium which include heavier, falcate ones. The prostomium is a simple, spatulate lobe, without appendages. The proboscis is a soft, eversible sack.

**LONGOSOMA**, new genusType: **L. catalinensis**, new species**Longosoma catalinensis**, new species

Plate 27, Figs. 1-3

*Collection*.—900-39 (1).

An anterior end consisting of 9 thoracic setigerous segments and 3 greatly prolonged ones is 14 mm long. The prostomium is somewhat depressed, tapers anteriorly but is broadly rounded in front, lacks eyespots or other pigment marks. No appendages or indications of their bases can be made out. The first segment is achaetous, apodous, biannulate (perhaps represents 2 segments). This is followed by an anterior, thoracic region of 9 setigers in which the rings are short, broad, with laterally disposed setal fascicles. Long, cirriform tentacles, one pair to each segment, arise from the dorsal sides of the second to ninth setigers, totaling 8 pairs (pl. 27, fig. 1); they are slender, cylindrical, recall the lateral tentacles of the cirratulids. This tentacular region is followed by one in which the segments are very long; there are at least 3 such rings (posteriorly incomplete). Each of these rings is crossed by many, closely spaced, transverse wrinkles, as though capable of great extension in life. The first long segment is only about one third as long as the second, and the latter is only about two thirds as long as the third. Each ring is surrounded, dorsally and laterally, at its posterior margin, by fascicles of yellow setae, that leave the ventrum plain.

The proboscis is a smooth, soft sack, resembling that of the spionids; in the type it is everted (pl. 27, fig. 1).

Parapodia of the first 9 pairs are lateral, notopodia and neuropodia separated by a narrow, depressed gap; the upper ramus resembles the lower one save that its fascicles are a little shorter, thinner, and it lacks the short, thick, postsetal lobe which projects behind the neuropodial fascicles of the first 8 setigers (pl. 27, fig. 1). Parapodia, posterior to this region, are depressed, the fan-shaped fascicles seemingly project directly from the body wall. Setae, so far as known, are entirely simple, smooth, in very dense, transversely spreading fascicles. They are pale yellow, slender, distally tapering, terminate in a fine point (pl. 27, fig. 3b). About 11 or 12 pairs in the posterior portion of the first neuropodium are longer, thicker, end distally in a hook (pl. 27, fig. 3a). Setae of the prolonged segments are somewhat finer, longer than those in front, and much more numerous, but also simple, tapering, distally pointed.

*Holotype*.—AHF no. 71.*Type locality*.—Off Long Point, Catalina Island, in 40 fms, from brachiopod and sponge masses (coll. 900-39).*Distribution*.—Southern California.

Family **Ctenodrilidae**Genus **CTENODRILUS** ClaparèdeType **C. serratus** (Schmidt)**Ctenodrilus serratus** (Schmidt)

Plate 27, Figs. 6, 7

Fauvel, 1927, pp. 108-109, fig. 38; Monro, 1933, p. 265; Augener, 1936, p. 350.

*Collections*.—1438-41 (8); San Francisco Bay, California (10).

Minute, inconspicuous, only 2.5 to 6 mm long; number of segments 9 to 11 or a few more. The prostomium is a simple, bluntly conical lobe, lacks appendages or eyespots, but is heavily ciliated. The first segment lacks setae but has a band of cilia ventrally (pl. 27, fig. 6). Notopodia and neuropodia are represented only by reduced setal fascicles, typically 2 to 4 in each bundle; they are simple, distally serrated (pl. 27, fig. 7).

Color in life was noted for individuals from Point Richmond, San Francisco Bay. The body is translucent, pale at either end, with a maroon to purple cast over the middle half to two thirds of its length; the entire surface is speckled with dark. Progression is a slow, creeping movement, in either direction. Individuals have been recovered from clumps of debris; no tube or burrow has been identified.

The family with which this species is identified has sometimes been regarded as a subfamily of the Cirratulidae (Fauvel, 1927, p. 107). It is herein considered distinct because of the presence of unique characters, notably the ciliation of prostomium and first segment, the reduced number of body segments, inconspicuous parapodia, and simple setal fascicles.

Reproduction by transverse fission, protandric hermaphroditism, and internal gestation have been reported for individuals from Europe (see Fauvel, 1927, p. 109). These interesting phenomena have not been investigated for specimens from the Western Hemisphere.

*Distribution*.—Central and southern California; West Indies; Europe.

Family **Sabellariidae**

The family Sabellariidae constitutes a comparatively small, distinct group; affinities with other chaetopods are not easily discernible, but present-day forms are probably nearest the Pectinariidae. The reef-building habit is more or less strongly established. Species are typically colonial, in some cases known to construct sandy reefs of great extent (pl. 42, fig. 106); less often they are solitary, the sandy tubes attached

to solid objects, such as shell and stones. They are largely intertidal or littoral, subject to a varying amount of exposure through tidal action, but a few species have been recorded from abyssal depths (some species of *Lygdamis*). There is direct proportion between the degree of exposure endured and the extent of opercular development. In species of *Phragmatopoma* (p. 346) often existing high up near the barnacle zone (pl. 42) the operculum is a firm, conical structure capable of sealing the open end of the tube, specially adapted to prevent desiccation. In other species the opercular spines are progressively less adapted for this purpose but perhaps increasingly so for protection against predatory organisms. Geographically, the Sabellariidae are widely distributed, but the majority of species abound in warmer seas.

The body of the Sabellariidae consists of (1) an anterior end sometimes called the opercular disk and stalk, (2) a thorax, (3) an abdomen, and (4) a caudal tail (=cauda). Differentiation is sharp in each of these regions. The total number of larval somites which come to form the adult body is variable and perhaps great, but difficult to determine because of the high degree of specialization. Even a study of larval stages is inadequate to satisfactorily settle these problems, since metamorphosis is very pronounced and comparatively rapid. Several important studies have been made toward the elucidation of problems concerning the origin and homology of specialized parts. The investigations of Quatrefages (1848), Meyer (1887, 1888), and Johansson (1927) have been foremost in clarifying some of the issues. The important studies by Wilson (1929) on the development and metamorphosis in some species should also be stressed, but are based largely on external manifestations during larval and settling stages. They include also interesting observations on the structure of the caudal appendage and the organs involved in the process of tube building.

The origin of the conspicuous opercular stalk, constituting the crown, has been explained in several ways. Fauvel (1927, p. 205) considers the operculum probably "les rames dorsales fusionnées des deux premiers pieds." Perhaps this means only the 2 parapodia of the first pair, and not the first 2 pairs. The 2 fascicles of capillary setae, near the oral aperture, and those on the following segment are considered to correspond to the ventral rami. These conclusions correspond somewhat with those proposed by Meyer (1887, 1888). Johansson's conclusions (1927, pp. 25-39), based on a careful study of the nervous system and other anatomical parts, are of great interest and significance; they differ from those of Meyer in several important respects. Meyer concluded that the opercular paleae

were developed from the first segment. Johansson proposed that they develop from the second last prothoracal segment, but that, preceding this, there are several (from 3 to 5) segments that have come to be more or less reduced. They are suppressed by the unusually great development of the paleal segment (designated segment 2 by Johansson) and have fused with one another and with the prostomium so that all indications of septa are effaced. The segment most clearly discernible is the one preceding segment 2 (designated segment 3 by Johansson), since here the setae, though reduced and embedded in the opercular musculature, are still present. This is the condition in species of *Sabellaria*; in those of *Idanthyrus* and others where nuchal hooks are present, this segment 3 is believed to be represented by the nuchal hooks. Segment 4 (preceding segment 3) is so reduced that only the presence of spinal nerves indicates a former existence. It is likely that a fifth segment preceded it, indicated by large nerves in the musculature on the ventral side of the opercular paleae. In conclusion, therefore, Johansson believes that the opercular paleae originate from the notopodium not of a single segment, as Meyer thought, but of parts of 3, 4, or even 5 segments.

In addition, Johansson (1927, p. 25) believes (and I concur in this view) that in all members of the Sabellariidae there are fundamentally 2 rows of opercular paleae. Even in *Sabellaria* (p. 337), where 3 rows of paleae are usually considered, there are 2 rows so arranged that those of the inner and middle rows belong to a single series, alternately directed inward and outward. This view is strengthened by the fact that the paleae of the outer row often approximately equal in number the sum of the middle and inner rows. In addition to these stout, visible paleae, fine rudimentary capillary setae are present (in *Sabellaria*) embedded in the thick musculature on the dorsal side of the operculum. They are significant, since they herald the presence of another segment, and are the homologues of the heavy nuchal hooks in some other genera (*Idanthyrus* and *Lygdamis*).

It might be suggested that segment 3 (preceding segment 2 and so designated by Johansson) actually succeeds it posteriorly, since it is represented by a single ramus, the notopodium, and that the neuropodium of the first anterior thoracic segment is its corresponding ventral part. This would reverse the order of segments 2 and 3 (of Johansson), but would in no way change his conclusions.

In conclusion, therefore, it might be said for the segments which manifest themselves in the adult that the opercular crown, including the paleal spines (whether in 2 rows or 3 apparent ones), represent the

notopodium and neuropodium of a single segment, that the embedded capillary setae (of *Sabellaria*) or the conspicuous nuchal hooks on the dorsal side (of *Idanthyrus* and *Lygdamis*) represent the notopodium of another segment, and that the neuropodium of the first postoral segment represents its respective ventral portion. The operculum would thus represent the noto- and neuropodium of the first visible segment; the first postoral segment, the neuropodial portion of the second segment. The third visible segment is normal, with notopodia and neuropodia in normal relations. These last 2 named segments are herein designated the 2 anterior thoracic segments.

The following nomenclature is used herein. The operculum with its stalk refers to the portion anterior to the oral aperture; it includes the several rows of opercular paleae with the surrounding papillae, the oral tentacles (when present), and palpi. Although it is recognized that opercular paleae are actually in 2 rows (see above), in some genera (*Sabellaria* and *Phragmatopoma*), where outer, middle, and inner rows are visible, they are considered as 3 rows, recognizing, however, that the middle and inner rows are parts of the same series. The thorax is meant to include the portion posterior to the oral aperture; it includes 2 anterior thoracic and 3 (or 4) parathoracic segments, each except the first with biramous appendages, dorsal and ventral cirri, and simple branchiae. The caudal region (=cauda) is the long, cylindrical portion, lacks parapodia or setae, and is believed to represent perhaps many (50 to 60) segments, since the alimentary tract extends throughout its length, and there are internal traces of transverse septa (Wilson, 1929, p. 247). The anal aperture is at its posterior terminus.

*Development.*—Larval stages of Sabellariidae are familiar objects in the plankton along the coastal waters of California and the northeast Pacific during many months of the year. Although frequently observed, they have remained entirely unreported except through a recent reference by Rioja (1939, p. 299, figs. 1-5) under the designation of a spionid larva. The stage shown is a chaetosphere, but with metamorphosis advanced so that thoracic paleae and abdominal uncini are already developed. It resembles sabellarian larvae that have been described from other parts of the world by many observers (see Wilson, 1929, p. 221, for review).

Development of the sabellarian is typical; it proceeds from a spherical egg, through a pelagic trochophore, a more or less prolonged (perhaps many weeks) larval life, with striking metamorphosis to a sedentary adult. Early larvae of 2 common California species, *Phragmatopoma*

*californica* (p. 349) and *Sabellaria cementarium* (p. 340), agree on the whole with those of *S. alveolata* described by Wilson (1929, pp. 221-270). The eggs of *P. californica* are purple in mass and measure about 70  $\mu$  in diameter; those of *S. cementarium* are deep pink in mass and somewhat smaller. They are covered by a thin membrane, hardly visible even after fertilization. In *P. californica* swimming larvae develop about 12 hours after fertilization, and in 24 hours the typical parts of the trochophore are visible. The prototroch is well developed, but incomplete middorsally; the telotroch is weak, and apical cilia are few. After 2 days the larva has acquired about 5 pairs of long, spinose, natatory setae, and the alimentary tract is clearly visible because of its long, beating cilia and the large, humped, gastric portion. After 2 or 3 days a characteristic color pattern appears, consists of widely spaced, yellow-brown, epithelial cells (pl. 29, fig. 15), and on the oral side there is a greatly flattened equatorial disk. A pair of eyespots is usually visible after 2½ to 3 days. The lateral oral lappets are long, and the great extension of the equatorial disk on the oral side gives the larva a lopsided appearance.

Long, spinous (pl. 29, fig. 16) setae, greatly exceeding the larva in length, emerge from paired, fleshy, lateral lobes, the so-called setal sacks; they are postoral in position, but the sacks extend far up in the hood (pl. 29, fig. 15). As the larva increases in size, the number of setae is gradually increased to 30 to 50 on a side. They are held stiffly, in a fascicle, at the sides of the body when the larva is swimming, but are thrust outward and forward when disturbed or stopping in its forward progression. This brings the setal sacks in position nearer the mouth and tends to push the latter shut. This segment is unique in its precocious development in larval life and the major role it comes to have in the adult, since it is (at least primarily) the forerunner of the operculum and its stalk. During planktonic, larval life it occupies a normal position, posterior to the oral aperture, its setae directed back or laterally. During metamorphosis certain portions of this segment grow rapidly so that it is permanently pushed forward (pl. 29, fig. 17), on the dorsal side of the mouth, extends forward beyond it, its provisional long setae gradually replaced by the 1, 2, or 3 kinds of paleae which characterize the adult opercular crown. Thereafter this segment is permanently forward. The neuropodial portion of one of the larval somites (see above, p. 325) remains postoral and comes to be the first anterior thoracic segment.

During early larval life the ventrolateral edges along the prototrochal area grow out to form a pair of long, prehensile tentacles. They are partly covered with short cilia and are pigmented in their distal third. These

tentacles continue to be conspicuous through planktonic existence and into the adult in most species; they are the precursors of the paired palpi, conspicuous in some (*Phalacrostemma* and *Lygdamis*), but more or less concealed by the oral tentacles in others (*Phragmatopoma*). A pair of small tentacular structures, near the palpi and also ventral in position, are believed to be the rudiments of the oral tentacles. When fully developed, in the sedentary adult, they may be very numerous, in ranks of 7 to 11 rows, at the sides of the oral aperture. In *Phalacrostemma* (p. 330) they are absent, but the palpi are correspondingly enlarged and take over the function (food intake) of the oral tentacles in other species.

The 2 anterior, thoracic segments are slow in making their appearance; they arise just behind, and below, the great setal sacks. The first of these is believed to be only the neuropodial portion of the segment immediately preceding; the second is biramous. The large, glandular, U-shaped area just behind the mouth is the so-called building organ (Wilson, 1929) which secretes mucus for the adhesion of sand particles in tube construction. From the third segment the parapodial paleae are more or less conspicuously developed, even in very young stages. Inversion of parapodia, marking the transition from thorax to abdomen, is marked already in pelagic stages. The caudal tail is represented only by a thick, glandular area (pl. 29, fig. 17), and comes to assume its attenuate form only after settling.

*Systematic.*—The Sabellariidae are generally recognized through 7 genera (Johansson, 1927, p. 81) including *Phalacrostemma* Marenzeller, *Lygdamis* Kinberg, *Cryptopomatus* Gravier, *Idanthysus* Kinberg, *Gunnerea* Johansson, *Phragmatopoma* Kinberg, and *Sabellaria* Lamarck. Two others, *Eupallasia* Augener (1927, p. 236) and *Monorchos* Treadwell (1926, p. 191) are referred to the older *Lygdamis* (p. 331). In addition, *Tetreres* Caullery has long been considered identical with *Lygdamis* (Johansson, 1927, p. 81) and the following referred to *Sabellaria*, including *Centrocorone* Grube, *Chrysodon* Oken, and *Hermella* Savigny (Fauvel, 1927, p. 206).

Representatives from the Western Hemisphere belong to 4 genera, including *Idanthysus* Kinberg<sup>1</sup>, *Lygdamis* Kinberg, *Phragmatopoma* Mörch, and *Sabellaria* Lamarck. These 7 genera are separable as follows.

<sup>1</sup> Fauvel (1927, p. 213) uses *Pallasia* Quatrefages to include both *Idanthysus* Kinberg and *Lygdamis*. Since *Pallasia* Quatrefages (1866) is preoccupied in groups of insects and fishes (Annenkova, 1925, p. 125), *Idanthysus* is the next available. I consider *Lygdamis* distinct from the first, as indicated in the key below.

KEY TO GENERA

- 1. Without oral tentacles . . . . . *Phalacrostemma*
- 1. With oral tentacles . . . . . 2
- 2. With 4 paleal-bearing, parathoracic segments; opercular paleae in 2 visible rows . . . . . *Lygdamis*
- 2. With 3 paleal-bearing, parathoracic segments . . . . . 3
- 3. Opercular paleae greatly reduced, inconspicuous . . . . . *Cryptopomatus* Gravier
- 3. Opercular paleae developed, in 2 or 3 visible rows . . . . . 4
- 4. Opercular paleae in 2 visible rows . . . . . 5
- 4. Opercular paleae in 3 visible rows; without nuchal hooks . . . 6
- 5. With heavy nuchal hooks dorsally . . . . . *Idanthysus*
- 5. Without heavy nuchal hooks . . . . . *Gunnerea* Johansson
- 6. Middle row of opercular paleae completely conceals inner row and forms a flattened or pointed cone . . . . . *Phragmatopoma*
- 6. Middle row of opercular paleae not concealing inner row . . . . . *Sabellaria*

The following species, alphabetically arranged, are discussed below.<sup>2</sup> All save 2 (*Phalacrostemma setosa*, from Hawaii, and *Lygdamis philippinensis*, from the Philippines) are from the Western Hemisphere; 5 are described as new.

- 1. *Idanthysus armatus* Kinberg
- 2.       "       *ornamentatus* Chamberlin
- 3.       "       *pennatus* (Pallas)
- 4. *Lygdamis asteriformis* (Augener)
- 5.       "       *nesiotes* Chamberlin
- 6.       "       *philippinensis* (Treadwell)
- 7.       "       *tenerus* Augener
- 8. *Phalacrostemma setosa* (Treadwell)
- 9. *Phragmatopoma attenuata*, new species
- 10.       "       *californica* (Fewkes)
- 11.       "       *caudata* (Kröyer) Mörch
- 12.       "       *lapidosa* Kinberg
- 13.       "       *moerchi* Kinberg

<sup>2</sup> It is a pleasure to acknowledge thanks to the administration of the U.S. National Museum for permission to examine important type materials, to Dr. Waldo L. Schmitt for the use of valuable materials, equipment, and laboratory space; to Dr. Martin W. Johnson of the Scripps Institution of Oceanography at La Jolla, where larval stages were observed; to the American Association of University Women for a grant in partial support; and to the administration of the Allan Hancock Foundation for most significant aid.

14. *Phragmatopoma peruensis*, new species
15.       "       *virgini* Kinberg
16. *Sabellaria bella* Grube
17.       "       *bellis* Hansen
18.       "       *cementarium* Moore
19.       "       *fissidens* Grube
20.       "       *floridensis*, new species
21.       "       *gracilis*, new species
22.       "       *moorei* Monro
23.       "       *nanella* Chamberlin
24.       "       *spinulosa* Leuckart
25.       "       *vulgaris* Verrill
26.       "       "       *beaufortensis*, new subspecies

Genus **PHALACROSTEMMA** Marenzeller

Type **P. cidariophilum** Marenzeller

**Phalacrostemma setosa** (Treadwell)

*Sabellaria setosa* Treadwell, 1906, pp. 1180-1181, figs. 78-81.

*Material examined*.—Type specimen at U.S. Nat. Mus., no. 5224.

This species was originally described from a collection made by the U.S.S. *Albatross* at station 4041, in 1902, off the west coast of Hawaii, in 253-382 fms. The type collection contains 2 specimens. There are 4 paleal-bearing, parathoracic segments; the opercular paleae are arranged in 2 rows; oral tentacles are lacking; it is therefore to be referred to the genus *Phalacrostemma* Marenzeller. The paired palpi are proportionately large, fill the space usually taken over by the oral tentacles when present; they are lingulate, with ruffled margins, extend distally to the middle of the longer opercular paleae. A pair of lateral lobes partly surrounds the base of the palpi. Other membranes bordering the oral aperture at the sides and below are also larger and longer than in most species of this family. The lower lip is thick, emarginate.

There are 4 or 5 pairs of amber-colored, nuchal hooks, forming a straight series on either side; their tips are bent inward and cross those of the opposite side. These hooks are dorsal to the opercular paleae. The latter are pale yellow, in 2 rows but of a single kind, consist of shorter and longer ones. They increase in length from dorsal to ventral ends, and those of the outer series are slightly the longer. They are long, tapering, finely and closely transversely serrated and extend far beyond the anterior end of the body. The longest paleae are 4 to 6 times as long as the nuchal hooks. On either side there is a single, spiral (or nearly a

complete oval whorl) of 18 to 24 of these long spines, but all are similar to one another in form, color, and thickness. Under high magnification the tip is seen to be minutely pilose. There are 18 pairs of paleae in the outer set; the inner has only about 10 pairs. The membrane immediately surrounding the paleae is strongly fringed, with about 18 filaments on each side, those along the ventral end are both longer and more crowded than those more superior.

The first setiger, at the sides of the oral aperture, has a few long, slender, hairlike setae and a pair of long, triangular cirri about two thirds as long as the palpi. The next (second anterior thoracic) segment has dorsal and ventral cirri and a dorsal branchia, but seemingly no setae. The next 4 segments (parathoracic) have each a long fascicle of slender setae ventrally and a transverse series of paleae dorsally, in addition to cirri and branchiae.

*Phalacrostemma* is a small genus, known through only 3 species, including the type, *P. cidariophilum* Marenzeller (Fauvel, 1927, p. 212) from the Mediterranean Sea, *P. elegans* Fauvel (1914, p. 270) from near Madeira in 1,968 meters, and *P. setosa* (Treadwell).

*Distribution*.—Known only from Hawaii, in 253-382 fms.

### Genus **LYGDAMIS** Kinberg

#### Type **L. indicus** Kinberg

(Includes *Eupallasia* Augener and *Monorchos* Treadwell.)

The operculum is well developed, provided with paleae arranged in 2 apparent rows. There are one or more pairs of heavy, nuchal hooks on the dorsal side. Oral tentacles and palpi are well developed. The thorax consists of 2 anterior thoracic, and 4 paleal-bearing, parathoracic, segments.

The following species are believed to belong to this genus.

1. *Lygdamis asteriformis* (Augener).
2. " *giardi* (McIntosh) from western Australia.

Originally described as *Sabellaria* (*Pallasia*) *giardi* McIntosh (1885), it has been referred to *Lygdamis* by Johansson (1927, p. 86), although Augener (1927, p. 236) had erected a new genus, *Eupallasia*, for it. I accept the conclusions of Johansson.

3. *Lygdamis indicus* Kinberg (Johansson, 1927, pp. 84-86) from the Indo-Pacific.
4. *Lygdamis muratus* (Allen) (Johansson, 1927, pp. 83-84) from the north Atlantic.
5. *Lygdamis nesiototes* (Chamberlin).

6. *Lygdamis philippinensis* (Treadwell).
7. " *porrectus* (Ehlers) (Johansson, 1927, p. 86) from west Sumatra, in 1,280 meters.
8. ?*Lygdamis tenerus* (Augener) from the Barbados Island in 200 fms. Johansson (1927, p. 86) has referred this to *Lygdamis*; however, since it is said to lack nuchal hooks and even palpi (designated "die beiden mächtigen Mundcirren"), it is doubtful whether it belongs here. The type and only known specimen was an anterior fragment only 1 cm long; it is not known to exist where it was said to be deposited.

The 3 species discussed below are separable as follows.

- |   |                          |   |
|---|--------------------------|---|
| 1. Paleae of inner row numerous and much coarser than those of outer row . . . . .                                  | <i>L. nesiotes</i>       |   |
| 1. Paleae of inner row of few, only 3 to 5 pairs, those of outer series conspicuous, larger, and numerous . . . . . |                          | 2 |
| 2. Paleae of outer series broad, spatulate (pl. 31, fig. 30) . . . . .  | <i>L. asteriformis</i>   |   |
| 2. Paleae of outer series long, tapering, though somewhat flattened . . . . .                                       | <i>L. philippinensis</i> |   |

### ***Lygdamis nesiotes* (Chamberlin)**

*Tetreres nesiotes* Chamberlin, 1919, pp. 490-493, pl. 75, figs. 1-7.

?*Tetreres treadwelli* Hoagland, 1920, p. 627, pl. 3, figs. 14-23.

Johansson, 1927, pp. 84-85.

*Idanthyrus pennatus* Hartman, 1939, p. 19 (not Peters).

*Collection*.—28-33 (1).

*Other material examined*.—At the U.S. Nat. Mus., type specimen (no. 19742) from Fakarava, Paumotu Islands, from fringing reef; Corregidor Light between Cebu and Leyte, off south Luzon, Philippines, *Albatross* station no. 5109 (1); Makemo, Paumotu Islands, *Albatross* station (1); Clipperton Island, shore (1).

The opercular paleae are arranged in 2 well-developed rows, the outer paleae much finer than the inner ones. There are about 17 pairs in the inner, and about 29 pairs in the outer row. The inner paleae are thick, straight, slightly flattened, but taper to blunt, distal ends. The outer, paler, finer spines are bent inward at their distal end, nearly at right angles to the main shaft; they taper to a point at the free end. The 2 nuchal spines are heavy, dark brown, strongly U-shaped distally. There are 10 to 14 pairs of elongate cirri surrounding the opercular paleae, in a single series; this membrane appears serrulate. The oral tentacles form about 12 transverse rows on each side of the mouth.

The single specimen from Clipperton Island, which was reported (Hartman, 1939, p. 19) as *Idanthysus pennatus*, has been re-examined and compared with the type of *L. nesiotes* with which it agrees fully. The type of *Tetreres treadwelli* Hoagland (USNM no. 18964) from the Philippines includes a single specimen with several coarse tube fragments, partly constructed of coral-shell fragments. The body proportions are much as in *L. nesiotes*; here also the inner paleae are much thicker than the outer, and the latter are curved inward near the tip but at an angle that is less marked. The membrane bordering the outer row of paleae is similarly serrated, the fringes number about 11 on side, but they are somewhat longer than in the type of *L. nesiotes*. It seems that the 2 are identical.

*Distribution*.—Paumotu Islands; Philippines; Bonin, Marshall, and Gilbert islands; Clipperton Island; Galapagos. Littoral.

***Lygdamis asteriformis* (Augener)**

Plate 31, Figs. 30-33

*Hermella varians* Treadwell, 1902, p. 210, fig. 81; 1906, p. 1180; *not* Webster, 1879.

*Sabellaria (Pallasia) asteriformis* Augener, 1906, pp. 167-171, pl. 7, figs. 129-138.

Johansson, 1927, p. 86.

*Materials examined*.—Type of *Hermella varians*, USNM no. 16246 from Puerto Rico; other specimens so labelled, from Hawaii.

The following description is based on the type specimen of *Hermella varians*, collected by the steamer *Fish Hawk* in Mayaguez Harbor, Puerto Rico, Jan. 13, 1899. Opercular paleae are of 2 distinct kinds; the outer row contains 25 to 30 pairs of broad, thin, spatulate ones (pl. 31, fig. 30) overlapping one another at their lateral edges, forming a trim flange about the operculum. The inner paleae number only 4 on a side, are short, thick, taper to a blunt, spinelike tip, and are much darker than those of the outer row; they are inserted near the median line of the operculum, on the lower half of the crown. Nuchal hooks consist of a single pair; they are large, flat, dark brown, their tips strongly curved, their expanded basal portion with a sharp cutting edge. The membrane surrounding the paleae on the outer side is bounded by about 20 closely spaced, basally thick, long, tapering cirri.

Palpi are very long, cylindrical but taper distally; they extend forward beyond the opercular setae. The oral papillae are not numerous, but form a longitudinal series along the free edge of the opercular base.

The 2 anterior thoracic segments are provided with slender, hairlike setae. The 4 parathoracic segments have spatulate paleae, the first with 3, the second with 4, the third and fourth segments each with 5 on a side. Figs. 30, 32, on pl. 31, show an outer opercular palea from near the ventral end of the series and a parathoracic palea from the fourth segment. This specimen agrees fully with the description of *Lygdamis asteriformis* (Augener).

The national collections contain a lot from the south coast of Oahu Island, *Albatross* station 3909, from 308-322 fms, in which there are numerous smaller specimens and tube fragments. On the whole, they agree well with the type from Puerto Rico, except that the outer opercular paleae are somewhat different. They agree in that there are also about 25 pairs of paleae that are flat, spatulate, but they terminate distally in a blunt point (pl. 31, fig. 31) giving the operculum a slightly different aspect. The inner row contains also only 3 or 4 pairs of much shorter, thicker, spinelike setae. Figs. 31 and 32 on pl. 31 show an opercular palea from near the ventral end of the outer series and a thoracic palea from the fourth paleal-bearing segment.

*Lygdamis asteriformis* (Augener) was originally described from the Barbados Island, in 103 fms. Augener (1906, p. 170) surmised the identity of this with *Hermella varians*, since he says, "Es ist möglich, dass die vorliegende Art mit der *Sabellaria varians* von Porto Rico zusammenfällt, welche ähnliche Paleen zu haben scheint und ebenfalls zwei grosse Mundcirren besitzt." But he adds, "nach der ungenügenden Beschreibung dieser Art ist es nicht möglich, die *Sabellaria asteriformis* mit ihr zu identifizieren." Examination of the type, however, substantiates their identity. Augener concludes, "Da der Name *S. varians* schon von Webster für eine neue *Sabellaria* mit 3 Paleenkreisen, welche offenbar nicht mit der Treadwell'schen Art zusammenfällt, gebraucht wurde, muss ausserdem *S. varians* von Porto Rico mit einem anderen Namen bedacht werden." I follow this conclusion.

*Distribution*.—Puerto Rico; Barbados Island, in 103 fms; Hawaii, in 308-322 fms.

### ***Lygdamis philippinensis* (Treadwell)**

*Monorchos philippinensis* Treadwell, 1926, pp. 191-193, figs. 13-20.

*Material examined*.—Type collection in the U.S. Nat. Mus. (no. 19207).

The type and 5 other specimens in the collection originate from the Philippines, in 805 fms, and were collected by the steamer *Albatross*. The

thorax includes 4 parathoracic segments; the opercular crown has an outer series of about 18 pairs of spines, the inner row consists of only 4 pairs. There is a single pair of dark nuchal hooks on the dorsal side; each is strongly falcate, with a broad base and sharp cutting edge, much as in *Lygdamis asteriformis* (above). The outer paleae are pale, somewhat flattened, taper distally. The inner row is limited to 2, 3, or 4 pairs of shorter, darker, tapering, blunt spines, about as thick as the outer ones, but distally blunt.

The oral tentacles are long, consist of about 12 rows on a side, but there are few in a row. Palpi are well developed, long, cylindrical. The first parathoracic paleal-bearing segment is notably smaller than the 3 following, but similar in other respects. It is herewith referred to the genus *Lygdamis*.

*Monorchos* Treadwell (1926, p. 190) was newly erected for this single species, supposedly differing from other genera in that a single row of paleae was thought to be present, but a second row is actually described and originally figured. A reduced number is characteristic for this species, as in some others of the genus *Lygdamis* (see *L. asteriformis*, above). It seems unnecessary to erect a genus for the reception of this species.

*Distribution*.—*L. philippinensis* has remained unrecorded save through its original discovery, from the Philippines, in 805 fms.

### Genus **IDANTHYRSUS** Kinberg

#### Type **I. armatus** Kinberg

(Includes *Pallasia* Quatrefages, preoccupied in Diptera and Pisces, see Johansson, 1927, p. 87.)

*Idanthyrus* differs from *Lygdamis* (above) mainly in having only 3, instead of 4, paleal-bearing, parathoracic segments. The operculum has 2 rows of modified spines. There are 2, to a few, heavy nuchal hooks on the dorsal side of the operculum. Oral tentacles are developed.

Two species, *I. pennatus* and *I. armatus* (below), have been widely reported, especially from shallow seas. As already shown (Augener, 1914, pp. 79-82, and others) *I. armatus* is very close to the older *I. pennatus* and may be only a variety. Another closely related species, *I. ornamentatus* (below), is here recognized, although its affinities with the others are obvious. In addition, a sabellarian was described by Bosc (1802) from Charleston Bay, S.C., as "*Sabella negata*," later referred to *Pallasia* (Quatrefages, 1848, p. 25) without enhancing the original brief account, but it remains too incompletely known to be determinable.

The 3 species discussed below are separable as follows.

- |   |                        |   |
|---|------------------------|---|
| 1. Paleae of outer opercular series with strongly curved, plumelike shaft (pl. 31, fig. 35) . . . . . | <i>I. pennatus</i>     |   |
| 1. Paleae of outer opercular series with nearly straight shaft . . . . .                              |                        | 2 |
| 2. Spinelets on outer paleae widely separated, curved outward (pl. 31, fig. 36) . . . . .             | <i>I. armata</i>       |   |
| 2. Spinelets on outer paleae closely spaced, appressed to shaft (pl. 31, fig. 34) . . . . .           | <i>I. ornamentatus</i> |   |

### ***Idanthysus pennatus* (Peters)**

Plate 31, Fig. 35

Fauvel, 1917, pp. 262-264 (with synonymy).

*I. cretus* Chamberlin, 1919, pp. 485-487, pl. 75, figs. 8-15.

*I. regalis* Chamberlin, 1919, pp. 487-490, pl. 74, figs. 1-8.

Johansson, 1927, pp. 88-90.

*Collections*.—(Most are tube masses, the number of individuals is therefore not stated save in a few instances.) 30-33; 56-33; 69-33; 80-33; 94-33; 101a-33; 129-33; 239-34; 258-34; 261-34; 413-34; 414-45; 433-35; 435-35; 444-35; 447-35; 464-35; 859-38.

*Other material examined*.—At the U.S. National Museum, type of *I. cretus*, from Taboguilla Island; type of *I. regalis*, from Chatham Island, Galapagos, shore; specimens from Punta Santa Elena, Guayaquil, Ecuador, tide pool, several tubes collected by W. L. Schmitt.

The type specimen of *I. cretus* Chamberlin (USNM no. 19716) is so fixed that the operculum is expanded, hence described as "opercular lobes . . . diverging." Though much smaller than the type of *I. regalis* Chamberlin (USNM no. 19385), it agrees well in all details, and both must be referred to the older *I. pennatus* (Peters). They were originally considered distinct because of differences in comparative sizes of the dorsal thoracic paleae, a difference which is believed to be due to varying sizes of the entire body. Johansson (1927, pp. 88, 90) has already considered them with *I. pennatus*.

*Distribution*.—*I. pennatus* was originally described from Mossambique, but has been widely reported from tropical parts of the Pacific and Indian oceans; in the Western Hemisphere it occurs from western Mexico, south to Ecuador, from shore to 18 fms.

### ***Idanthysus armatus* Kinberg**

Plate 31, Fig. 36

Kinberg, 1867, p. 350.

*Hermella macropalea* Schmarda, 1861, pp. 23-24, pl. 20, fig. 172 (in part).

*Pallasia sexungula* Ehlers, 1897, pp. 125-129, pl. 8, figs. 194-202.

Johansson, 1927, pp. 90-91 (synonymy); Monro, 1933, p. 1066, fig. 14.

*Materials examined*.—At the U.S. National Museum; Port William, Port Stanley, Falkland Islands, in 8-10 fms, and south of municipal jetty on shore, coll. by W. L. Schmitt (2); Strait of Magellan, in 61 fms, coll. by steamer *Albatross*, station 2778, Jan. 3, 1888 (2).

The operculum has about 11 pairs of paleae in the inner row and about 16 to 18 pairs in the outer one. Those of the former have a shaft that is nearly straight and the lateral teeth are directed outward (pl. 31, fig. 36); they are not at all plumelike, as in *I. pennatus* (above).

*Distribution*.—Originally described from Valparaiso, Chile, *I. armatus* has since been recorded from other parts of western and southern South America, and from Gorgona Island, Panama (Monro, 1933, p. 1066). On the whole, its range appears to extend southward from that of *I. pennatus*. Its bathymetric range is intertidal to 20 fms.

### **Idanthysus ornamentatus** Chamberlin

Plate 31, Fig. 34

Chamberlin, 1919, pp. 262-263, pl. 3, figs. 2-5.

?*Sabellaria saxicava* Baird, 1863, p. 109.

*Material examined*.—Between Sitka and the Columbia River, in 66 fms, coll. by the steamer *Albatross*, station 2878, Sept. 25, 1888 (1); near Canoe Bay, Alaska, coll. by W. L. Schmitt, Sept. 1940 (several).

The outer opercular paleae (pl. 31, fig. 34) distinguish this from the 2 species mentioned above. The inner row of paleae includes about 8 pairs; the outer row consists of about 34 pairs.

Earlier (1938, p. 16) I accepted Berkeley's (1930, p. 74) conclusion in referring this to *I. johnstoni* (McIntosh) from the Cape Verde Islands. However, there are differences in the outer opercular paleae, which may warrant the retention of Chamberlin's name. *Sabellaria saxicava* Baird (1863, p. 109) from Vancouver may belong here, since its range approaches that of *I. ornamentatus*, but it remains too incompletely known to assign to any species.

*Distribution*.—First described from Mendocino, California, it is believed to range north to Alaska, in depths to 66 fms.

### Genus **SABELLARIA** Lamarck

Type **S. alveolata** (Savigny)

The operculum is provided with 3 apparent rows of paleae in which all are visible externally. (Actually the middle and inner rows probably represent a single series in which the middle paleae are directed outward

or anteriorly, the inner ones toward the center.) Nuchal hooks are absent. The thorax includes 2 anterior thoracic segments provided with only capillary setae, and 3 parathoracic segments provided with flattened paleae dorsally, and similar, though much smaller, setae ventrally. The abdomen consists of a variable number of segments; its notopodia are provided with tori bearing uncini and its neuropodia with fascicles of fine setae. The caudal tail (=cauda) is smooth, cylindrical, sharply set off from the abdomen. Oral tentacles are present, arranged in 7 to 11 ranks of transverse rows. The paired palpi are simple, taper distally, and are usually more or less concealed from view by the oral tentacles.

Species of the genus *Sabellaria* appear much alike in minute details save in characters of the operculum. The major differences are believed to be in the terminal portions of the opercular paleae, especially in those of the middle and inner series. The outer paleae are often distally serrulate, the middle portion more or less prolonged, sometimes as a spike, with or without surface ornamentation, or it may be more or less finely serrated. When uninjured, this character is usually highly diagnostic. Those of the middle row are even more specific; they may be of a single kind (pl. 32, fig. 51) or they may alternate long and short (pl. 31, figs. 37, 38). The paleae of the inner row are usually directed inward, toward the center of the disk; usually they terminate in a point (pl. 30, fig. 42), but in a few species they are distally serrated (pl. 31, fig. 40). This may be summarized as follows, for the species herein considered.

Inner paleae distally serrated.

Middle paleae all of the same length: *S. bellis*, *S. moorei*.

Middle paleae alternate long and short: *S. floridensis*.

Inner paleae distally entire.

Middle paleae all of the same length.

Outer paleae with bifurcated tip: *S. fissidens*.

Outer paleae with simple spike: *S. nanella*.

Outer paleae with penicillate spike: *S. cementarium*, *S. vulgaris*, and subsp. *beaufortensis*.

Outer paleae with serrated tip: *S. spinulosa*, *S. gracilis*.

Middle paleae alternate long and short: *S. bella*, *S. alcocki*.

Other features concerning the thoracic and abdominal setae and hooks are usually too uniform from one species to the next for specific distinction. Most, perhaps all, species of *Sabellaria* are colonial, construct tubes of cemented sand that adhere to one another; they sometimes make up masses of great extent. The size of sand particle used may have some significance.

A considerable number of species from the Western Hemisphere have been described as *Sabellaria* (or one of its synonyms), but some have been, or are herein being, referred to other species or genera, indicated in brackets below. They are as follows:

*S. bella* Grube.

*S. bellis* Hansen (Augener, 1934, pp. 151-153, fig. 31) from Brazil (see key below).

[*S. californica* Fewkes, see *Phragmatopoma*.]

*S. cementarium* Moore.

[*S. falcigera* Johansson, see *S. vulgaris*.]

*S. fissidens* Grube (Ehlers, 1901, pp. 196-199) from Chile (see key below).

[*Hermella macropalea* Schmarda, see *Idanthyrus* and *Phragmatopoma*.]

*S. nanella* Chamberlin (1919, pp. 261-266) from California (see key below).

[*Hermella orbifera* Ehlers, see *Phragmatopoma*.]

*S. pectinata moorei* Monro (1933, pp. 1063-1064, fig. 12) from Balboa, Panama. (This comes close to *S. bellis*, see key below.)

[*Centrocorone spinifera* Treadwell, see *Phragmatopoma*.]

*S. spinulosa* Leuckart (Monro, 1933, pp. 1063-1064) from Balboa, Panama. (This differs from typical *S. spinulosa* in its much smaller size, but was not described in other respects.)

[*S. varians* Webster, see *S. vulgaris*.]

[*Hermella varians* Treadwell, see *Lygdamis*.]

[*S. virgini* Ehlers, see *Phragmatopoma*.]

*S. vulgaris* Verrill.

In addition, *S. spinulosa alcocki* Gravier has been reported (Fauvel, 1919, pp. 477-478) from French Guiana, but differs from Gravier's species in that the paleae of the middle opercular row do not alternate long and short, but are all of the same length. *S. alcocki* has been further reported from southern California (Berkeley, 1941, p. 51); it may be close to, if not identical with, *S. bella* Grube (below). Two species, *S. floridensis* and *S. gracilis*, and one subspecies, *S. vulgaris beaufortensis*, are newly described.

#### KEY TO SPECIES OF SABELLARIA LAMARCK

- |   |   |
|---|---|
| 1. Inner opercular paleae distally serrated (pl. 31, fig. 40)         | . . . . . 2   |
| 1. Inner opercular paleae distally simple (pl. 32, fig. 42)           | . . . . . 3   |
| 2. Middle opercular paleae short, spoon-shaped (pl. 30, figs. 25, 28) | . . . . . <i>S. bellis</i> Hansen and <i>S. moorei</i> Monro <sup>3</sup> |

<sup>3</sup> The outer, middle, and inner paleae, as originally shown, are as in plate 30, figs. 27-29 for *S. bellis*, and as in plate 30, figs. 24-26 for *S. moorei*; the similarities are so striking that it is difficult to separate them.

2. Middle opercular paleae alternately long and short (pl. 31, figs. 37, 38) . . . . . *S. floridensis*
3. Middle opercular paleae alternately long and short (pl. 33, figs. 54, 53) . . . . . *S. bella*
3. Middle opercular paleae resemble one another . . . . . 4
4. Middle and inner opercular paleae resemble one another except for longer or shorter distal ends . . . . . *S. gracilis*
4. Middle and inner opercular paleae differ more or less sharply from one another . . . . . 5
5. Outer opercular paleae with a long, penicillate spike (pl. 32, fig. 49). . . . . 6
5. Outer opercular paleae without penicillate spike . . . . . 7
6. Middle opercular paleae distally blunt, recurved (pl. 32, fig. 43), inner paleae elongate (pl. 32, fig. 42) . . . . . 6a
  - a. Outer paleae with many serrations distally (pl. 32, fig. 44) . . . . . *S. vulgaris*
  - a. Outer paleae with few serrations distally (pl. 32, fig. 45) . . . . . *S. vulgaris beaufortensis*
7. Outer opercular paleae with smooth spike (pl. 30, fig. 18); middle and inner paleae as in plate 30, figs. 19, 20 . . . . . *S. nanella* Chamberlin
7. Outer opercular paleae with distal serrations . . . . . 8
8. Longest part of outer opercular paleae with simple, bifurcated tip (pl. 30, fig. 21); middle and inner paleae as in plate 30, figs. 22, 23 . . . . . *S. fissidens* Grube
8. Longest part of outer opercular paleae with prolonged, serrated tip . . . . . *S. spinulosa* Leuckart

### **Sabellaria cementarium** Moore

Plate 32, Figs. 49-52

Moore, 1906, pp. 248-253, pl. 12, figs. 45-51.

*Collections*.—610-37 (1); 886-38 (1); 891-38 (1); 901-38 (3); 972-39 (1); 1191-40 (1); 1210-40 (3); 1232-41 (2); 1274-41 (1); 1280-41 (3); 1283-41 (1); 1284-41 (several); 1410-41 (1); 1413-41 (4); 1415-41 (1); 1417-41 (2); 1418-41 (2); 1419-41 (1); southern California, shore (several).

The opercular stalk is blotched with black, persists in alcohol. The opercular paleae are characteristic; the outer ones terminate in a long, slender spike, penicillate all around (pl. 32, figs. 49, 50); the middle paleae are prolonged distally to a tapering point (pl. 32, fig. 51); the

inner paleae are short, spoon shaped (pl. 32, fig. 52); under high magnification they appear minutely crenulate along their margins, because of their transversely striated structure; they show none of the dentation shown by Fauvel (1932, p. 34) for specimens so identified from India.

*Distribution*.—Lower California, north to Nanaimo, British Columbia (Berkeley, 1930); intertidal to 40 fms.

### ***Sabellaria vulgaris* Verrill**

Plate 32, Figs. 42-44, 48

Verrill, 1873, p. 611, pl. 17, fig. 88; Andrews, 1891, p. 297; Sumner, 1913, p. 634; Waterman, 1934, pp. 97-114, 1 pl.

*S. varians* Webster, 1879, pp. 259-260, pl. 9, figs. 133-136, pl. 10, figs. 137-139.

*S. falcigera* Johansson, 1927, pp. 95-98, fig. 11.

*Materials examined*.—Beaufort, North Carolina, outer end of Pivers Island, shore (1); eastern America, Massachusetts, south to South Carolina, collected by the SS *Fish Hawk*, now deposited in the U.S. National Museum (many).

The opercular spines are pale straw-colored. The outer ones are distally serrated with a prolonged median portion, delicately pilose (pl. 32, fig. 44). Middle paleae are of one kind, with a blunt, digitate, slightly inwardly directed, distal portion (pl. 32, fig. 43); they are deeply channeled subdistally, into which the convex arm of the inner paleae slides. The inner paleae are deeply cuspidate, terminate distally in a slender point (pl. 32, fig. 42). Abdominal uncini are about 5-dentate (pl. 32, fig. 48).

The type of *S. varians* Webster (1879, pp. 259-260) from Virginia has been compared with these specimens and found to agree in so far as comparison is possible. The type collection (USNM no. 489) contains 3 individuals, all with paleae considerably worn or broken off, the pilose tips not clearly visible now. The middle paleae are bluntly rounded and channeled, just as in *S. vulgaris*, and the inner paleae have identical structures.

*S. falcigera* Johansson (1927, pp. 95-98) from Savannah, Georgia, has many similarities to *S. vulgaris* and is now believed to be identical, a view which the original describer suggested. Since, however, *S. vulgaris* has been too incompletely known from its description to permit comparison, the identity could not be definitely established. The outer opercular paleae are serrated in the same way, and the middle paleae terminate in a blunt, somewhat recurved tip. The pilose tip of the outer paleae was not described.

*Distribution*.—*S. vulgaris* is known to occur from New England, south to Georgia; its bathymetric range includes intertidal to several fathoms. It is usually attached to dead shell fragments, or stones.

***Sabellaria vulgaris beaufortensis*, new subspecies**

Plate 32, Figs. 45-47

*Collection*.—Near Beaufort, North Carolina, dredged outside inlet, in about 10 fms (several, with tube mass on shell surfaces).

Small tube masses, removed from the surfaces of dead shells, contained several specimens of a *Sabellaria*, that approach *S. vulgaris* in some respects, but differ as indicated below. The largest measure only 7 to 10 mm long. The opercular paleae are pale yellow; the opercular stalk is pale, with irregularly scattered black spots. Outer opercular paleae number about 22 pairs; they terminate distally in 5 serrations, in addition to the median, longer spike (pl. 32, fig. 45). Median paleae are all of one kind, sharply recurved at their distal end, and more or less strongly transversely lined (pl. 32, fig. 46). Inner paleae are distally pointed, transversely lined (pl. 32, fig. 47). They differ most significantly from those of *S. vulgaris* in those of the middle series, since they are strongly recurved, and the distal ends of the outer paleae have few serrations.

*Holotype*.—AHF no. 57.

*Type locality*.—Beaufort, North Carolina.

*Distribution*.—North Carolina, in about 10 fms.

***Sabellaria bella* Grube**

Plate 33, Figs. 53-65

Grube, 1870, p. 69; Augener, 1934, pp. 151-153, fig. 31.

*Collections*.—Beaufort, North Carolina, in the sound, from red sponge (several); 832-38 (1).

*Other material examined*.—At the U.S. Nat. Mus., from Beaufort, North Carolina, collected by E. A. Andrews, shore (3).

This species is characterized in having the middle opercular paleae of 2 kinds, including a long (pl. 33, fig. 62) and a short (pl. 33, fig. 63), alternating with one another; the shorter ones are cuspidate on their inner side. Outer paleae are broad, with elongate, serrate edge at the distal end (pl. 33, fig. 56). Inner paleae are distally entire (pl. 33, fig. 55), intermediate in length between the long and short ones of the middle row.

The opercular stalk (preserved) is marked with black, longitudinal stripes on the dorsal sides and more or less diffuse black pigment at the sides of the oral tentacles. Outer opercular paleae number about 24 on a

side, the middle row includes about 6 long ones on a side, alternating with 6 or 7 short paleae. There are about 16 pairs of papillae surrounding the outer base of the opercular spines; they increase in length going ventrally. Abdominal uncini have usually 6 (seldom 5) teeth (pl. 33, fig. 65) in a row, seen from the side.

*S. bella* Grube was poorly known until it was re-examined by Augener (1934, p. 151) and the opercular paleae identified (pl. 33, figs. 57-60). The description, however, seems to include one misinterpretation, perhaps caused by the macerated condition of the type. Augener says, in part, "Was die Kronenpaleen betrifft, so waren diese durcheinander gewirrt und die Paleenkronen drohte schon bei leichter Berührung auseinander zu fallen . . . während es unsicher ist, ob die 2te von mir mit Fragezeichen als Innenpalee angesprochene Form der Innenpaleen tatsächlich dem inneren Paleenkreise angehört." I suggest that Augener's fig. 31d (herewith pl. 33, fig. 59) is really an inner palea, but that his fig. 31c (herewith pl. 33, fig. 60) is the alternating long form of the middle series; the short paleae are as in plate 33, fig. 58. If this be so, the arrangement and form agree very well with the specimens so designated herein.

Another specimen from Peru (coll. 832-38) differs from the Atlantic form chiefly in that the distal end of the outer paleae (pl. 33, fig. 61) is more closely serrated; the middle (pl. 33, figs. 62, 63) and inner (pl. 33, fig. 64) paleae are much like those in the other specimens.

The form of opercular paleae, especially the alternating long and short ones of the middle series, is reminiscent of the condition in *S. alcocki* Gravier (1909, p. 298) first described from India. Here, too, the middle opercular paleae alternate long and short, but in the latter the outer paleae are much more prolonged distally and provided with a very long, serrated barb. If this character is highly variable, as seems possible, it may be necessary to refer *S. alcocki* to the older *S. bella* Grube.

The tube consists of thick walls of sand cemented together, forming masses; they are attached to the under sides of stones, shells, and other hard objects.

*Distribution*.—Beaufort, North Carolina, south to Desterro [Florianopolis], Brazil; ?Independencia Bay, Peru. Intertidal.

### ***Sabellaria gracilis*, new species**

Plate 34, Figs. 66-72

*Collections*.—901-38 (8); 906-38 (1); 1159-40 (many); 1437-41 (many); La Jolla, California, shore (several).

This is one of the smallest species of the genus. Length of a larger specimen, fixed in the tube, is 16.5 mm without, 20.8 mm with, caudal tail. The average length is 15 to 20 mm. The entire body is pale or colorless save for a few, scattered, longitudinal, dark splashes on the opercular stalk and thoracic region. The opercular spines and other setal structures are pale amber in color. Some of the specimens show large, extruded eggs, indicating sexual maturity.

The opercular disk is circular when fixed free from the tube, otherwise elongate or oval. Spines of the outer series are directed outward, in a uniformly long, continuous circle; those of middle and inner rows appear shorter but are actually about as long (pl. 34, figs. 66, 67, are companion paleae), or those of the middle row may be somewhat shorter and blunter (pl. 34, figs. 68, 69 are companion paleae from another individual). Those of the middle and inner rows resemble one another more closely than is usual in species of this genus. There are 17 or 18 pairs of short papillae in a single series around the outer base of the opercular crown; they are partly dark on the ventral side and almost entirely black on the dorsal side.

Oral tentacles are arranged in 7 ranks on a side, consist of 6 or 7 in a row. Palpi are tapering, cirriform, exceed the oral tentacles in thickness but not in length; they are completely concealed from view by the overhanging tentacles. The oral aperture is bounded posteriorly by the thick, glandular building organ, and immediately at the sides are the first pair of neuropodia, each provided with a thick ventral cirrus adjacent to the building organ; I am unable to find setae in it.

The second anterior thoracic segment has its ventral cirrus nearly in contact with, but at the outer sides of, that of the first segment; it is similarly pointed triangular, resembles the dorsal cirrus in shape and size; its rami are provided with 7 to 10 simple, slender setae. A dorsal branchia arises from its upper side, resembles those farther back.

The 3 parathoracic segments are longer and thicker than those in front. Paleae in each are arranged in a single row, increase slightly in size and length from the first to the third segments, and their number decreases gradually such that the first has 7 paleae on a side, the second has 6, and the third has only 5. They are somewhat spatulate in shape, with serrated edge (pl. 34, fig. 70). Abdominal segments number about 20; they decrease in width and length, from anterior to posterior directions. Abdominal uncini have usually 5 teeth, seen from the side (pl. 34, fig. 71).

The outer opercular paleae number 25 to 30 on a side, the middle and inner ones number each about 15 on a side. The outer paleae are thin, translucent, the distal edge delicately serrulate when uninjured, and the middle, longest portion has lateral barbs (pl. 34, fig. 72). Middle (pl. 34, figs. 69, 66) and inner (pl. 34, figs. 68, 67) paleae resemble one another in general shape; each terminates distally in a point; they are closely, transversely striated, but translucent. In some specimens (from La Jolla, California) the middle paleae have a much longer point (pl. 34, fig. 69) than in others (sta. 1159-40) (pl. 34, fig. 66), but in other respects the individuals agree.

Tube masses are constructed of fine sand and are easily broken apart. They are attached to the under sides of rocks and other hard surfaces, sometimes occurring on the same surfaces with *Phragmatopoma californica* (below), but easily distinguished from the latter by much smaller size and more delicate pattern.

*S. gracilis* differs from other species in having middle and inner opercular paleae very similar to one another; also, it is notably smaller than typical for others of the genus.

*Holotype*.—AHF no. 58.

*Type locality*.—Pt. Fermin, California, shore (coll. 901-38).

*Distribution*.—Southern California; intertidal to 25 fms.

### ***Sabellaria floridensis*, new species**

Plate 31, Figs. 37-41

*Collection*.—Lemon Bay, Englewood, Florida (2).

A collection of 2 individuals, from Grove City Key, on Lemon Bay, depart so widely from other species of the genus that they are believed to represent an undescribed form. Length of the body is 12 mm without, 15.5 mm with, caudal tail. The opercular base is marked with closely spaced patches, oval in a transverse direction. The operculum is circular in shape, fixed out of the tube; it consists of about 22 pairs of paleae in the outer row; the middle row contains about 6 long and 6 short paleae on each side, and the inner row has about 11 pairs of them. There are 14 pairs of elongate papillae around the outer base of the crown. Oral tentacles are numerous, more or less tightly coiled, completely fill the area about the buccal cavity and conceal the tapering palpi; the latter are longer and thicker than the oral tentacles but not conspicuous.

The outer opercular paleae are prolonged in their distal portions; they have 2 larger serrations on a side and a minute tooth at the outer base; the middle portion is drawn out as a great serrated membrane (pl.

31, fig. 39). Middle paleae are alternating long and short, the difference between the 2 especially conspicuous (pl. 31, figs. 37, 38); both are somewhat excavate at their thickened part. Inner paleae are unique in that they terminate distally in a serrated edge (pl. 31, fig. 40), especially noticeable when the palea is seen from the back (pl. 31, fig. 41). I know of only 2 other species from the Western Hemisphere in which such a condition has been described; they are *S. bellis* Hansen, as redescribed by Augener (1934, p. 149) from Brazil, and *S. moorei* Monro (1933, p. 1064) from Balboa, Panama. In both of these the outer paleae terminate in comparatively blunt teeth (pl. 30, figs. 24, 27) and the median prolongation is somewhat crenulate; middle paleae are short, excavate, all resembling one another (pl. 30, figs. 25, 28) and the inner paleae are distally serrate (pl. 30, figs. 26, 29). The two are hardly distinguishable from one another from their only known accounts; their identity seems not unlikely.

*S. floridensis* differs from both *S. bellis* and *S. moorei* in having middle opercular paleae alternating long and short instead of a single kind, and outer paleae terminate in a long, serrated membrane.

It is a pleasure to acknowledge thanks to the administration of the Bass Biological Laboratory, Englewood, Florida, for making possible collection of this material.

*Holotype*.—AHF no. 59.

*Type locality*.—Lemon Bay, Florida; intertidal.

*Distribution*.—Lemon Bay, Florida.

### Genus **PHRAGMATOPOMA** Mörch

Type **P. caudata** (Kröyer)

The type of the genus remains incompletely known. Mörch (1863, p. 442) erected the genus, based on "*Serpula caudata* Kröyer," from the West Indies, but it has never been adequately characterized. Ehlers (1901, p. 203) re-examined the type specimen in the museum at Copenhagen and considered it close to *P. virgini* Kinberg; but, since Ehlers did not recognize the genus *Phragmatopoma*, he placed it in *Sabellaria*, saying that the species is readily distinguishable from *P. virgini* in its outer opercular paleae, "die am dorsalen Umfange der Krone mit einem langen, dünnen, rauhen Faden auslaufen, der schon dem unbewaffneten Auge auffällt, und die auf der Fläche des Endblattes stark blättrig rauh sind." This description applies very well to the condition in *P. lapidosa* (below) which Ehlers did not consider in his account. The 2 species are, moreover, possibly the same as already suggested by Johansson (1927, p.

99); without additional information, however, the older name, *P. caudata*, remains a questionable synonym. Ehlers (loc. cit.) was unable to distinguish it from either *P. lapidosa* Kinberg or *P. moerchi* Kinberg, but the latter is a distinct species (see below).

Species of the genus *Phragmatopoma* are not numerous. Most of them originate from intertidal zones of the eastern Pacific and West Indian waters, but they are most conspicuous from western South America. Only one species, *P. californica* (Fewkes), is known from the northeast Pacific. *P. moerchi* Kinberg is shown from the Hawaiian Islands and Chile; *P. lapidosa* Kinberg occurs on both sides of South America, through the West Indian region to southern Florida; *P. virgini* Kinberg is from southernmost South America. In addition, 2 species from western South America are newly described below. *Sabellaria castelnaui* Grube (1870, p. 69), from New Zealand, was redescribed by Augener (1926, pp. 214-215) after re-examination of the original; Johansson (1927, p. 99) referred it to *P. lapidosa* Kinberg. *Sabellaria antipoda* Augener, from New Zealand, was referred to *Phragmatopoma* by Monro (1936, pp. 170-171), but its opercular paleae are unquestionably those of a *Sabellaria*. One other name merits consideration, since it differs from others named above; it was reported as *Sabellaria (Phragmatopoma) virgini* Monro (1933, pp. 1062-1063) from Perlas Islands, Panama, but differs from *P. virgini* Kinberg (below) and other known species of the genus in its outer opercular paleae; I am referring it to *P. attenuata* (below).

*Phragmatopoma* is herein considered to include the following species; 2 are described as new.

1. *P. californica* (Fewkes)
2. ?*P. caudata* (Kröyer) Mörch, questionably *P. lapidosa*
3. *P. lapidosa* Kinberg
4. *P. moerchi* Kinberg
5. *P. virgini* Kinberg
6. *P. attenuata*, new species
7. *P. peruensis*, new species

KEY TO SPECIES OF PHRAGMATOPOMA MÖRCH

- |  |                     |
|--|---------------------|
| 1. Outer opercular paleae with a long, spikelike plume . . . . .                                 | 2                   |
| 1. Outer opercular paleae with a flat, membranous appendage . . . . .                            | 3                   |
| 1. Outer opercular paleae with distal membrane palmately filamentous (pl. 38, fig. 91) . . . . . | <i>P. attenuata</i> |
| 1. Outer opercular paleae without distal appendage (pl. 35, fig. 77) . . . . .                   | <i>P. virgini</i>   |

2. Distal spike pennate (pl. 35, fig. 73) . . . . . *P. lapidosa*
2. Distal spike plumose (pl. 37, fig. 87) . . . . . *P. californica*
3. Larger; tubes coarse; opercular paleae with distal appendage frayed (pl. 35, fig. 76) . . . . . *P. moerchi*
3. Tiny; tubes small, fine; opercular paleae with distal appendage entire (pl. 37, fig. 84) . . . . . *P. peruensis*

### **Phragmatopoma lapidosa Kinberg**

Plate 35, Figs. 73-75; Plate 36, Fig. 79; Plate 40, Figs. 102, 103

?*P. caudata* (Kröyer) Mörch, 1863, p. 442.

Kinberg, 1867, p. 349.

*Sabellaria (Pallasia) castelnaui* Grube, 1870, p. 69; Augener, 1926, pp. 214-216.

*Sabellaria fauveli* Gravier, 1909, pp. 650-654, pl. 18, figs. 60-69.

Johansson, 1926, p. 2; 1927, pp. 99-100.

*Centrocorone spinifera* Treadwell, 1939, pp. 1-3, figs. 1-9; 1939, pp. 307-309, fig. 118.

*Collections.*—A 20-39 (3); A 25-39 (1).

*Other materials examined.*—Type specimen, Swedish Museum (no. 921). The following at the U.S. National Museum: Itajahy, St. Catharina, Brazil, coll. H. Lüderwaldt in 1919 (6+); east of Gaulliè, Florida, shore, coll. E. M. Kindle, Dec. 10, 1938 (10+); Miami Beach, Florida, shore, coll. Capt. Frank O. Bowman, July, 1936 (20+); ocean jetty near Norris Cut, connecting Biscayne Bay with Atlantic, about 3½ mi. east of Miami, Florida, coll. E. Bursten Thomson (tube masses); from rocks near Praia, São Francisco, Brazil, shore, coll. W. L. Schmitt, Oct. 1926 (tube masses); Conto do Rio, Brazil, shore, coll. W. L. Schmitt, Aug. 1925 (1+).

*P. lapidosa* has been redescribed by Johansson (1927, pp. 99-100) and clearly distinguished from other species. The opercular crown is more or less circular, flattened; outer paleae are characteristic, having a long, conspicuous, pinnate plume, arising some distance from the upper distal edge of the palea (pl. 35, fig. 73). The opercular crown and stalk, from the right side, are shown in pl. 36, fig. 79; from the front, the crown is more or less circular, flattened. There are about 10 rows of oral tentacles. Palpi are long, slender, tentacular. Abdominal tori, from about the fourteenth abdominal segment, are very long. Total number of abdominal segments is 32 or more.

*P. lapidosa* may be an important agent in constructing sandy reefs in warmer parts of the west Atlantic; from Brazil, north to Miami, Florida,

it is known through large masses of concreted sandy tubes. It may be significant in preventing shifting of large sand masses along shore, or even in shore-building.

*Centrocorone spinifera* Treadwell (1939, pp. 1-3, figs. 1-9) was recently newly described from Puerto Rico. Although *Centrocorone* Grube has long been considered a synonym of *Sabellaria* Lamarck, I believe that this species belongs not to the latter, but rather to *Phragmatopoma*, and that it is probably identical with *P. lapidosa* Kinberg. The operculum was described as disk-shaped, dark brown, as typical of species of *Phragmatopoma*, but was said to have only 2 kinds of paleae. It seems likely that the innermost row, which is normally concealed and not visible save by dissection, might have been overlooked. The outer paleae are shown to have the long, slender plume, as in *P. lapidosa*. The given range (Puerto Rico) falls well within that of the older species.

Johansson (1927, p. 99) has already identified both *Sabellaria fauveli* Gravier and *S. castelnaui* Grube, as redescribed by Augener (1926) to *P. lapidosa*. *P. caudata*, the type of the genus, is too inadequately known to permit comparison.

*Distribution*.—Brazil; West Indian seas, north to Miami, Florida; Peru.

### ***Phragmatopoma californica* (Fewkes)**

Plate 29, Figs. 15-17; Plate 37, Figs. 86-89; Plate 41, Fig. 105

*Sabellaria californica* Fewkes, 1889, pp. 130-132, pl. 7, figs. 3, 4; Moore, 1909, pp. 293-294, fig. 6; Treadwell, 1914, p. 227; Chamberlin, 1918, p. 180; Hilton, 1918, p. 62; Chamberlin, 1919, p. 261; Berkeley, 1941, p. 50.

*Collections*.—901-38 (8); 904-38 (5); 912-39 (tubes); 913-39 (2); 1189-40 (tubes); 1193-40 (tubes); 1206-40 (tube); 1208-40 (many); 1209-40 (many); 1218-40 (many); 1221-40 (many); 1222-40 (2); 1284-41 (several); 1367-41 (several); 1370-41 (several); 1398-41 (many); 1406-41 (several); 1431-41 (2).

Mature specimens are usually marked with considerable dark pigment. The opercular stalk may be heavily streaked with oblique black stripes but is never spotted as is *Sabellaria cementarium* (above), with which it sometimes occurs. Ripe females are purple in the ovigerous region, mature males are white. The outer opercular paleae are conspicuously scabrous, covered on their upper side with minute scales; distally they terminate in a heavy recurved tooth on one side (toward the ventrum) and a frayed membrane on the other (toward the dorsum);

a heavy plume arises from a deep cleft between them (pl. 37, fig. 87). In lateral view the plume is seen to be directed nearly at right angles to the plane of the shaft (pl. 37, fig. 86). Middle opercular paleae (pl. 37, fig. 88) are also roughened on their outer surface; they are heavy, dark brown, with thick outer edge making up the outer part of the cone. Inner paleae, completely covered by the middle ones, are very much smaller, pale, the distal end thin and frayed out (pl. 37, fig. 89).

*P. californica* constructs sandy reefs in intertidal zones along many parts of southern and central California; it is often associated with a reef-building vermetid mollusk, *Aletes squamigerus* Carpenter. When removed from their tubes, they are unable to reconstruct them, but are capable of repairing damaged ones. Typically, a single individual occupies one tube, but those of a colony are so closely intertwined that the limits of any one are difficult to discern.

*Distribution*.—California, south to Ensenada, Lower California; intertidal to about 40 fms.

### **Phragmatopoma moerchi** Kinberg

Plate 35, Fig. 76; Plate 36, Figs. 80-83; Plate 39, Figs. 97, 98

Kinberg, 1867, p. 349.

*Sabellaria virgini* Ehlers, 1901, pp. 199-203, pl. 23, figs. 1-4, 7-12, pl. 24, figs. 1-5 (in part) (not Kinberg).

?*Hermella orbifera* Ehlers, 1901, p. 267.

Johansson, 1926, pp. 4-5; 1927, pp. 101-102.

*Collections*.—288-34 (many); 829-38 (1); 831-38 (4); 832-38 (1); 847-38 (1).

*Other materials examined*.—Type specimen, Swedish Museum (no. 922, Hawaii). At the U.S. National Museum, coll. by W. L. Schmitt: Salaverry, Peru (1); Chañaral, Chile, shore (5); Talcahuano, Chile (1).

The following is based on the type specimen. The flat opercular crown is nearly circular, seen from the front. Middle paleal tips come together only slightly off center. Outer opercular paleae are largely covered by minute scales on the surface directed forward; the distal end has a characteristic thin, rectangular flange, arising from a crescentic notch; its free end is more or less frayed (pl. 35, fig. 76). Middle paleae, making up the flat surface of the cone, are dark brown and transversely rugose, appear scabrous. Inner paleae are much smaller in size, completely concealed from view by the middle paleae; they are also slightly roughened on their outer side.

Collections from Chile and Peru compare favorably with the type from Hawaii. An anterior end, in right lateral view, is shown in pl. 36, fig. 80. Outer (pl. 36, fig. 81), middle (pl. 36, fig. 83), and inner (pl. 36, fig. 82) paleae are typical.

Ehlers (1901, pp. 199-203, pls. 23, 24) described as *P. virgini* some specimens which are undoubtedly representatives of *P. moerchi*. The description, moreover, indicates that more than one species is involved, as may be seen by comparing the figures on his plate 23 (cf. figs. 3, 4, as against figs. 5, 6). The outer opercular paleae (Ehlers' pl. 23, fig. 11) are seemingly those of *P. moerchi*, and obviously not *P. virgini* (below), since they have a terminal flange. Ehlers says, in part, of these paleae,—“Die messingelben äusseren Paleen tragen auf dem in der Haut steckenden dünnen und schlanken Stiel eine im Winkel dazu nach aussen gebogene Endplatte, die etwa dreimal breiter als lang ist [This should probably read longer than broad], wie eine Wurfschaufel gehöhlt, mit parallelen Seitenrändern, am Endrande mit einigen Seitenzähnen versehen, die ein schmäleres vorspringendes rechteckiges Endblatt umgeben, das am freien Rande sägeartig gezähnt ist.” In *P. virgini* there is no terminal plate (pl. 35, fig. 77) such as is present in *P. moerchi* (pl. 35, fig. 76).

*Distribution*.—*P. moerchi* ranges in tropical and subtropical eastern Pacific, from Peru to Chile, west to Hawaii. It is intertidal to 15 fms.

### **Phragmatopoma virgini** Kinberg

Plate 35, Figs. 77, 78

Kinberg, 1867, p. 349; 1910, pp. 70-71, pl. 27, fig. 4.

Johansson, 1926, p. 2; 1927, p. 100.

*Not Sabellaria virgini* Ehlers, 1901, pp. 199-203, *nor* Monro, 1933, p. 1062.

*Material examined*.—Type specimen, Swedish State Museum (no. 923), from southern Chile.

The following comments are based on the type specimen, from southern Chile. Outer opercular paleae have only 2 main teeth along their outer, distal margin, without dentations or a flange between them (pl. 35, fig. 77). The concave edge between these 2 teeth is thin, membranous, with no indication that there ever was an attached flange or other structure. The upper surface is weakly striated but not at all scabrous as in *P. moerchi* (above). Middle opercular paleae (pl. 35, fig. 78) are comparatively smooth, much finer than comparable ones in *P. moerchi*. The opercular cone, seen from the top, is subcircular, but the middle paleal

tips come together somewhat off center. Abdominal uncini have typically 6 teeth, seen from the side.

*P. virgini* was originally described from the Strait of Magellan. Later, Ehlers (1901, pp. 199-203) described at length some specimens which cannot be ascribed to *P. virgini* Kinberg, since the outer opercular paleae differ (see *P. moerchi*, above). *Sabellaria* (*Phragmatopoma*) *virgini* Monro (1933, pp. 1062-1063, fig. 11) is similarly not *P. virgini* Kinberg, but appears to differ from others; I am referring it herein to *P. attenuata* (below).

*Distribution*.—*P. virgini* is known only from southern Chile, in the vicinity of the Strait of Magellan; it is intertidal.

### ***Phragmatopoma attenuata*, new species**

Plate 38, Figs. 90-96; Plate 39, Figs. 100-101

?*Sabellaria virgini* Ehlers, 1901, p. 199, pl. 23, figs. 5, 6 (in part).

*Sabellaria* (*Phragmatopoma*) *virgini* Monro, 1933, pp. 1062-1063, fig. 11 (not Kinberg).

*Collections*.—10-33 (many); 15-33 (several); 229-34 (5); 403-35 (many).

*Other materials examined*.—At the U.S. National Museum, collected by Dr. W. L. Schmitt: Salinas, Ecuador, shore (many); south side of St. Elena Point, Ecuador, shore (several).

The opercular crown is high, conical, asymmetrical in lateral view (pl. 38, fig. 90), the dorsal paleae directed toward the ventral side so that their free ends approach one another ventrally. Mature individuals attain a length of about 35 mm; body width is about 4 mm. The abdominal region is usually closely speckled with black spots. Opercular paleae in the outer row number about 22-25 or at most 38-40 pairs; those of the middle and inner rows number 12 to 19 pairs each. Oral tentacles are arranged in about 12 to 14 rows. There are 2 anterior thoracic and 3 parathoracic segments, as typical of the genus. Abdominal setigers number about 31. The caudal tail is smooth, cylindrical, about as long as the last 8 to 10 setigerous segments.

Outer opercular paleae are unique in the character of their distal appendage; it consists of a palmately filamentous membrane, directed nearly at right angles to the main shaft (pl. 38, figs. 91, 92); the shaft itself has a strong, recurved tooth on the side facing ventral and is weakly scabrous on its upper surface (pl. 38, fig. 96). Middle opercular paleae are dark brown, resemble one another save that those on the dorsal side (pl. 38, fig. 93) are notably larger and stronger than those on the ventral

side (pl. 38, fig. 94). Inner paleae are pale, completely concealed from view by the middle paleae; they are thin, frayed out, at their distal ends (pl. 38, fig. 95). The opercular crown is externally bounded by 39 to 40 short, broad papillae, separated middorsally by a short space.

The palpi are to be seen only by lifting the oral tentacles to one side; they are short, cirrate. The parathoracic segments are provided, on either side, with flattened paleae, numbering about 6, 6 and 7, proceeding from anterior to posterior regions; the first set is smaller than those following.

Tube masses are constructed of sand particles, shell, or other flattened fragments. The galleries are about 30 to 50 mm long, but irregular because of massing. The great extent of tube masses in intertidal zones may be seen by comparison of the photographs in plate 42.

*P. attenuata* differs from other species of the genus in its slender, prolonged, opercular stalk and crown, in the obliquely disposed opercular paleae, and in the distal appendage of the outer paleae.

*Sabellaria virgini* Ehlers (1901, p. 199, pl. 23, figs. 5, 6) may belong here. There are 2 statements in the text that appear to refer to these specimens: (1901, p. 199) "die Buccalstrecke . . . ausgedehnt dreimal länger als breit," and on the next page, "diese Krone tragende Buccalstreck ist . . . bald langsgestreckt." The long, attenuate shape of the opercular stalk is characteristic of *P. attenuata*. *Sabellaria (Phragmatopoma) virgini* Monro (1933, pp. 1062-1063, fig. 11) from Perlas Islands, Panama, probably also belongs here, since the outer opercular palea is said to have a pectinate plume and is shown with a long-toothed brush at the end. The distal end of the shaft, however, is shown merely rounded, without teeth, and no mention is made of the unique, high cone, formed by the paleae of the middle series.

*Holotype*.—AHF no. 60.

*Type locality*.—La Libertad, Ecuador (coll. 15-33).

*Distribution*.—Ecuador; Colombia; ?Pacific side of Panama. Intertidal.

### ***Phragmatopoma peruensis*, new species**

Plate 37, Figs. 84, 85; Plate 39, Fig. 99; Plate 41, Fig. 104

*Materials examined*.—At the U.S. National Museum, collected by Dr. W. L. Schmitt: Salaverry, Peru, shore (tube masses).

A fine, black, cindery mass, consisting of many tubes closely cemented together (pl. 41, fig. 104) with minute apertures over its surface, was found to contain minute specimens of a *Phragmatopoma*, believed new. The tiny, slender individuals are pale, with light brown crown. Total length (mature) is only 8 to 9.5 mm with caudal tail, measuring 1.5 mm long. Greatest width, in the thoracic region, is 0.75 mm (based on speci-

men killed in tube). The thorax consists of 2 anterior segments, in which the first seems to lack setae; the second is provided with capillary setae, as typical of the genus. The 3 parathoracic segments have paleae in notopodia and slender, though similar, setae in neuropodia. The abdomen consists of about 26 setigers. Uncinigerous tori of the first 10 pairs are broader than long; after that they are increasingly longer and narrower.

The opercular crown is conical, asymmetrical, but less so than in *P. attenuata* (above). The outer row of paleae number about 25 on a side; the middle row consists of about 9 pairs, slightly transversely striated on the external surface; the inner, concealed paleae, numbering about the same as those of the middle row, are pale, inconspicuous. Outer paleae are unique in that the shaft is provided with terminal membrane that is long, spatulate, distally rounded (pl. 37, fig. 84), thin and smooth in texture; normally this appendage is curved inward so that it is directed toward the center of the cone on the exposed surface; in the figure it has been straightened out. The shaft itself terminates in a hard, strong tooth on one side (toward its ventral end) and a similar, though softer, tooth on the opposite side (pl. 37, fig. 84); the shaft is weakly striated and delicately toothed on one edge. Paleae of the middle series, forming the outer surface of the cone, are characteristic for having a long shoulder (pl. 37, fig. 85) making up the outer rim of the crown; the exposed surface is weakly striated. Inner paleae are similar to the outer ones, but are much weaker and smaller and are more or less frayed out at their distal end.

The outer base of the opercular crown is surrounded by about 42 low papillae, forming a low fold that is more or less excavate in the middorsal line but continuous all around. Oral tentacles are present, arranged in 6 to 8 crowded rows on a side. Palpi are slender, inconspicuous, to be seen only by laying the oral tentacles to one side; they resemble the oral tentacles but are only about two thirds as long. Abdominal uncini, in lateral view, have 5 teeth, but in frontal view they are seen to occur in double rows, as typical of the genus.

The tubes are constructed of fine, black sand, closely cemented together, the outlines of individuals not discernible.

*P. peruensis* differs from other species of the genus in its extreme small size, adult individuals measuring less than 10 mm long; outer opercular paleae have an attached membrane that is broadly rounded, entire, and the middle paleae have a conspicuous shoulder at their external edge.

*Holotype*.—U.S. Nat. Mus., no. 20561; paratype in AHF.

*Type locality*.—Salaverry, Peru.

*Distribution*.—Peru. Intertidal.

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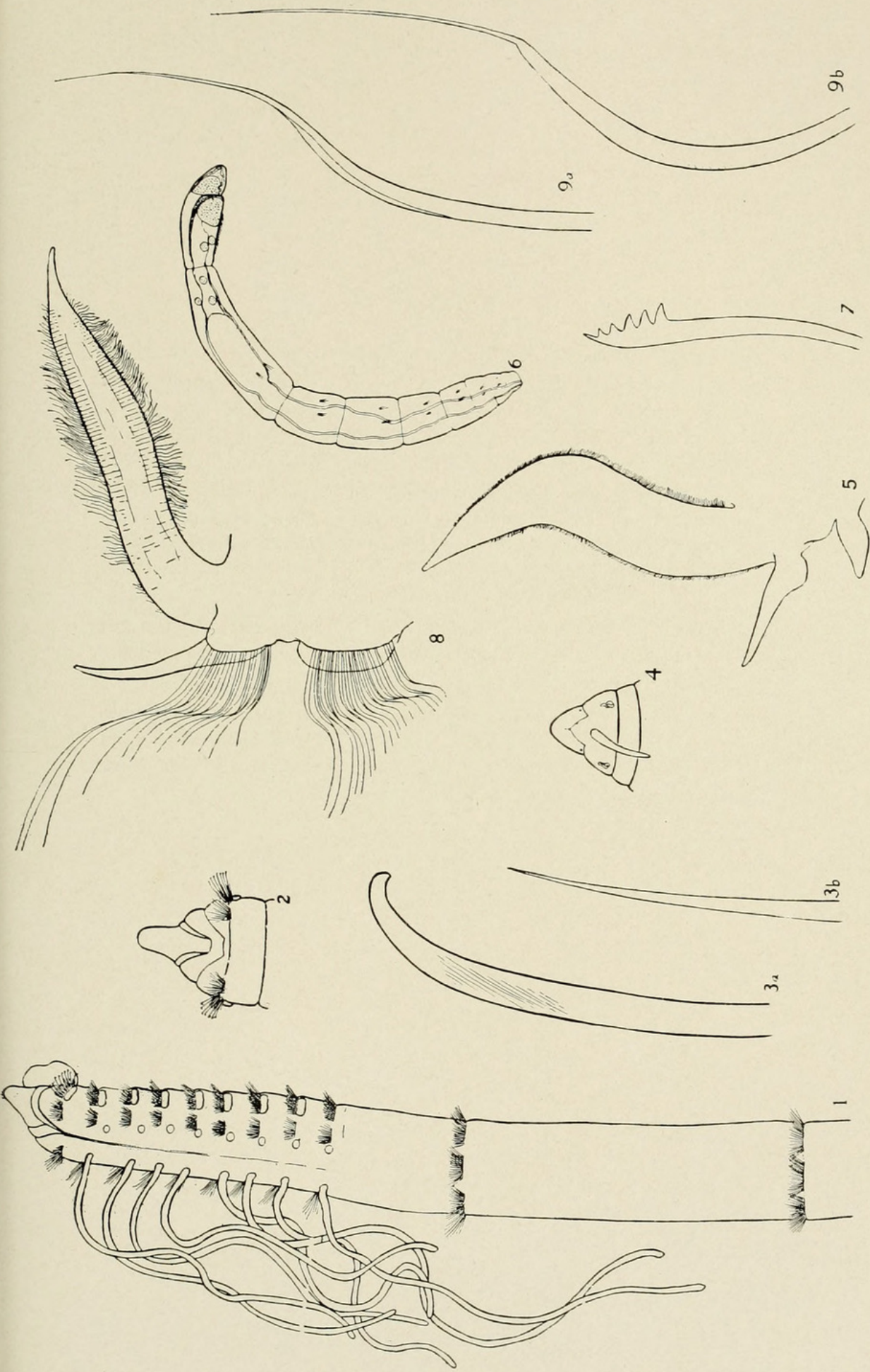
## PLATE 27

Figures 1-3, *Longosoma catalinensis*: Fig. 1, anterior end, in dorso-lateral view, with tentacles from right side removed, proboscis everted, x 12; Fig. 2, anterior end, including first setigerous segment, in dorsal view, to same magnification; Fig. 3a, one of heavy, curved hooks from first neuropodium, greatly enlarged; Fig. 3b, tip of a pointed seta from same fascicle, to same magnification.

Figures 4, 5, *Aricidea fragilis*: Fig. 4, anterior end in dorsal view, enlarged; Fig. 5, thirty-second parapodium with branchia, dorsal cirrus, and postsetal neuropodial lobe, x 58.

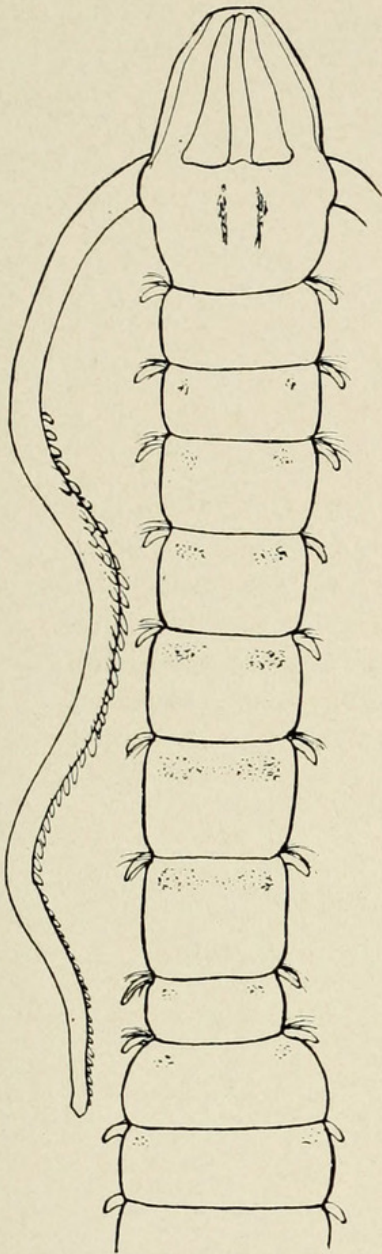
Figures 6, 7, *Ctenodrilus serratus*: Fig. 6, entire animal, in right lateral view, x 126; Fig. 7, seta from a postmedian segment, greatly enlarged.

Figures 8, 9, *Aricidea pacifica*: Fig. 8, seventeenth parapodium in anterior view, setae indicated, x 58; Fig. 9a, limbate notoseta from same parapodium, x 241; Fig. 9b, neuroseta from same parapodium, to same magnification.

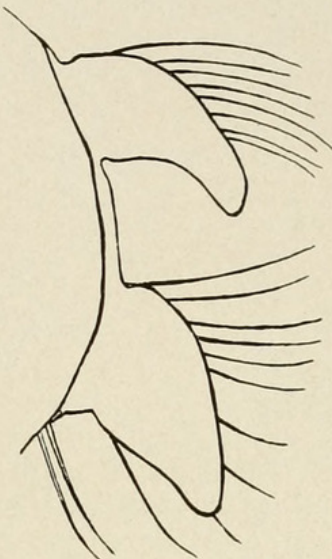


## PLATE 28

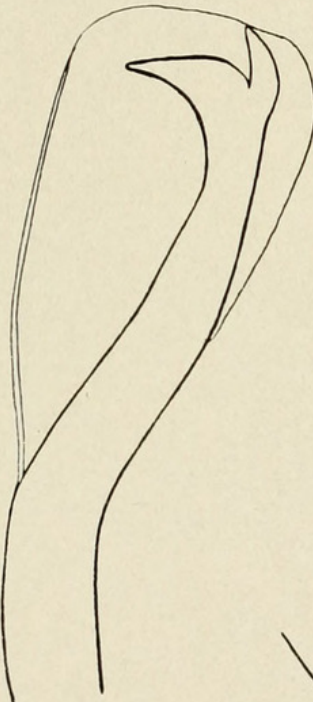
Figures 10-14, *Magelona californica*: Fig. 10 (903-38) anterior end, in dorsal view, including first 11 segments, x 30; Fig. 11, posterior end from same specimen, showing last 2 segments, anal ring with paired cirri and aperture, x 30; Fig. 12, ninth parapodium in posterior view, lamellae and position of setae indicated, x 30; Fig. 13, nineteenth parapodium with interramal lamellae and position of uncini indicated, x 30; Fig. 14, hooded hooks from same segment, showing relations of main and accessory teeth, x 957.



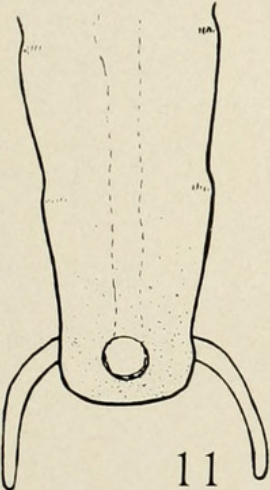
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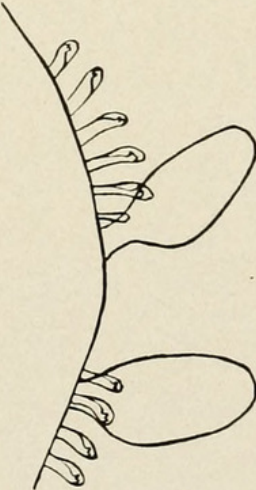
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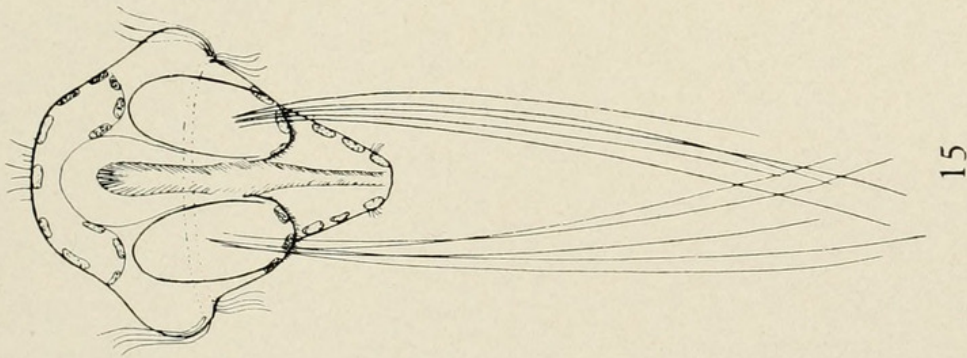
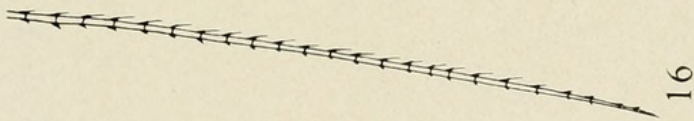
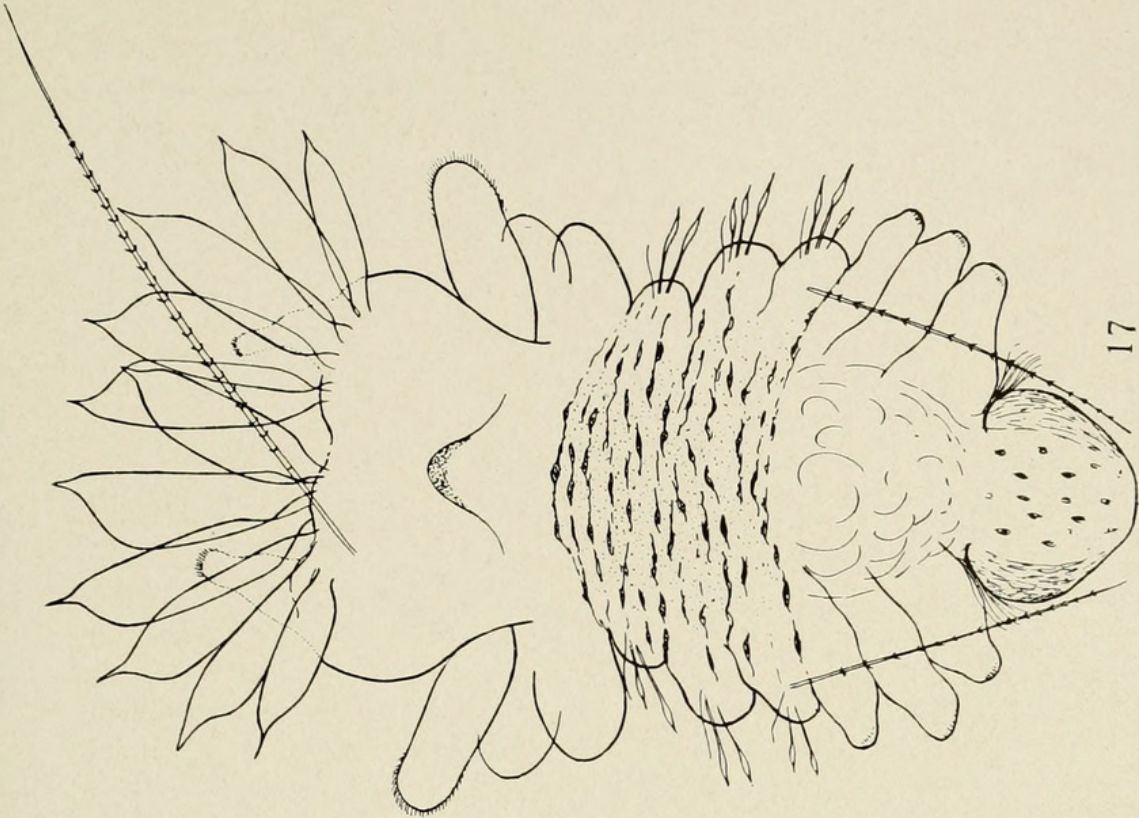
11



13

## PLATE 29

Figures 15-17, *Phragmatopoma californica*: Fig. 15, 3-day-old larva, showing distribution of pigmentation, setal sacks, ciliated alimentary tract, and swimming setae; Fig. 16, tip of larval, swimming seta; Fig. 17, metamorphosing larva, in dorsal view, with setal sacks permanently pushed forward, all but one larval seta replaced by opercular paleae, but with a pair of transitional spinous setae in the last thoracic segment, and with 3 abdominal segments preceding the thick caudal region.



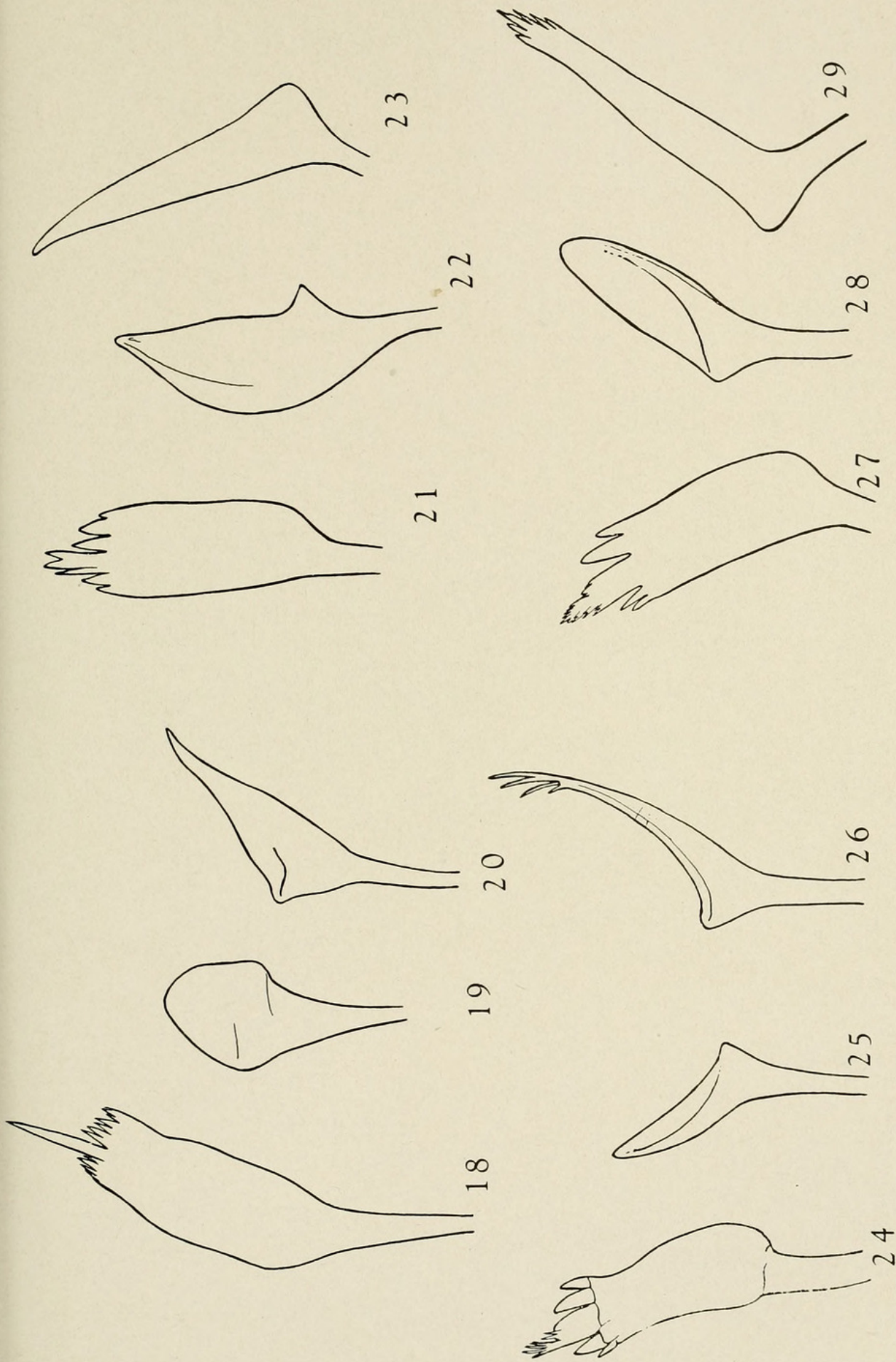
## PLATE 30

Figures 18-20, *Sabellaria nanella* (after Hartman, 1938): Fig. 18, outer opercular palea; Fig. 19, middle opercular palea; Fig. 20, inner opercular palea.

Figures 21-23, *Sabellaria fissidens* (after Ehlers, 1901): Fig. 21, outer opercular palea; Fig. 22, middle opercular palea; Fig. 23, inner opercular palea.

Figures 24-26, *Sabellaria moorei* (after Monro, 1933): Fig. 24, outer opercular palea; Fig. 25, middle opercular palea; Fig. 26, inner opercular palea.

Figures 27-29, *Sabellaria bellis* (after Augener, 1934): Fig. 27, outer opercular palea; Fig. 28, middle opercular palea; Fig. 29, inner opercular palea.



## PLATE 31

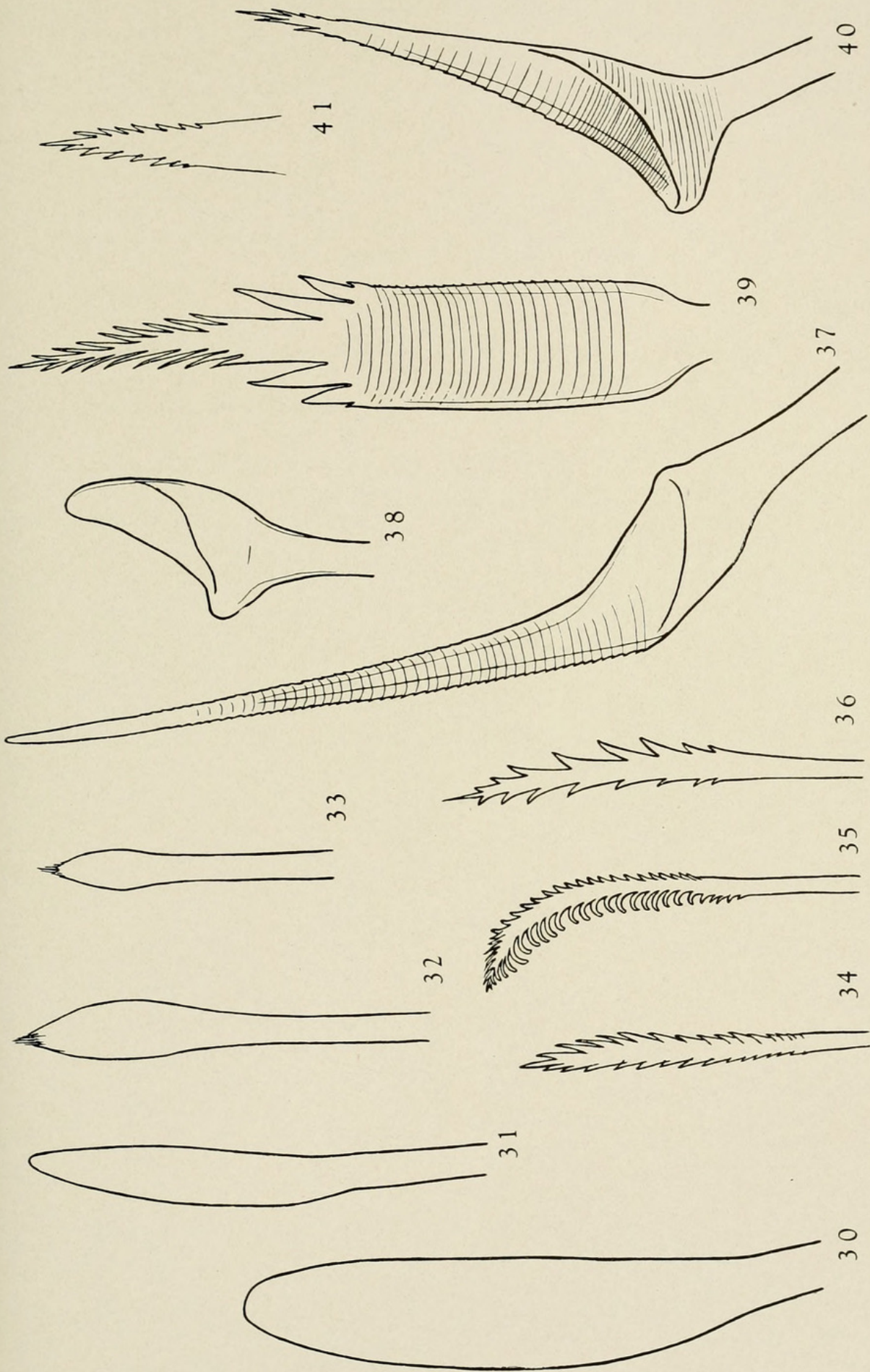
Figures 30-33, *Lygdamis asteriformis*: Fig. 30, outer palea from type of *Hermella varians* from Hawaii; Fig. 31, same, from specimen from Puerto Rico; Fig. 32, thoracic palea from the first; Fig. 33, thoracic palea from the second.

Figure 34, *Idanthysus ornamentatus*: opercular palea.

Figure 35, *Idanthysus pennatus*: opercular palea.

Figure 36, *Idanthysus armatus*: opercular palea.

Figures 37-41, *Sabellaria floridensis*: Fig. 37, long palea from middle of opercular series; Fig. 38, its alternating short palea; Fig. 39, distal part of outer opercular palea from upper side; Fig. 40, inner palea from side; Fig. 41, tip of inner palea from upper side (figs. 37-41 to same magnification).

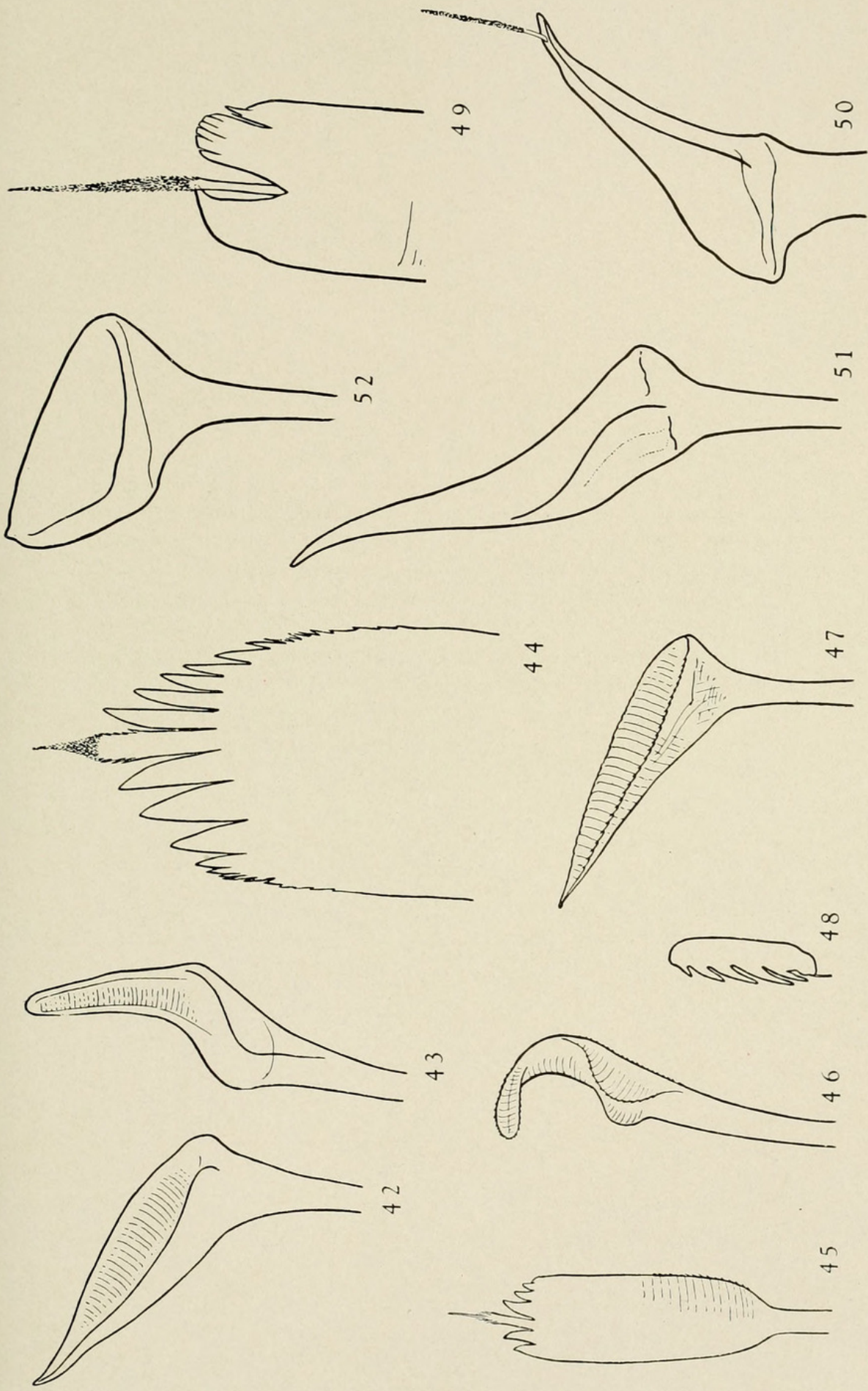


## PLATE 32

Figures 42-44, 48, *Sabellaria vulgaris*: Fig. 42, inner opercular palea; Fig. 43, middle opercular palea; Fig. 44, distal end of outer opercular palea, showing serrated edge and penicillate spike; Fig. 48, abdominal uncinus from the side.

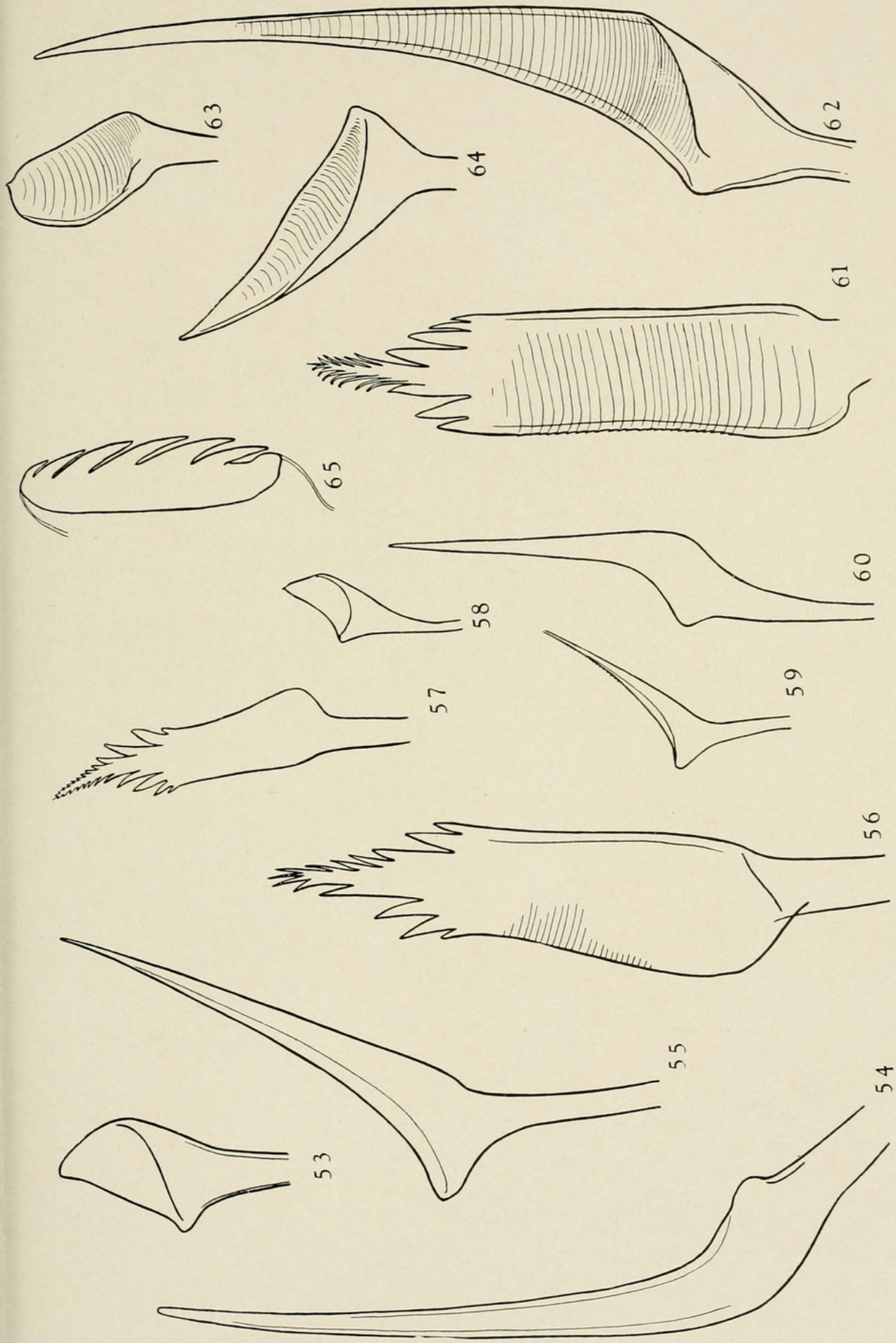
Figures 45-47, *Sabellaria vulgaris beaufortensis*: Fig. 45, outer opercular palea from the top; Fig. 46, middle opercular palea; Fig. 47, inner opercular palea (figs. 45-47 to same magnification).

Figures 49-52, *Sabellaria cementarium*: Fig. 49, distal end of outer opercular palea, showing penicillate spike; Fig. 50, outer opercular palea from side, showing insertion of spike; Fig. 51, middle opercular palea; Fig. 52, inner opercular palea (figs. 49-52 to same magnification).



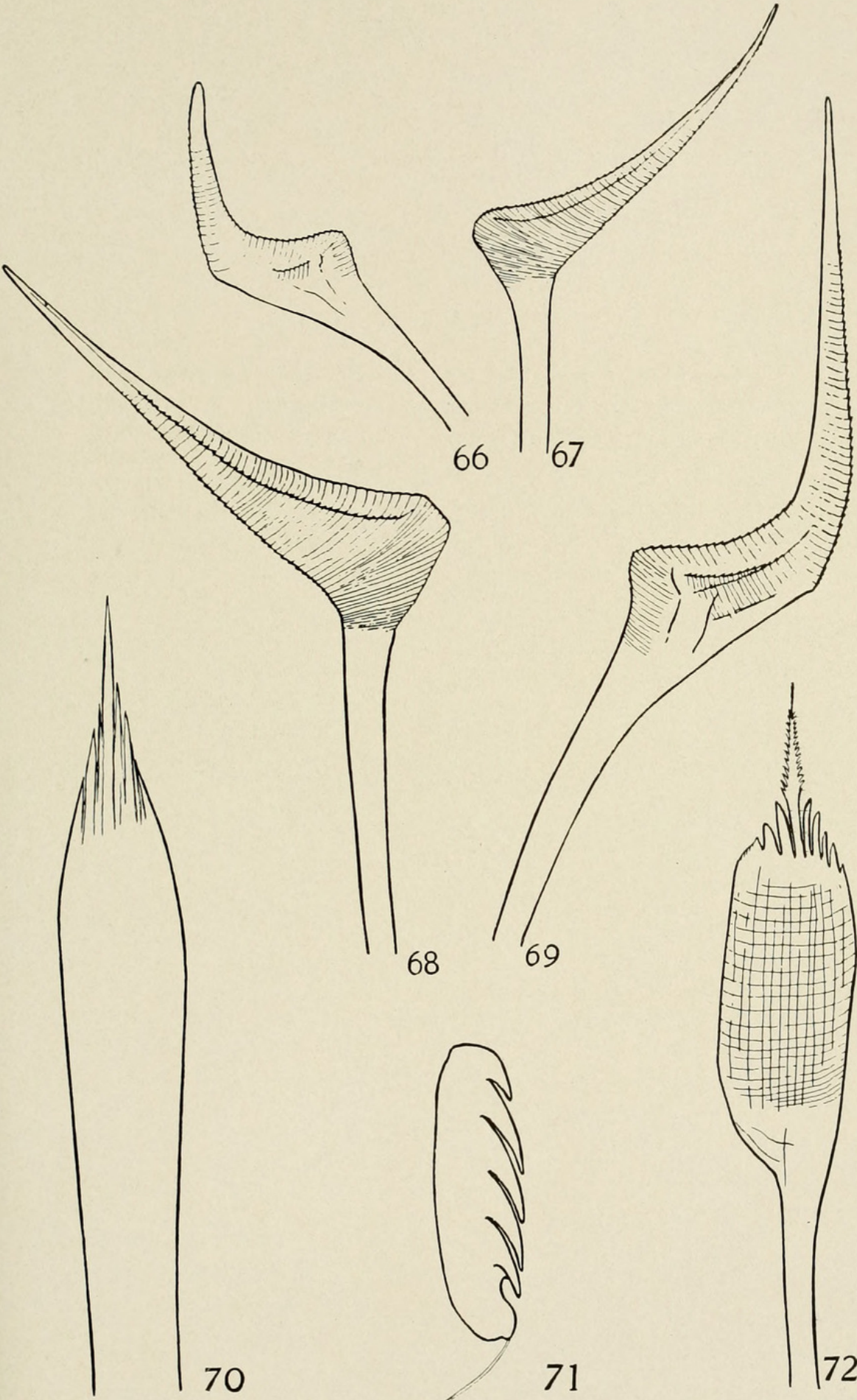
## PLATE 33

Figures 53-65, *Sabellaria bella* (Figs. 53-56 based on specimen from Beaufort; Figs. 57-60 from Augener, based on type from Brazil; Figs. 61-65 based on individual from Peru): Fig. 53, short middle opercular palea; Fig. 54, alternating long middle opercular palea; Fig. 55, inner opercular palea; Fig. 56, outer opercular palea (figs. 53-56 to same magnification); Fig. 57, outer opercular palea; Fig. 58, short middle opercular palea; Fig. 59, inner opercular palea; Fig. 60, alternating long middle opercular palea; Fig. 61, outer opercular palea; Fig. 62, long middle opercular palea; Fig. 63, short middle opercular palea; Fig. 64, inner opercular palea (figs. 61-64 from same individual to same magnification); Fig. 65, abdominal uncinus from side, greatly enlarged.



## PLATE 34

Figures 66-72, *Sabellaria gracilis*: Fig. 66, middle opercular palea with blunt tip; Fig. 67, inner opercular palea from same individual and position; Fig. 68, inner opercular palea from another, larger individual; Fig. 69, its corresponding middle palea (figs. 66-69 to same magnification); Fig. 70, thoracic palea; Fig. 71, abdominal uncinus, greatly enlarged; Fig. 72, outer opercular palea from a larger individual, enlarged as for Fig. 68.



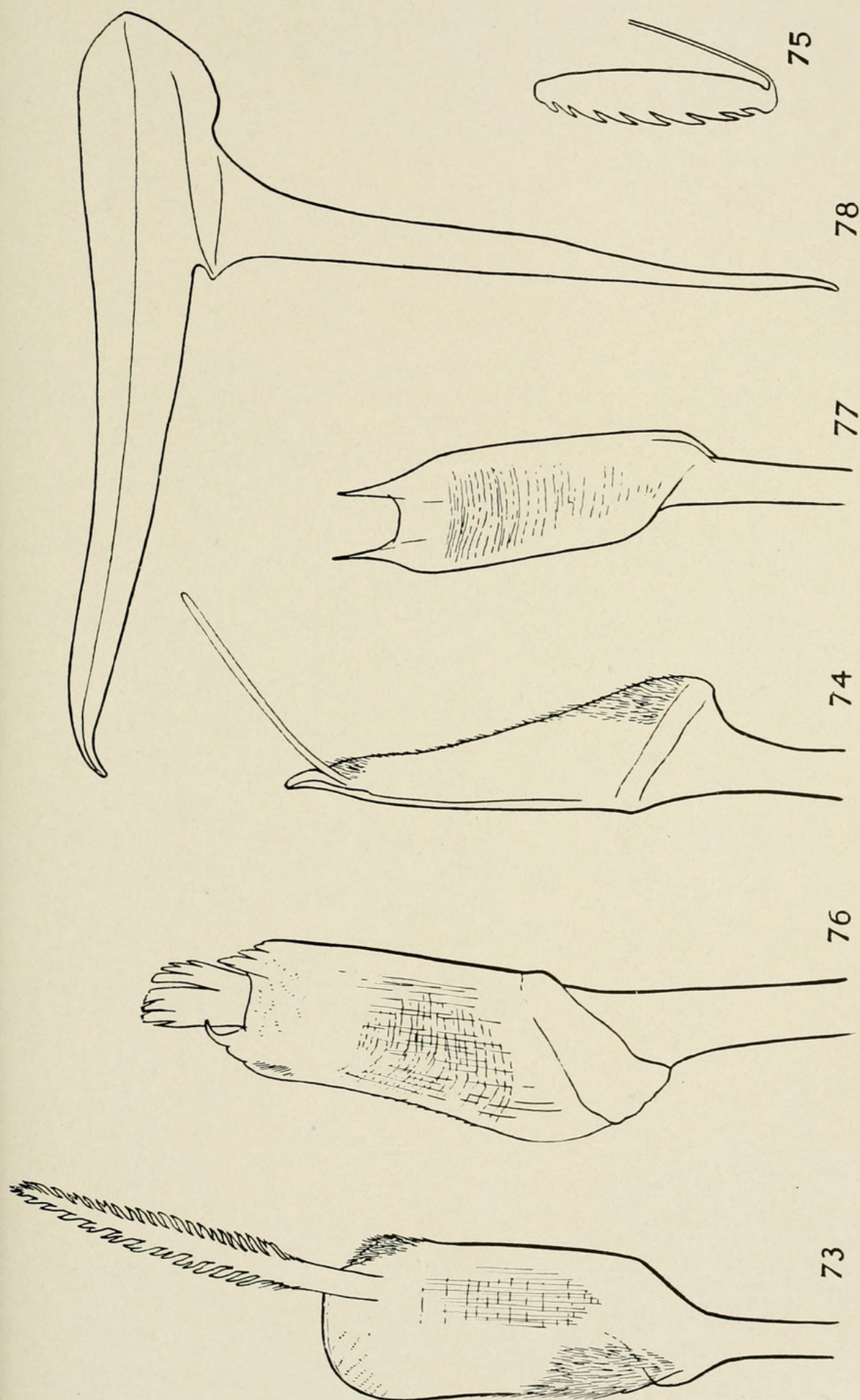
## PLATE 35

(Figures 73 to 78 made from types in the Swedish State Museum.)

Figures 73-75, *Phragmatopoma lapidosa*: Fig. 73, outer opercular palea; Fig. 74, same, from side; Fig. 75, abdominal uncinus.

Figure 76, *Phragmatopoma moerchi*: outer opercular palea.

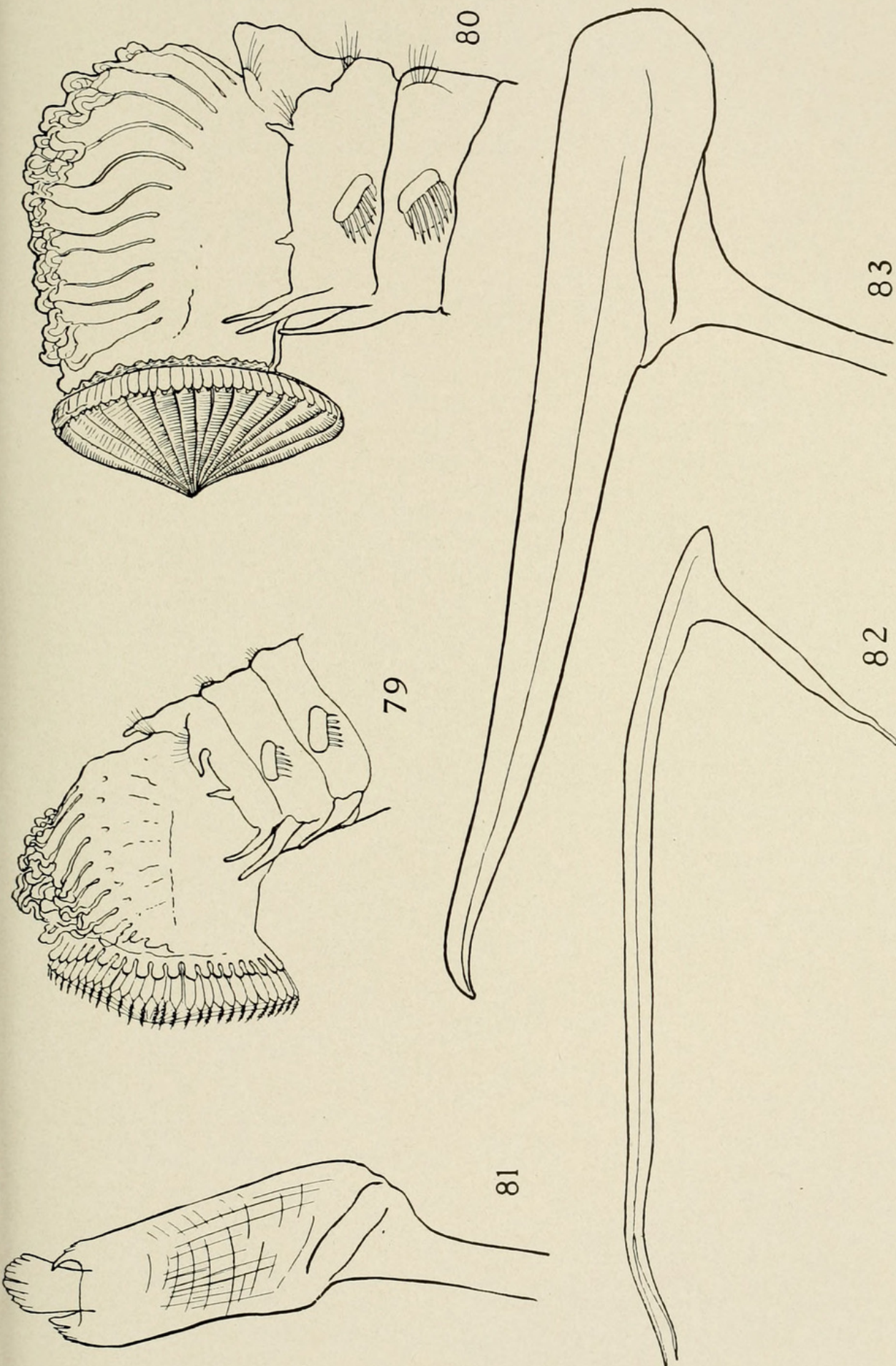
Figures 77, 78, *Phragmatopoma virgini*: Fig. 77, outer opercular palea; Fig. 78, middle opercular palea.



## PLATE 36

Figure 79, *Phragmatopoma lapidosa*: anterior end, from right side.

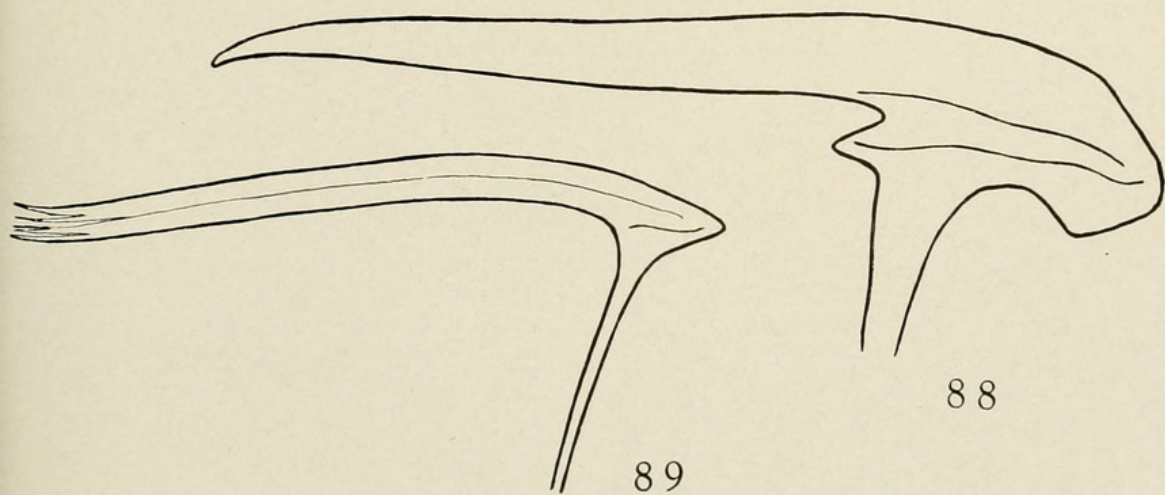
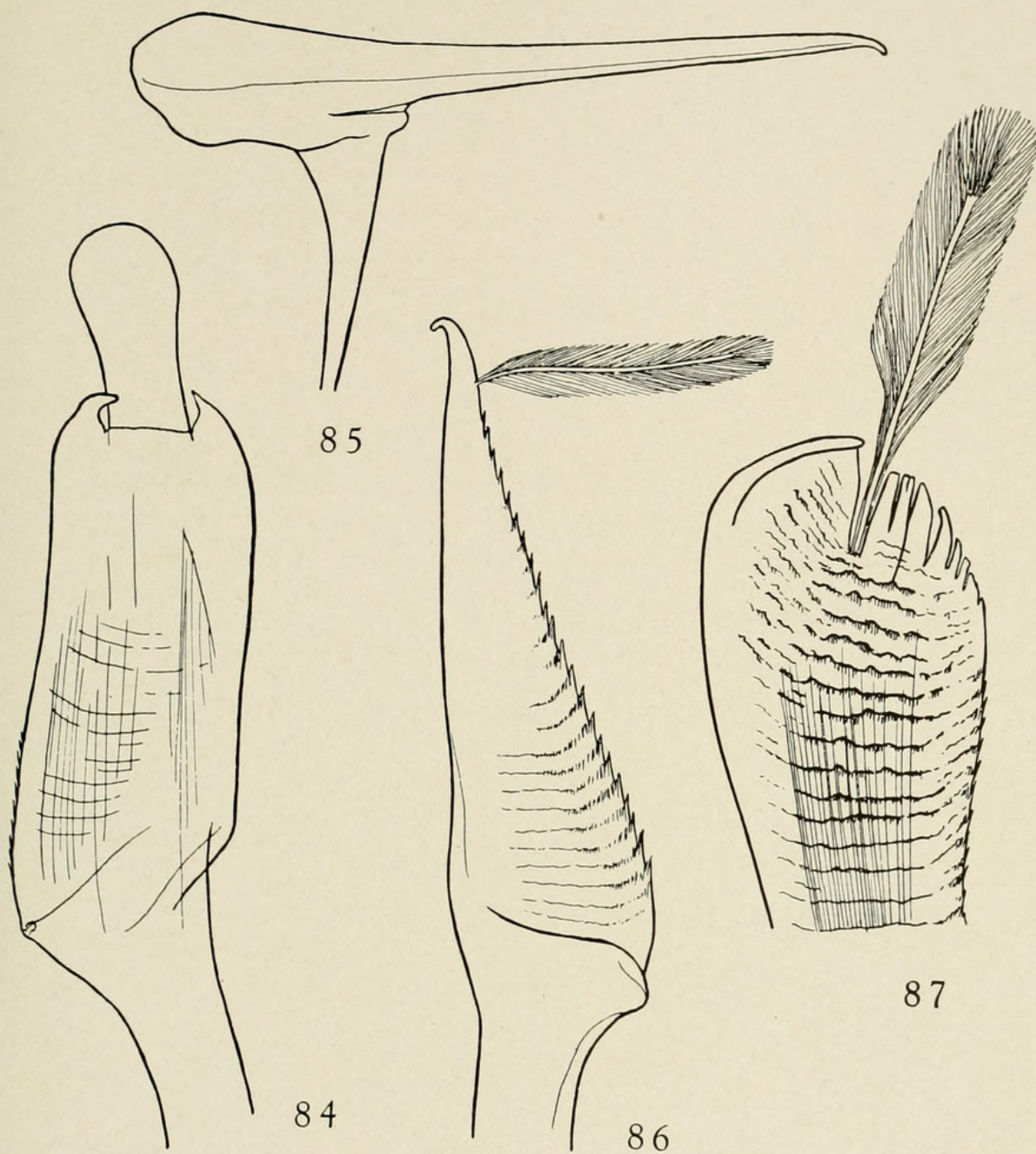
Figures 80-83, *Phragmatopoma moerchi*: Fig. 80, anterior end, from right side; Fig. 81, outer opercular palea; Fig. 82, inner opercular palea; Fig. 83, middle opercular palea.



## PLATE 37

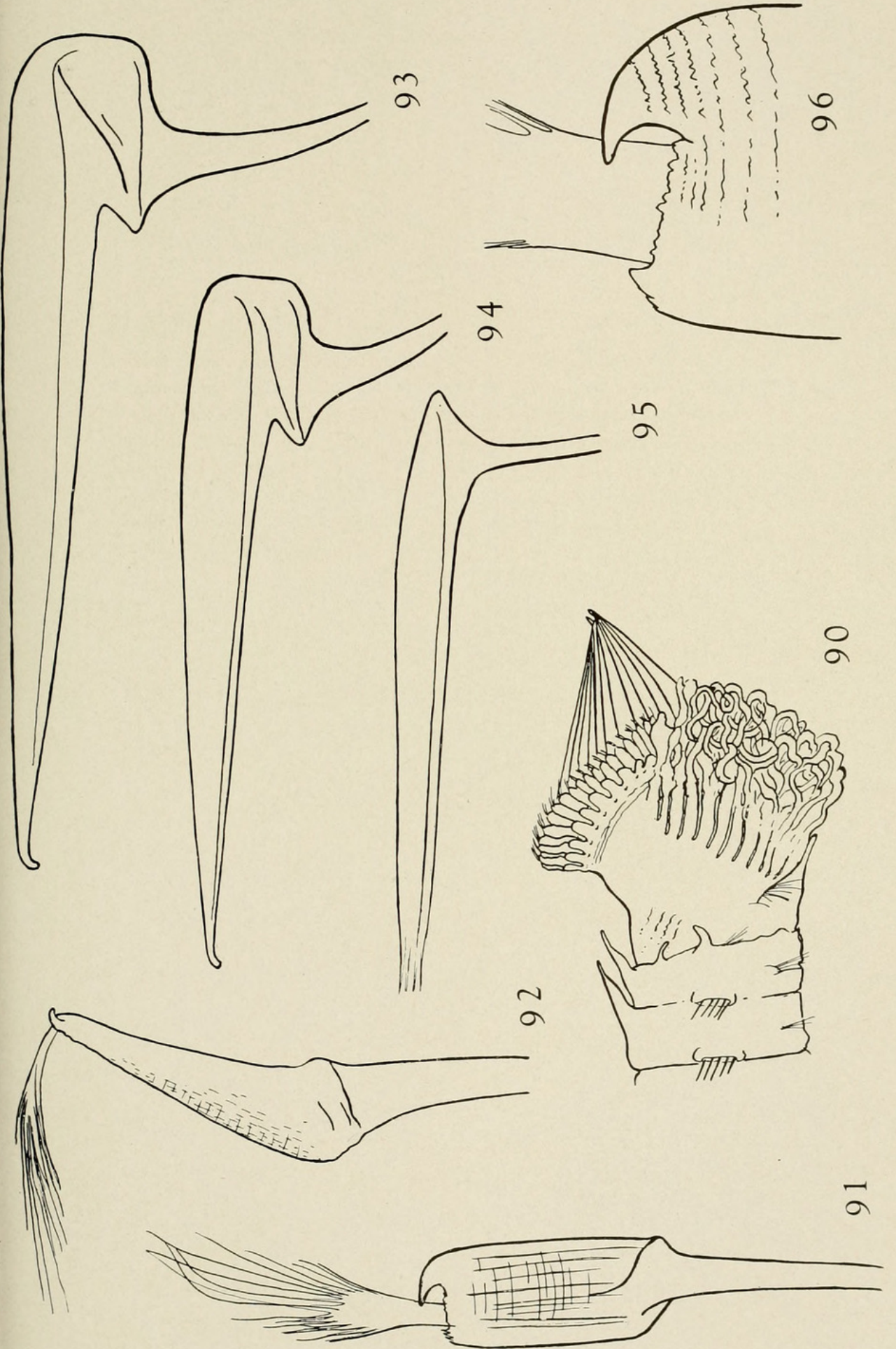
Figures 84, 85, *Phragmatopoma peruensis*: Fig. 84, outer opercular palea, the distal flange straightened out from a recurved position; Fig. 85, middle opercular palea.

Figures 86-89, *Phragmatopoma californica*: Fig. 86, outer opercular palea from the side, with appendage in normal position; Fig. 87, distal end of outer palea with plumose appendage, showing scabrous upper surface; Fig. 88, middle opercular palea; Fig. 89, its companion inner palea.



## PLATE 33

Figures 90-95, *Phragmatopoma attenuata*: Fig. 90, anterior end, from right side, showing high, conical operculum; Fig. 91, outer opercular palea with appendage, seen from the top; Fig. 92, same, from side, showing normal position of appendage; Fig. 93, middle opercular palea from dorsal end of series; Fig. 94, same, from ventral end of series; Fig. 95, inner opercular palea (figs. 91-95 from same individual, to same magnification); Fig. 96, distal end of outer opercular palea, showing major tooth on one side, enlarged.



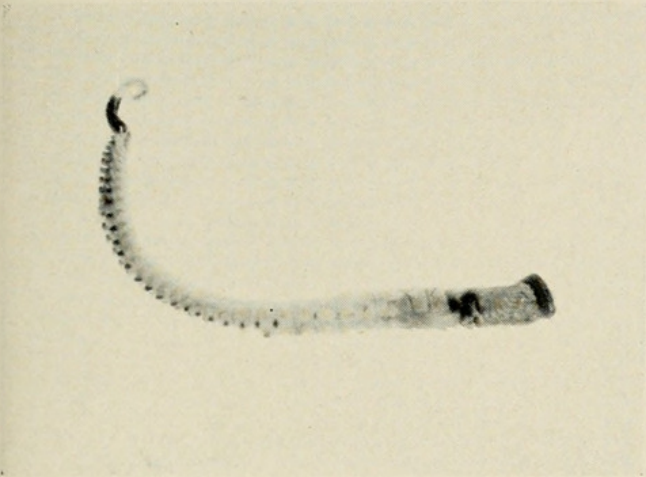
## PLATE 39

(Photographs by the U.S. National Museum, Washington, D.C.)

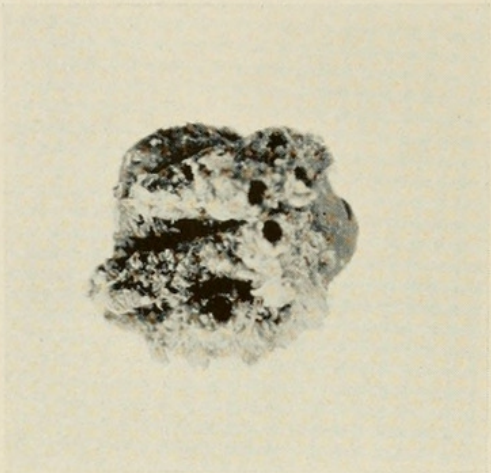
Figures 97, 98, *Phragmatopoma moerchi*: Fig. 97, entire individual, from the right side, x 3; Fig. 98, portion of tube mass, x 1.

Figure 99, *Phragmatopoma peruensis*: entire individual, from the right side, x 3.

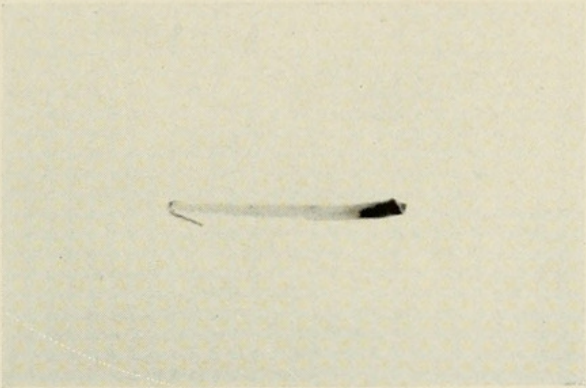
Figures 100, 101, *Phragmatopoma attenuata*: Fig. 100, entire individual, from the right side, x 3; Fig. 101, small portion of tube mass, showing oral apertures, x 1.



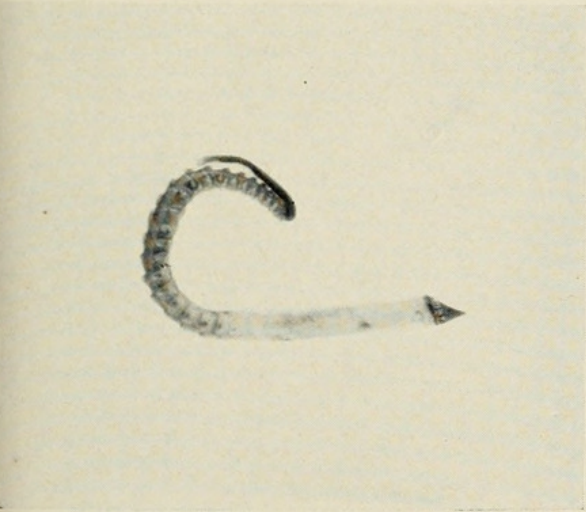
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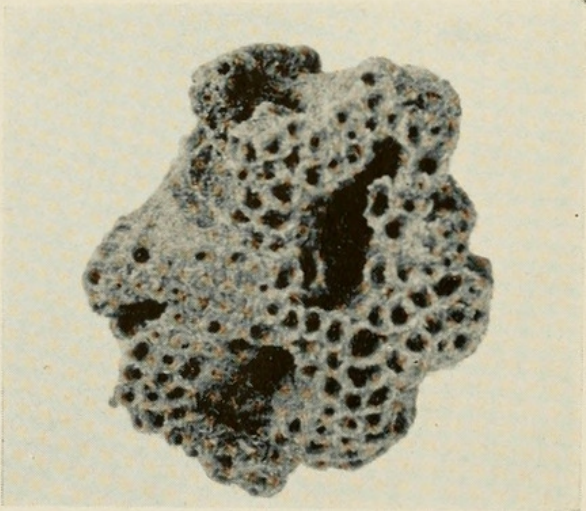
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100



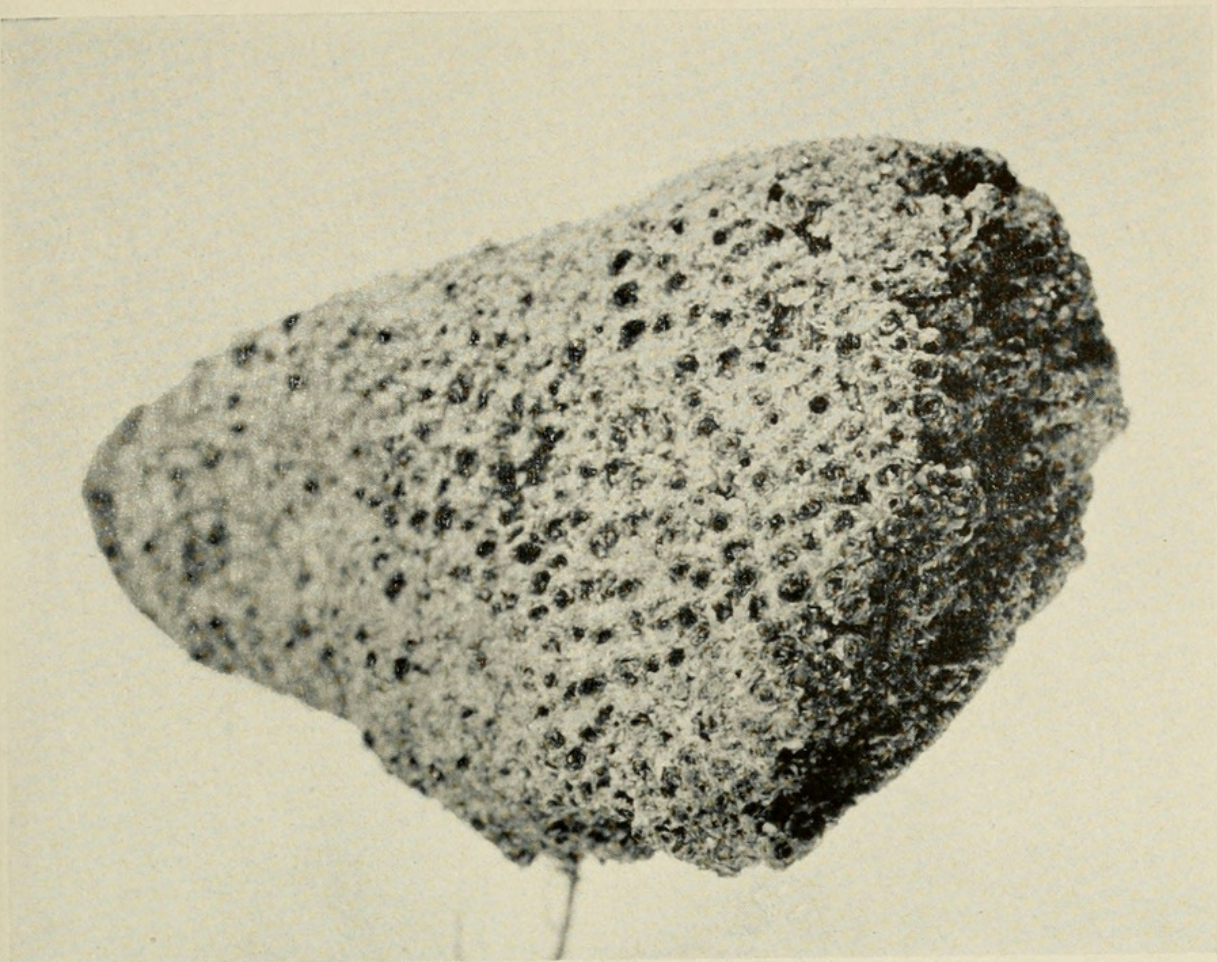
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## PLATE 40

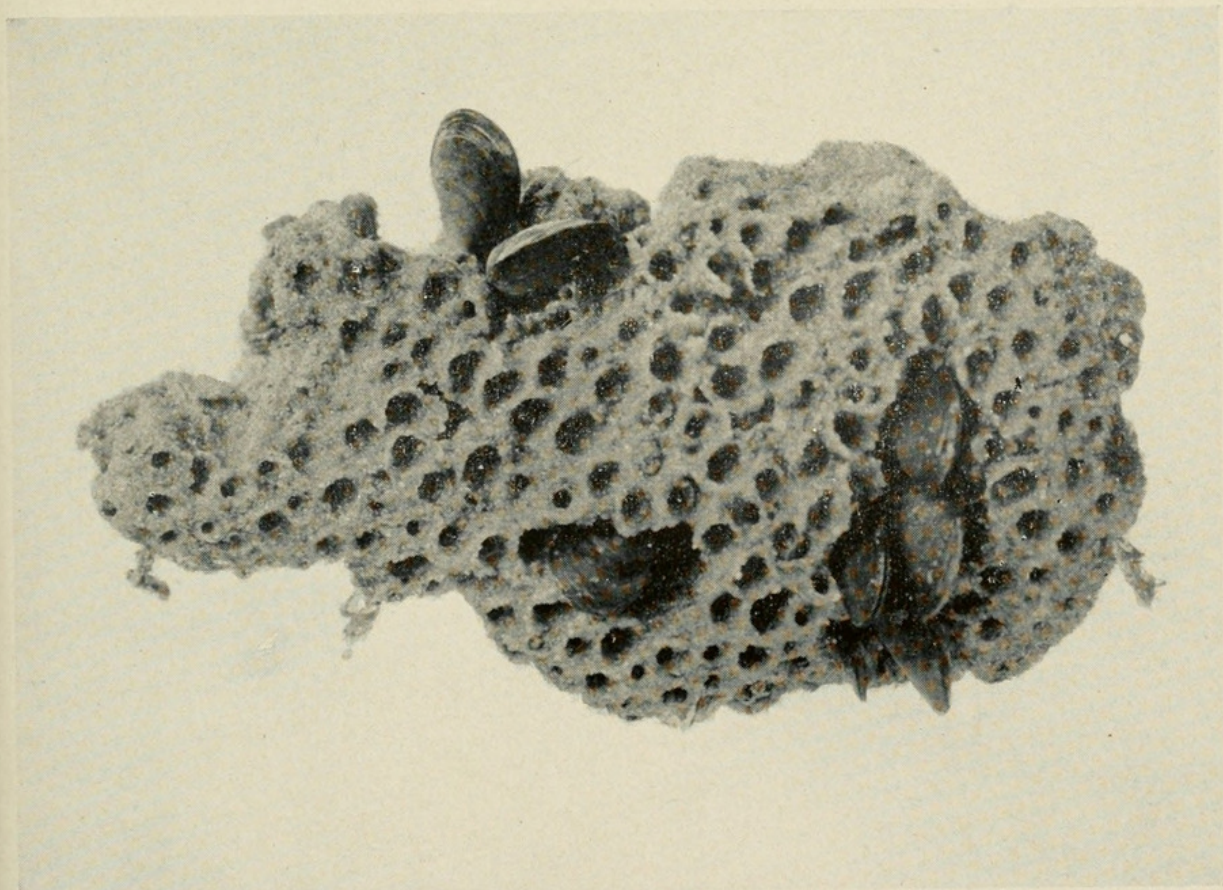
(Photographs by the U.S. National Museum, Washington, D.C.)

Figure 102, *Phragmatopoma lapidosa*: tube mass from Florida, x 1.

Figure 103, *Phragmatopoma lapidosa*: tube mass from Brazil, x 1.



102



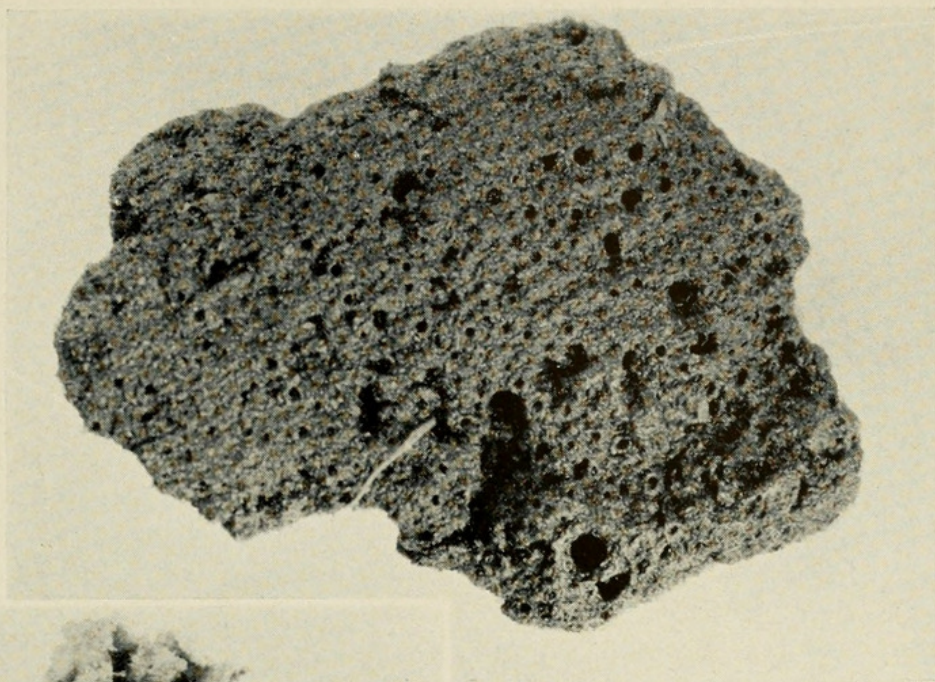
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## PLATE 41

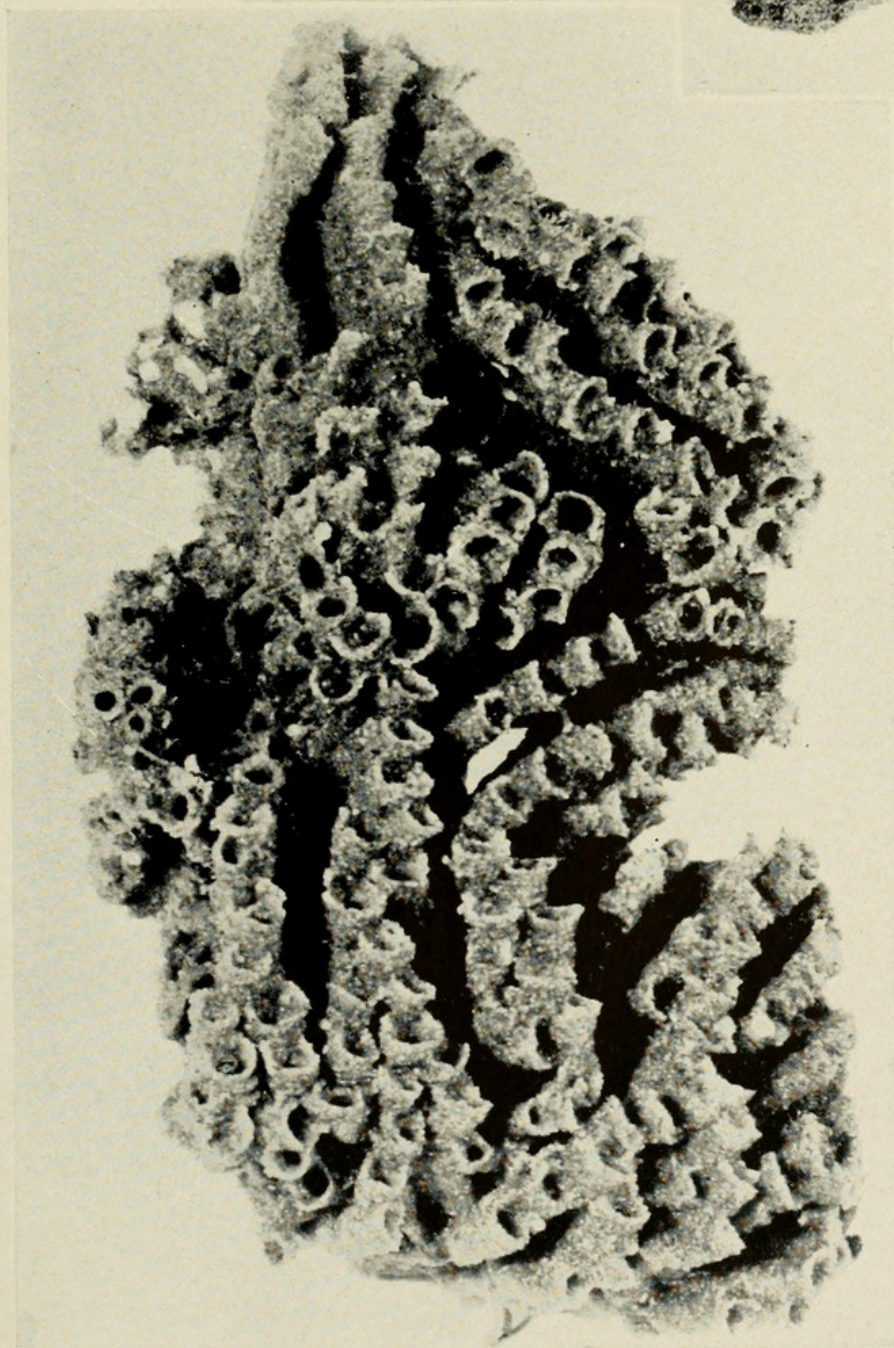
(Photograph in Fig. 104 by the U.S. National Museum, Washington,  
D.C.)

Figure 104, *Phragmatopoma peruensis*: tube mass, from Salaverry,  
Peru, x 1.

Figure 105, *Phragmatopoma californica*: tube mass from southern  
California (coll. 1218-40), x 1.



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## PLATE 42

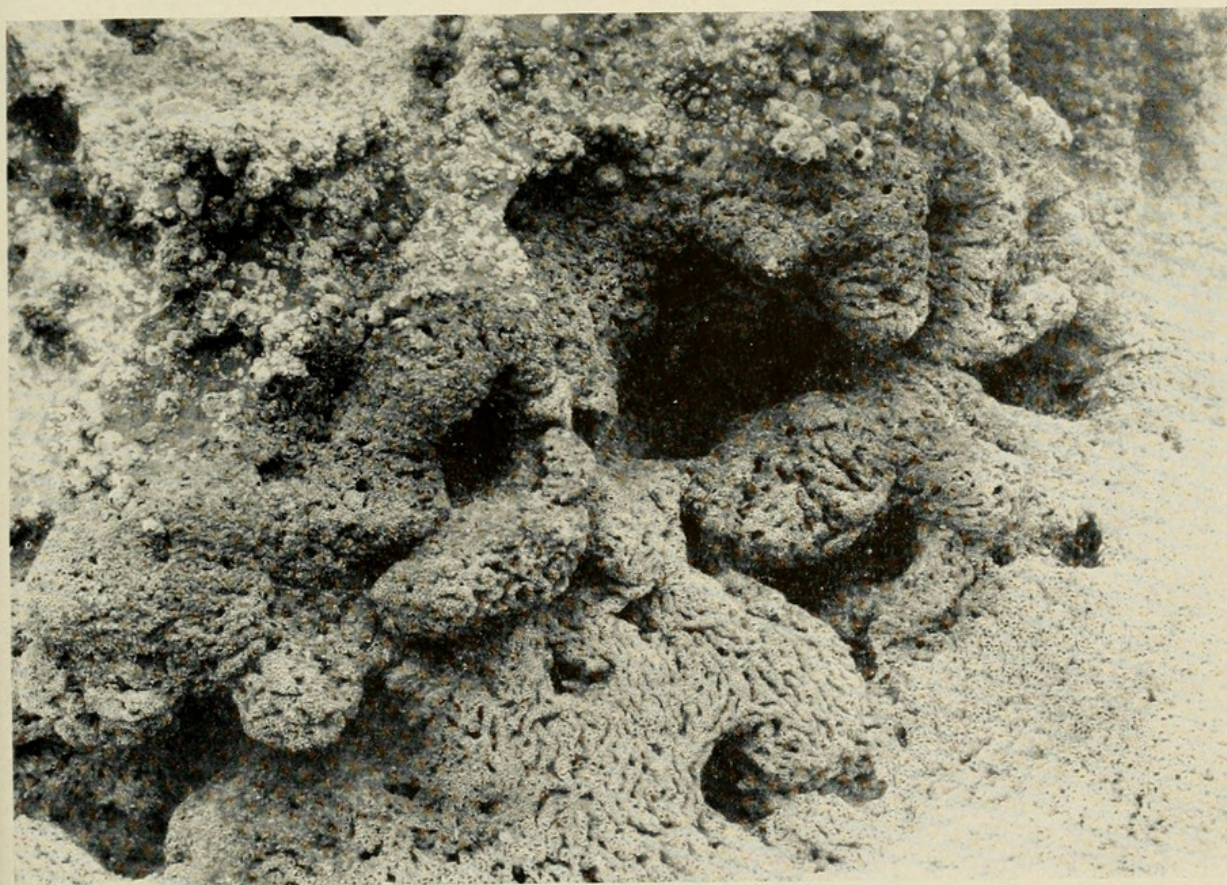
(Photographs by Dr. Waldo L. Schmitt, at Salinas, Ecuador.)

Figure 106, *Phragmatopoma attenuata*: tube masses exposed at low tide, looking toward the sea; the lower left-hand corner indicates the barnacle zone.

Figure 107, same, more highly magnified, showing the interlacing of tubes and oral apertures; the upper left-hand corner marks the barnacle zone.



106



107



Hartman, Olga. 1944. "Polychaetous annelids. Pt. 6. Paraonidae, Magelonidae, Longosomidae, Ctenodrilidae and Sabellariidae." *Allan Hancock Pacific expeditions. [Reports]* 10, 311–389.

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